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Setup and Troubleshooting Procedures for the Klein 5500 Sidescan Sonar

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ABSTRACT

This document outlines in detail all facets associated with the set up and usage of the Klein 5500 sidescan sonar. In particular this document outlines: (1) the different types of hardware that are required, how they need to be set up and networked, (2) how to set up and use the acquisiton software packages Isis and SonarPro, and (3) how to detect, analyse and troubleshoot incorrect set up and malfunctions in the hardware and software.

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Executive Summary

Setting up the Klein 5500 sidescan sonar involves numerous steps and techniques that a new operator may not know and which may be daunting and appear overwhelming.

This document was borne from two stimulations: (1) the need to increase the rate at which new operators learn how to set up and use the Klein 5500 sidescan sonar and (2) to illustrate the possible problems which may arise in the setup and how they can be circumvented.

By creating a document of this nature it should be possible to more quickly set up the Klein5500 sonar, so that the DSTO tasks of research and development surrounding this sonar can be attempted sooner.

The topics covered in this document include the: (1) hardware required, its correct setup and network architecture, (2) set up of the data acquisition computer, (3) usage of the sonar computer (the Transceiver and Processing Unit (TPU)), (4) set up and usage of the acquisition software packages Isis and SonarPro, and (5) trouble-shooting the overall installation.

Contents

1 Introduction - Sidescan Sonar and DSTO

One requirement of the Maritime Operations Division (MOD), within the Defence Science and Technology Organisation, is to evaluate new and emerging methods that are available which can characterise the seabed and to also test new techniques.

For several years now, MOD has been maintaining its knowledge base of how to operate the Klein 5500 sidescan sonar with the aim of investigating ways of: (1) optimising the data gathered (2) fusing the data gathered with other forms of data and, (3) the different ways of archiving the data.

DSTO has several aims involving sidescan sonars. These include investigating new acquisition software and post-processing software, developing new software and investigating ways of maximising the usefulness of the data gathered.

As it can take several hours to set up a sidescan sonar, then the stimulus for this report was to document the setup procedures that have been established at DSTO, and the techniques needed to circumvent known problems. By documenting such information it should enable the investigations which need to be performed with the sidescan sonar to be conducted more quickly than would otherwise be the case.

This document will begin with some background information on how sidescan sonar works and what makes it a useful tool for object detection and determining changes in bottom texture. This document will, most importantly, outline how to set up and run the Klein 5500 sonar as well as some of the common errors that can be expected and ways of circumventing them.

1.1 Background Information

Sidescan sonars are instruments which use acoustic energy to survey the seafloor, displaying backscatter levels. The images produced appear similar to aerial photographs, the major differences being that they have been rendered using acoustic energy instead of light and from lower grazing angles (or larger angles of incidence). They also have the difference that aerial photographs are generated using passive means of sensors where as sidescan sonars are active. The resolution achievable by sidescan sonars in recent years is sub-meter, approximately ten to twenty centimetres.

By displaying the backscatter levels of the seafloor, sidescan sonars have been used successfully to provide information on the locations of objects on the seafloor. The objects they are often used to find include wrecks, reefs, debris fields and sediment boundaries. Sidescan sonars can also provide position information of objects as well as their length, breadth and if any, their height above the seafloor.

Sidescan sonars use a horizontal line array of transducers mounted either side of a tow body called a towfish to generate an acoustic beam which is narrow in the along-track direction and which is wide in the across track direction (see Figures#1a and 1b, respectively). The acoustic beam is orientated orthogonal to the towfish so the sound pulses generated propagate away from either side of the towfish being reflected from any surfaces they ensonify**.** **At a predefined time delay after each ping, the transducers switch from being acoustic generators to acoustic receivers, inverting the acoustic signals being backscattered into electrical energy which the sonar can display**. By moving the towfish along and displaying each successive acoustic return (or ping) a swath can be generated showing changes in seafloor acoustic backscatter. It is by analysing this accumulation of neighbouring acoustic returns for contrasts in backscatter that objects and sediment boundaries can be easily identified.

(a)

(b)

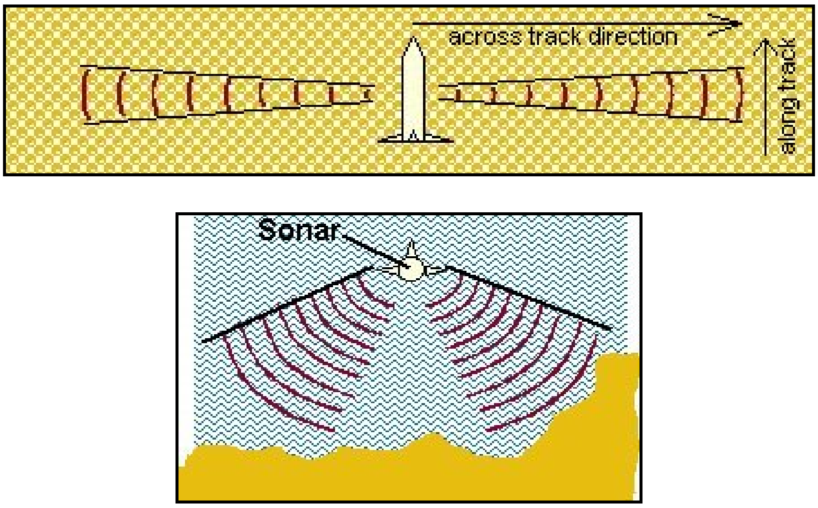


Figure 1 (a) Plan view of the acoustic beam generated by a sidescan sonar showing its narrow along-track characteristic. (b) Cross-sectional view of a sidescan sonar's acoustic beam showing the relatively large coverage achieved in the vertical which spreads out in the across-track direction. The sonar is travelling into the page.

The acoustic energy which is generated by the transducers on either side of the towfish is not a pulse of constant frequency but is a pulse whose frequency increases linearly over the length of the pulse. This slide in frequency is called a chirp and the pulses generated called chirped pulses or Linearly Frequency Modulated waves (abbreviated to LFMs). Such pulses have the characteristic of achieving longer ranges whilst retaining the same resolution that would be achieved using pulses of constant frequency. Some sonars permit the pulse width (also called pulse length) of the LFMs to be altered. This can be warranted if different ranges or resolutions are required than those being used. In particular the longer the pulse width the more energy being imparted to the water column (assuming the peak power is not altered) and hence the longer the range scales that can be achieved, but the downside is that the resolution in the across track direction decreases with increasing pulse width (assuming the frequency bandwidth is not altered).

When an acoustic pulse propagates through the water column its sound pressure decreases the further it propagates because of three different processes. In order of decreasing magnitude these include:

- Spherical spreading caused by the outgoing pulse occupying larger volumes the further it propagates. This causes the intensity to drop in proportion to the squared distance of the pulse from the transducers.

- Absorption of sound energy due to two distinct processes. There is absorption of sound energy as a result of shear viscosity and volume viscosity: The latter represents "the flow of water under pressure into lattice holes in the crystal structure" (Urick, 1991). In salt water there is additional absorption below 500kHz due to the disassociation of some of the minor salt constituents. This type of absorption increases with increasing frequency and below 2kHz occurs as a result of the dissociation of boric acid (H_3BO_3), whereas from 2kHz to 500kHz it is caused by the dissociation of magnesium sulphate ions ($MgSO_4$). Above 500kHz the pressure changes too rapidly for dissociation to occur and the only mechanism of absorption is by viscosity.

  In addition to being strongly related to frequency, the absorption of acoustic energy is also governed by the temperature of the fluid. Water pressure (or equivalently depth) and salinity have less of an affect (Waite, 2002). Figure 2 shows the relationship between the absorption and frequency for fresh and salt water.

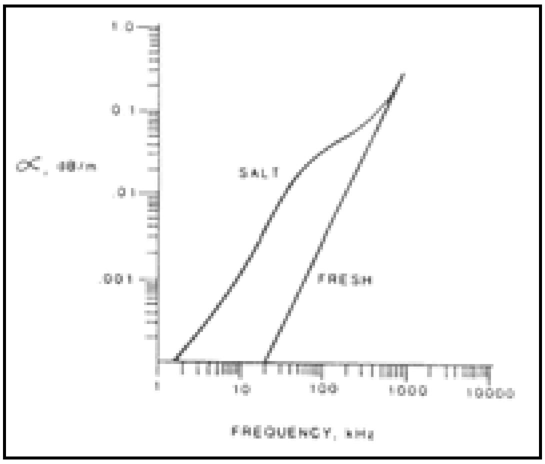


Figure 2 The empirical relationship determined by Francois and Harrison (1982) between the absorption coefficient of acoustic energy and frequency for fresh (10^oC) and saltwater (10^oC and 35parts per thousand).

- Decrease in sound pressure due to scattering by objects within the water column. These can include suspected sediment particles, air bubbles and marine life. This scattering not only decreases the intensity of the wave front that is needed to ensonify the seafloor but also generates a background acoustic intensity that the sonar is constantly sampling and which the backscatter from any surface needs to be above in order for it to be detected. In modelling the decrease in acoustic energy caused by scattering it is normally assumed that there is an even distribution of scatterers in the swath.

Unless this decrease in sound pressure is taken into account, from the transducers to the seafloor and return, before the data is displayed, then the artefact will be created that the seafloor at the outer extremities of the swaths have lower acoustic backscatter characteristics than those closer to the sonar. The other artefact will be that for those areas with visibly differing contrast, the contrast will appear to be less than it actually is.

To account for spherical spreading, absorption of sound intensity and the scattering of sound by suspended matter, the gain of the returning signals is increased to account for the sound intensity that has been lost.

In any survey the range the sonar is required to display backscatter data from, for the port and starboard sides, needs to be selected. This is the maximum distance from the sonar to the seafloor and is termed slant range. For surveys in which object detection is required small slant ranges are employed whereas large ranges are employed for sediment boundary detection. The slant ranges employed by sidescan sonars used in the coastal zone are typically between 50m and 150meters.

The slant range in conjunction with the sound speed of the water (nominally 1500m/s) enables the sonar to calculate the time window over which it needs to sample the acoustic backscatter. Once the sonar has received the backscatter versus time data for each pulse (or ping) it applies corrections for spherical spreading, absorption and suspended matter and the data is ready to be displayed.

Port and starboard backscatter data for each frequency generated by a sonar are displayed to the operator in what is known as a waterfall display. Such displays consist of two regions of equal width placed side by side. The left hand region displays the port backscatter versus slant range (or equivalently backscatter versus time) data horizontally across the screen for each ping, originating from the centre of the display, and the right hand side displays the corresponding starboard backscatter versus time data. Each ping's echoes are placed beneath the former creating a picture which shows the regional acoustic backscatter characteristics across the width of the swath. Figure 3 shows as example of a water fall display.

Acoustic backscatter data is displayed in waterfall displays with dark regions representing high acoustic returns, and whiter regions representing low acoustic returns, although sometimes "inverse video" mode is invoked in which this scheme is reversed. Acquisition packages permit operators to alternate between these two modes. However, as the mode invoked determines how the waterfall display is interpreted, then an operator needs to be aware of the convention being used at any time.

Figure 3 shows a real example of a waterfall display during data acquisition. Starting at the centre of the display is two dark lines. These represent the outgoing pulses generated by the sonar on the port and starboard side. The following white regions on either side are the low acoustic energy being received by the sonar during the time taken for sound to travel through the water column to the seafloor beneath the sonar. The display changes colour to greyscale on either side at the edges of the white area. This is the first return from the seafloor. If a sonar is located close to the sea surface, as occurs with sonars that are mounted to the survey platform, then before the first bottom return there may be a weak return from the sea surface (see Figure 4). Sometimes the sea surface can be detected because of breaking waves or raining, as both processes inject air bubbles into the water which have a high acoustic reflectivity.

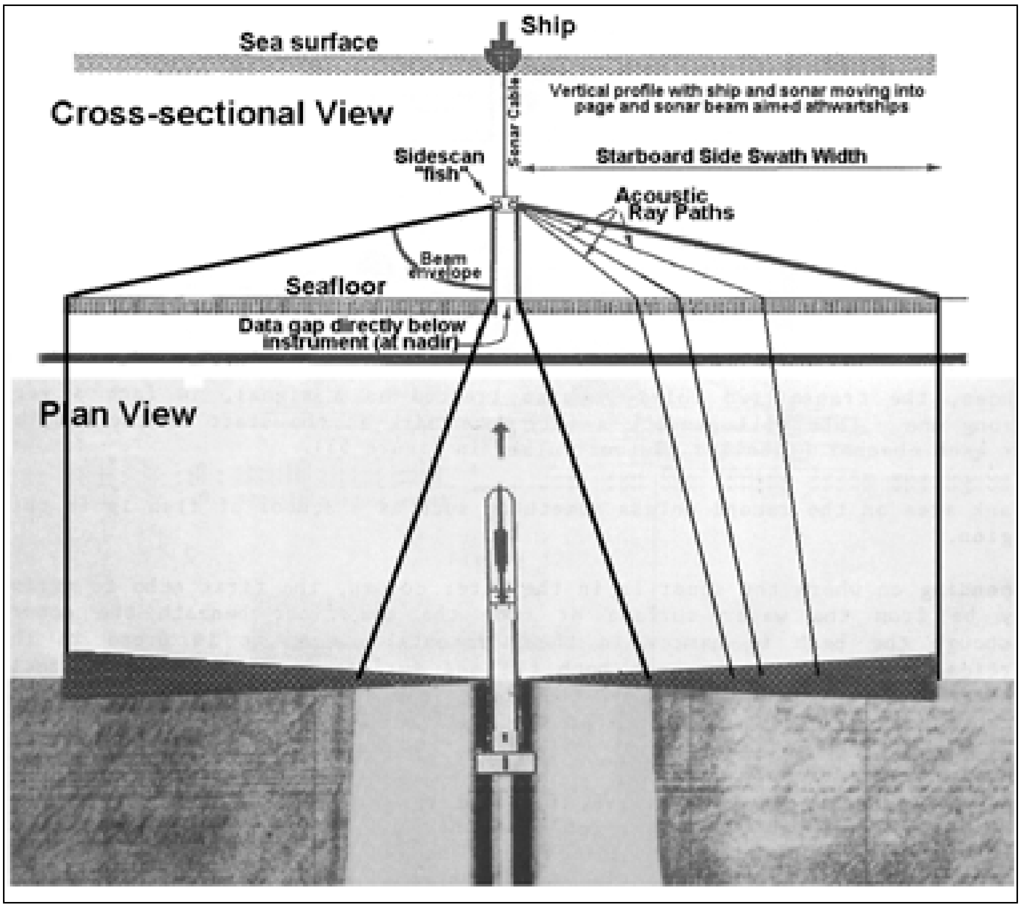


Figure 3 A diagram showing a waterfall display and the two-dimensional cross-sectional geometry. Top schematic adapted from Kleinrock (1991). The bottom image adapted from Klein (1985).

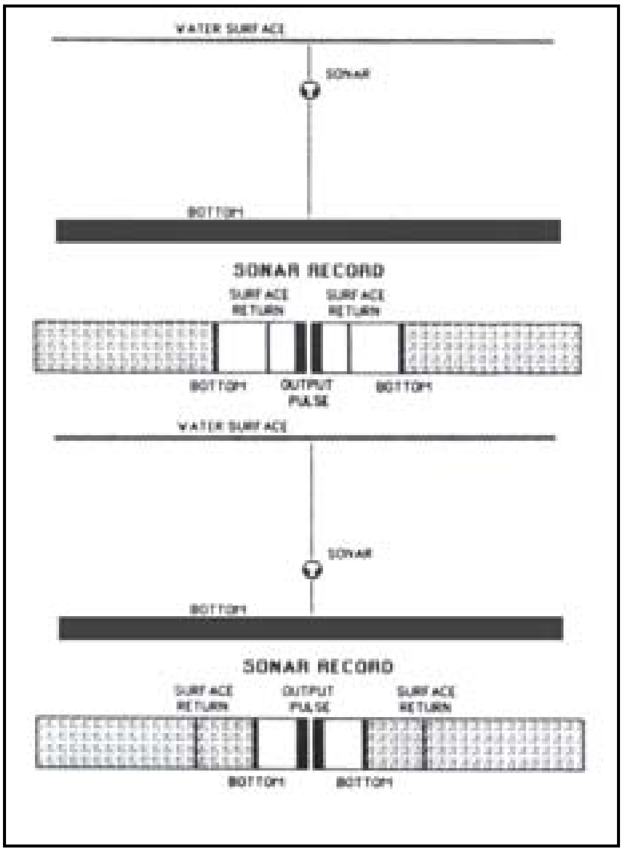


Figure 4 Two schematic waterfall displays showing how the slant range of a weak surface return in a waterfall display is related to the depth of a sonar. Taken from Klein (1985).

The seafloor's backscatter characteristics that are displayed in a waterfall display are a distortion of what they are in reality. There are several distortions that occur in a waterfall display. These are:

- a compression of the image in the across track direction which increases as the sonar's nadir is approached, when backscatter is displayed versus slant range. This occurs because the differences between the slant ranges of the start and end of any region of the seafloor is less than the region's horizontal length, with this discrepancy, or compression, decreasing across the track. Figure 5 shows an example of this compression. As compression can inhibit the interpretation of target shapes in a waterfall display then it is common practice to display the backscatter versus horizontal range and not slant range. This not only removes the across track compression, but it also permits operators to gauge at a quick glance the distance an object is from the sonar without having to consider the slant range and sonar altitude.

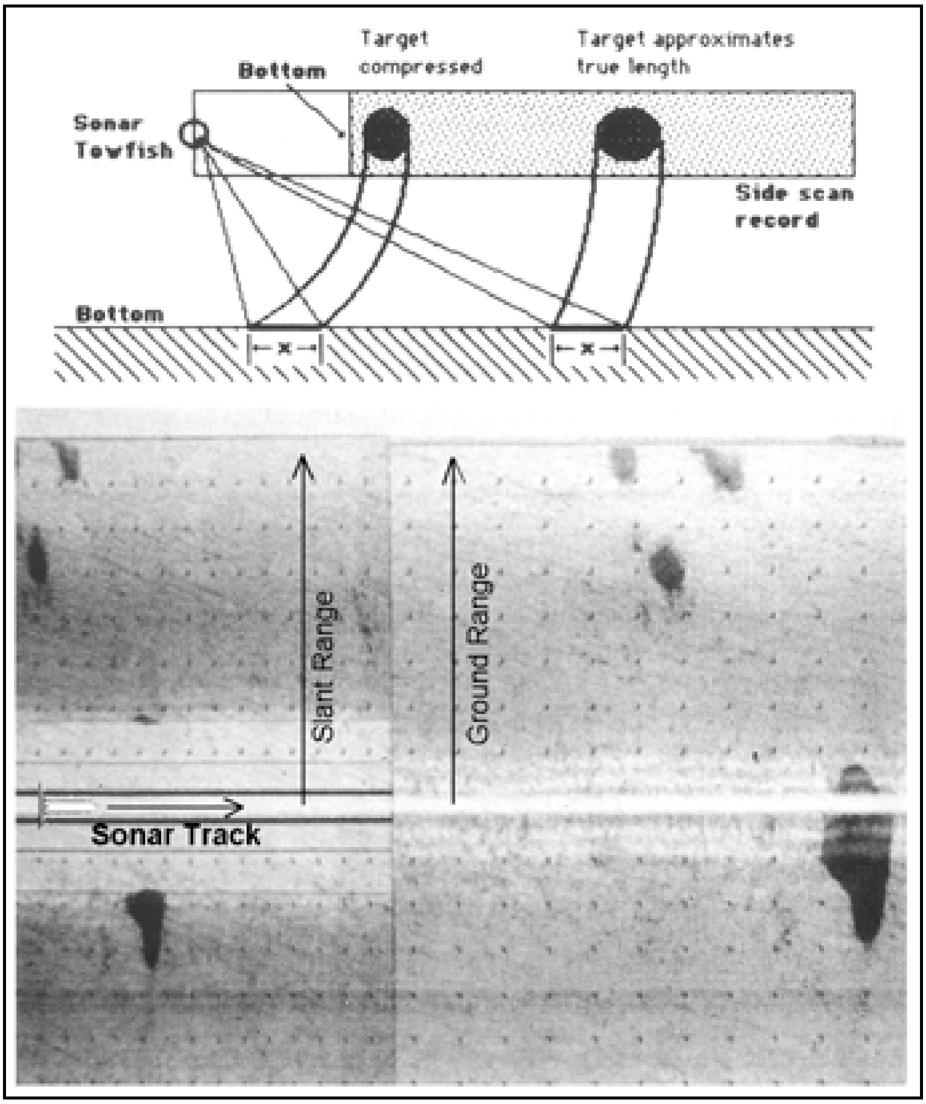


Figure 5 A schematic showing the across track compression that occurs in waterfall displays when backscatter levels are displayed versus slant range and how this compression can be circumvented by displaying backscatter levels versus ground range and not slant range. Adapted from Klein (1985).

Often the seafloor is a fairly flat surface and by making this assumption, the horizontal distance each backscatter pixel (or picture element) is from the nadir of the track can be calculated using the slant range of the pixel and the height of the sonar above the seafloor. If it is known that the seafloor is not flat in the across track direction, and bathymetry data is available, then more complicated methods exist which permit the horizontal distance of each pixel to be calculated (see 9, 39, 41, 61 and 62 of Kleinrock).

- A compression or stretching of an object in the along-track direction of the waterfall display is caused by the sonar ensonifying an object at differing speeds and the sonar then displaying the backscatter results at regular time intervals. The ramification of this compression is that it generates the artefact that targets appear larger or smaller than they really are. Figure 6 shows an example of such a scenario. This along-track compression is circumvented by displaying the backscatter results for each ping not at regular time intervals but at intervals which are directly proportional to the speed or distance the sonar has transversed.

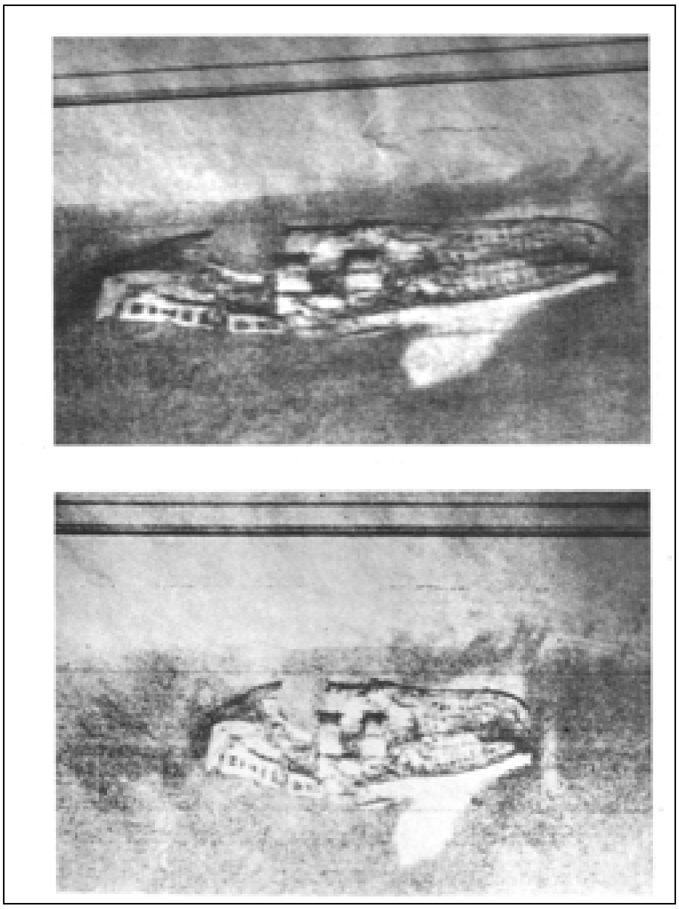


Figure 6 Two waterfall displays of a sunken ship collected at three knots (top image) and six knots (bottom image). Adapted from Klein (1985).

- The minimum along-track distance which two targets must be separated in order for them to appear as two distinct targets in a waterfall display and not be merged and represented as one target, increases in the across track direction. This is caused by the acoustic beam spreading, with the beamwidth for a line of transducers directly proportional to (λ/L), where λ is the wavelength of the pulse and L is the length of the array, and equal to 50.6 (λ/L) (Klein, 1985). Figure 7 shows an example of this artefact for two targets which are represented as one target on the outer edges of a swath whilst being shown as two distinct targets closer to the sonar's nadir.

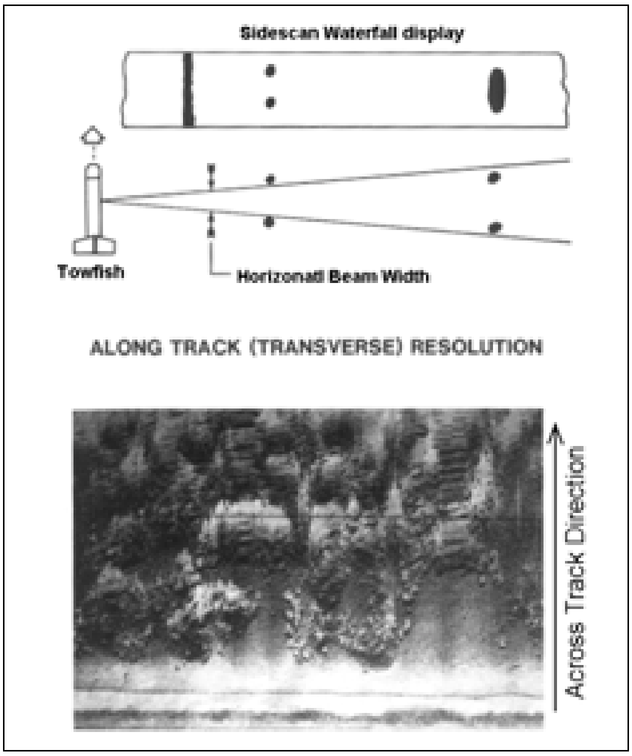


Figure 7 A schematic diagram showing how beam spreading as the across track distance increases can result in two targets appearing as one target. Adapted from Klein (1985).

Sidescan sonars can be towed behind a platform which places the sonar closer to the seafloor and produces longer acoustic shadows. This deployment technique has the advantages that:

- It permits the highest possible detail of the bottom. Such detail may be needed for locating objects whose dimensions approach the resolving capability of a sonar.
- It maximises the contrast between surfaces of differing orientation,
- acoustic shadows are maximised.
- the possibility of any surface reflections is minimised.
- the motion of the towfish is partially decoupled from the motions of the tow vessel.
- the sonar can be placed beneath any diurnal thermoclines that would refract acoustic energy upwards, towards the surface and away from the intended target, the bottom. The acoustic energy propagating in a thermocline will also undergo more absorption due to the associated higher temperatures compared to an acoustic beam that was located beneath a thermocline.

The disadvantages with towing a sonar is:

- special equipment is needed to deploy and recover the sonar, with such steps made difficult and treacherous in rough weather.
- that the operator cannot see what is approaching and the pilot may need to make quick changes to avert losing the sonar on a rocky outcrop or wreck. If the pilot does know that the depth of the sonar needs adjusting then the depth can be decreased by increasing the speed of the towing vessel, if a depressor wing is not being used, however if a wing is attached then the depth of the sonar can be decreased by decreasing speed.
- that the exact location of the sonar in the horizontal plane is difficult to determine. This is attributable to inaccurately measuring the length of cable used, its shape under tow and also because of difficulties in modelling how the sonar "follows" the towing platform.

Sidescan sonars can also be mounted to their support platforms (as a hull-mounted or bow-mounted (see Figure 8). Such a configuration has the major advantage of accurate position information for any objects, as the exact location of the sonar is known. Bow or hull-mounted sonars have the disadvantage that the backscatter detail that can be resolved in the across track direction of a waterfall display is lower that is resolvable when a sonar is towed and because of this they are normally only used in shallow areas.

Figure 8 An example of a sidescan sonar mounted to the bow of the survey platform. The sonar in this picture was the Klein 5500.

Object detection in a waterfall display proceeds by identifying areas of contrasting backscatter. Such areas maybe localised and appear as regions of high acoustic backscatter backed by low acoustic backscatter. This would be typical of rocks proud of a seafloor composed of soft sediment. Or the areas of contrasting backscatter maybe over much larger areas, indicating sediments of different composition. After an object has been detected in a waterfall display, its shape can give an indication as to the origin of the object. Those objects that often have easily identifiable shapes include wrecks, metal drums, shipping containers, cables or pipelines, car bodies, rocks and reefs. The identification process of unidentifiable objects can be improved by ensonifying any features from different bearings. In this way the two-dimensional shape of an object is more accurately determined.

The characteristics of an object that determine the degree to which it reflects acoustic energy ensonifying it back to the sonars transducers, are the orientation of the object's surface with respect to the orientation of the wavefront and the acoustic impedance of the materials used in construction the object. The acoustic impedance is the product of the materials density, ρ_m, and the speed of sound, c_m, in the material. The higher the impedance the more acoustic energy will be reflected back to the sonar. A more helpful quantity, which indicates the amount of energy reflected back to the sonar is the reflection coefficient (R), expressed as a percentage. This is defined as the ratio of the reflected acoustic intensity to the acoustic incident intensity and may be calculated using the approximate relationship:

$$R = \frac{I_R}{I_i} = \left[\frac{\rho_m c_m - \rho_s c_s}{\rho_m c_m + \rho_s c_s} \right]^2 \times 100\% \quad (1)$$

Where:

1. I_R is the acoustic intensity of the reflected pulse.
2. I_i is the acoustic intensity of the incident pulse.
3. ρ_s is the density of sea water .
4. C_S is the speed of sound in sea water.
5. $\rho_s C_S$ is the acoustic impedance of sea water.

Some materials for which the reflectivity coefficient is often needed are cited below together with their acoustic impedance.

Table 1 A list of materials often located by sidescan sonars and their associated acoustic impedances and reflection coefficients.

Material	Acoustic Impedance (kg/m^{2}s) (x10^6)	Reflection Coefficient (%)
Air	0.000428	99.9
Fresh Water	1.48	0.04
Seawater	1.54	0
Wood (Pine)	1.57	0.0009
Wood (Oak)	2.90	9.4
Concrete	8.0	46
Steel	47.0	88

It can be seen from Table 1 that air has a relatively large impedance, reflecting virtually all the acoustic energy impinging on the seawater-air interface. This is the reason why surface waves breaking and injecting air bubbles into the water can cause a surface return to be visible in a waterfall display. It is also the reason why animals containing air pockets (for example humans, dolphins) can be detected by sidescan sonars. It can also be seen from Table 1 that some materials have unusually low impedance, such as wood. This example raises the important point that sidescan surveyors trying to locate specific objects, for example wrecks which have been constructed out of wood, which have low impedance and which may be difficult to detect, need to consider the impedance of the material to be located and choose the ranges accordingly.

The areas identified as having differing backscatter than the surroundings may have an associated acoustic shadow on their leeward side, indicating they are proud of the seafloor. Acoustic shadows occur because the orientation of the outgoing acoustic pulse wave front compared to a target does not permit the pulse to ensonify a section of the seafloor leeward of a target (see Figure 9). Although it is often stated that the acoustic shadow represents a time window in which no acoustic energy is being scattered back to the sonar, they really represent a time window in which the sonar is detecting the small acoustic energy that has been scattered off particulate matter within the water.

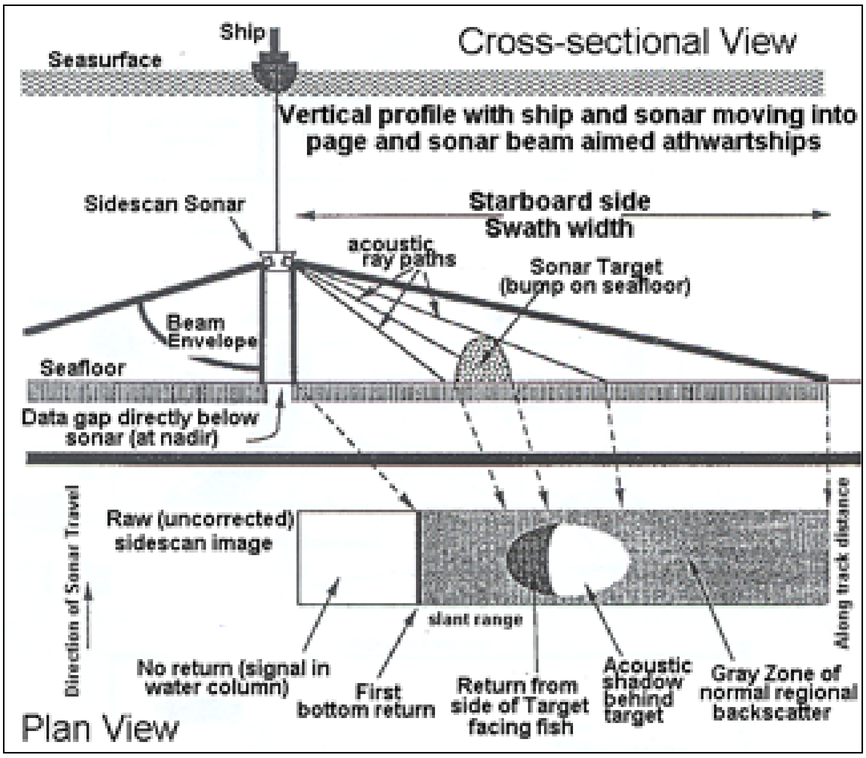


Figure 9 A schematic diagram showing how an acoustic shadow occurs behind a target that is proud of the seafloor. Taken from Kleinrock (1991)

Although acoustic shadows are often observed in a waterfall display on the leeward side of anomalously high acoustic returns with objects proud of an otherwise relatively flat seafloor, they can exist with no preceding contrast in the backscatter. This can occur for troughs associated with buried pipelines or telecommunication cables as well as sand waves. Figure 10 shows an example of these two features.

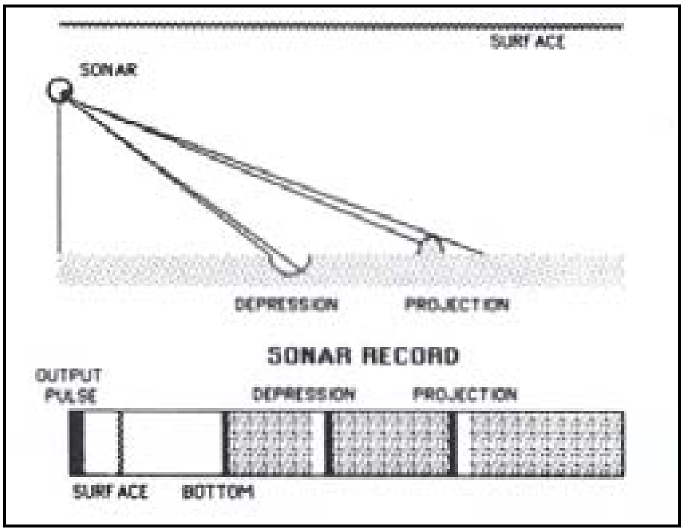


Figure 10 A schematic diagram showing how both depressions as well as prowd targets can generate shadows in a waterfall display. Taken from Klein (1985).

Determining the location of objects observed in a waterfall display is a two step process. The first involves determining the location of the sonar relative to the GPS (Global Positioning System) antenna with the second step involving using the bearing of the sonar together with the horizontal distance the object is from the sonar (termed layback).

The location of the sonar relative to the GPS antenna can be determined using a measuring tape for bow or hull mounted sonars and such configurations have the advantage that they do not change during a survey. For sonars that are being towed behind a survey vessel, their location is calculated using the horizontal distance the GPS antenna is from the fairlead together with layback. The layback is calculated using the cable-out values in conjunction with the depth of the sonar below the fairlead, which has the two components; the height of the fairlead above the waterline and the depth of the sonar. Sidescan sonars have built in pressure transducers so their depth beneath the waterline can be determined.

The horizontal distance (R_h) an object is from the sonar is calculated using the altitude of the towfish above the seafloor (H_f), making the assumption the seafloor is flat from beneath the sonar (the nadir) to the object, and using the slant range to the object (R_s) (see Figure 11). Another important characteristic of objects is their height (H_t), or altitude for floating objects, above the seafloor. This can be determined by invoking similar triangle relationships because the triangle generated by the height of the object, the length of the object's shadow and the slant range from the object's crest to shadow end (L_S), is similar to that generated using the altitude of the sonar, the slant range to the object's shadow (R_S) and the horizontal length from the nadir to the shadow, as their three angles are equal. By virtue of the fact that for two similar triangles the ratio of any two corresponding sides is equal, it can be stated that the ratio of the height or altitude of the object to the altitude of the sonar is equal to the ratio of the slant range from the sonar to the end of the shadow to the length of the shadow from the object.

By virtue of similar triangle characteristics it follows that

$$\frac{H_t}{H_f} = \frac{L_S}{R_S + L_S} \quad (2)$$

By rearranging equation#2 for the unknown object height (H_t) it happens that

$$H_t = \frac{H_f L_S}{R_S + L_S} \quad (3)$$

This argument is outlined in Figure 12.

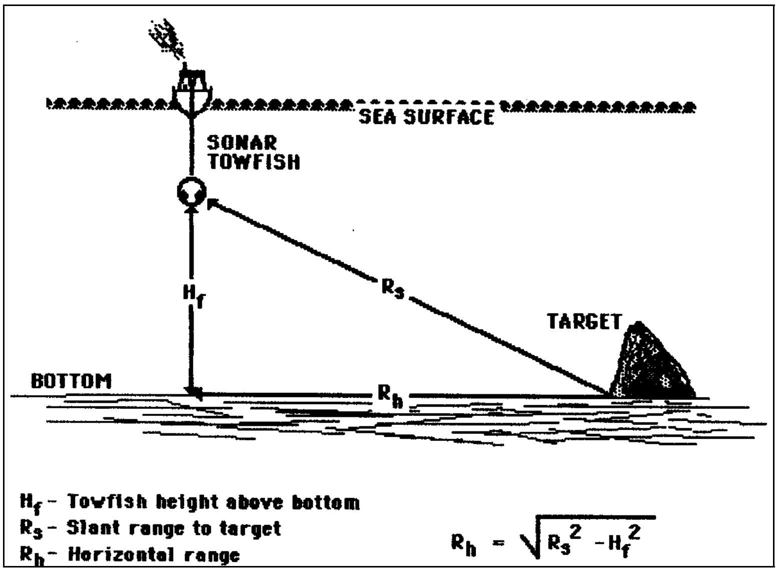


Figure 11 A schematic diagram showing how the horizontal distance of a target from the nadir of the sonar is calculated. Taken from Klein (1985)

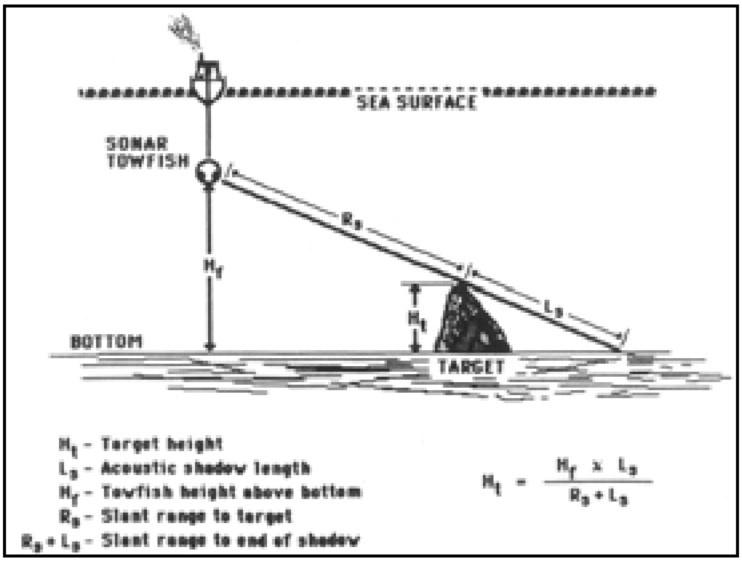


Figure 12 A schematic diagram of a sidescan's across track geometry showing how a target's height above the seafloor is calculated. Taken from Klein (1985).

Sidescan sonars can be used quite successfully to infer sediment boundaries. Figure 13 shows sidescan sonar data gathered at Middle Head in Sydney Harbour. The red line indicates the shoreline and a rocky outcrop can be seen protruding out from Middle Head. Also clearly evident are two strong sediment boundaries, one between the rocky outcrop and soft sediment (probably sand) to the northeast of it with a second boundary to the north between two types of sediment, one harder, with a different composition than the other and which runs out from the shoreline in the bottom left of the figure.

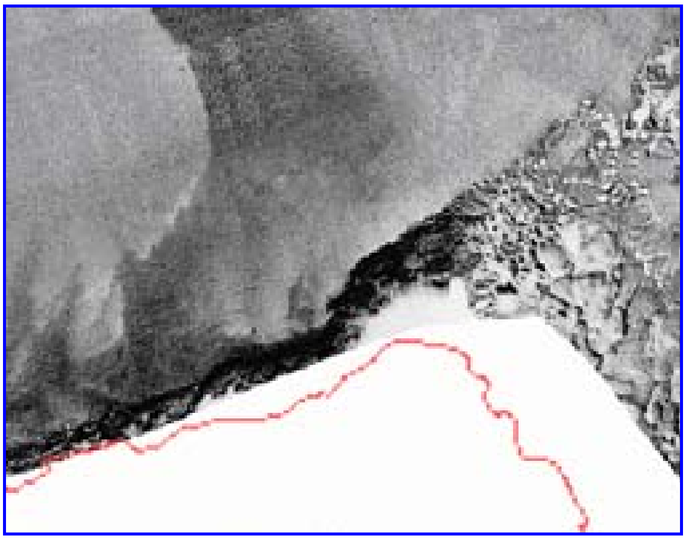


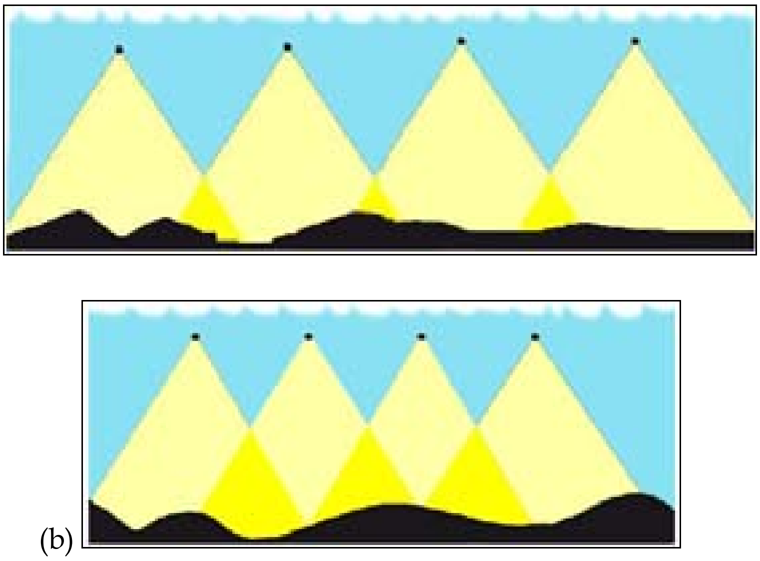
Figure 13 An example of sidescan sonar data collected at Middle Head, Sydney Harbour showing differing sediment types.

Due to spherical spreading, absorption and scattering, there is an upper limit on the swath width that can be employed by a sidescan sonar whilst maintaining a desired resolution. If a sidescan sonar is being used to survey an area where more than one swath is needed then an operator will need to construct a set of tracklines. Tracklines are imaginary lines which a survey vessel needs to follow in order to survey an area whose width is larger than a swath width. Tracklines are normally drawn parallel to each other and orientated in one direction. The only time tracklines may not be orientated in one direction is when they follow the shape of a coastline (such as estuaries), when a sonar needs to survey an area of changing bathymetry, or when the dimensions of a target needs to be checked and instead of one set of tracklines being constructed, two sets of perpendicular tracklines are constructed. Such tracklines are sometimes called cross-lines.

As some objects have aspect ratios that are non-unity, meaning that one axis is longer or shorter than the other, then it can occur that the bearing of the ensonification is such that the sonar ensonifies the smallest possible cross-sectional area of a target. This induces the possibility that simply due to the orientation of the trackline a target maybe missed. To circumvent this possibility some conservative surveys, not only have a 200% coverage but have a second set of tracklines that are orthogonal to the first set. Then if any targets do have non-unity aspect ratios and the first set of tracklines causes the sonar to ensonify the smallest cross-sectional area then the second set will have the maximum possibility of detecting the target.

The construction of tracklines can be achieved by some sidescan sonar data acquisition packages (for example Isis and SonarPro) and there are some purpose built software packages (for example Hypack) which can construct them. In either case what is commonly displayed to the pilot is an electronic nautical chart of the region being surveyed, superimposed with the chosen survey lines, and either the vessel location or sonar location. If a sonar location is given then the area of the seafloor the sonar is ensonifying is also often displayed. The survey vessel then uses GPS or DGPS to determine its location and the pilot continually alters the course of the vessel so as to keep as close to the trackline as possible whilst maintaining a reasonable speed.

One of the key parameters in constructing tracklines is to establish the line spacing, or horizontal distance between neighbouring survey lines. This is governed by the aim of the survey and for complete coverage must be less than half of the swath width. For surveys which are trying to locate large targets (relative to the pixel size) on a smooth seafloor and in non-turbid waters, Fish and Carr (1990) recommend using a line spacing which is 75% of the total swath width. This line spacing equates to any two contiguous swaths overlapping by 25% or a seafloor which has a coverage of 150%; 100% for the lane proper and 25% from each neighbouring lane. Figure 14a shows the area of the seafloor ensonified when this recommendation is employed. When small targets are being searched for consideration should be made to the fact that there is limited resolution beneath a towfish (encompassing the nadir). For this case an operator will circumvent the low nadir resolution using the outer ranges of an adjoining swath line. This approach equates to a line spacing which is 50% of the swath width or a coverage of 200% for all lanes which are encompassed by the two outside lanes and which is 150% for the two outside lanes. Figure 14b illustrates the concept of 200% coverage.



(a) (b)

Figure 14 A cross-sectional illustration showing the concept of a line spacing which is (a) 25% of the swath width and which equates to a 150% coverage, and (b) a line spacing which is 50% of the swath width and which equates to a coverage of 200%. The black dots represent the sonar, the yellow regions the area of the water column which is ensonified when the sonar follows each trackline and the bright yellow areas represent the overlap of each swath with their neighbours.

If the aim of a survey was to simply locate one or more objects along one or more tracklines, then if high quality sidescan sonar data and navigation data have been collected, and the object(s) has been found then the survey is complete. On the other hand if the aim of the survey was to locate or identify features which spanned more than the width of one swath, then the sonar data needs further manipulation.

In the early 1960's and 1970's only relatively low frequency sidescan sonars were in usage and they permitted large swath widths of several kilometres to be used but this was at the cost of low resolutions (several meters). Such sidescan sonars are still in operation today. In the late 1980's much higher frequency sonars were being manufactured and they were achieving high resolutions of sub-decimeter but this was at the cost of much smaller swath widths (approximately 300meters). Mosaics are a way of retaining the high resolutions whilst displaying the backscatter results over areas that were of comparable size to the swath widths of the lower frequency and lower resolution sonars. A mosaic is a picture showing the acoustic backscatter from one or more swaths that have been geo-referenced onto a projection of a region of the globe.

Mosaics are generated for a wide variety of reasons. These include: (1) showing sediment boundary locations, (2) showing debris fields from downed aircraft, (3) showing the location and coverage of geological features such as boulders and reefs (4) showing ship wrecks which span more than the width of one swath, (5) surveying bottom habitats, (6) archaeological surveys, (7) pipeline inspecting. To increase the readability of a mosaic it maybe placed on top of an electronic nautical chart of the area or the mosaic may simply have an outline of the coastline. Their readability and interpretation can be also be enhanced by having contours of bathymetry or magnetic anomaly draped over them (Fish and Carr, 2002).

The resolution of the final mosaic is determined by the operator and can be as high as the original sonar data. There is however a trade-off between the resolution of the mosaic and the size of the graphic files generated; the higher the resolution, the bigger the graphics file and the more computer room that is needed, whilst for lower resolution mosaics (which have bigger grid cell sizes) the smallest targets that can be detected will be bigger than the high resolution case but the advantage is that the files generated will be smaller.

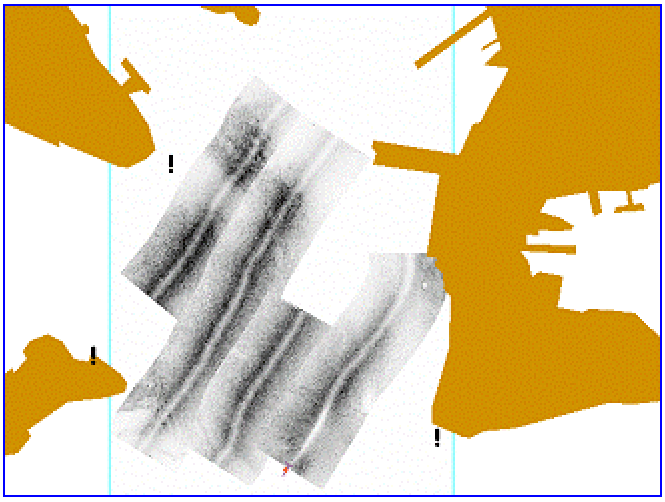


Figure 15 An example of a mosaic of several sidescan sonar swath data.

Once a mosaic has been rendered it is possible to classify the backscatter levels in terms of differing sediment types. There are two main ways this can be achieved. There are textural methods (or pattern recognition) which needs only sidescan sonar data to be implemented. This approach first requires the texture where the sediment is known (so-called "training regions") and then incrementally scans the whole sidescan sonar mosaic trying to match the textures observed against those from the training regions (Bell, Chantler and Wittig, 1999). Textural approaches have the flaw that they do not use the process that generated the sonar image. There is also the problem that sidescan sonar data, and hence the texture, can be dependent upon the ensonifying bearing angle. For example, sand waves are unlikely to be detected if the sonar track is orthogonal to their orientation (that being parallel to the wave crests) whereas they will be detected if the track is parallel to their orientation. Figure 16 shows an image of sand waves.

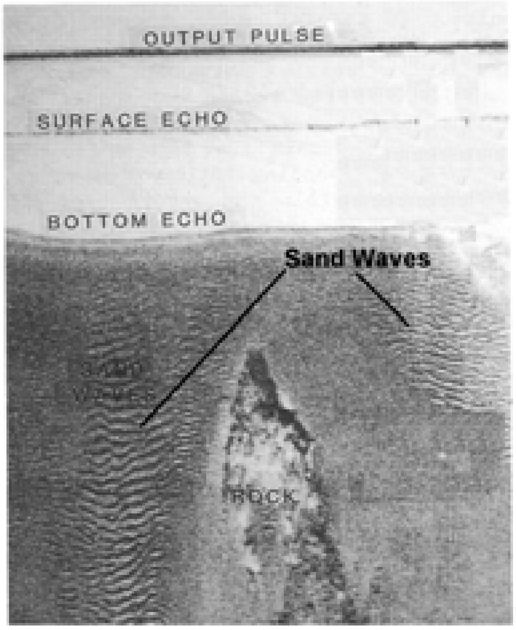


Figure 16 A sidescan sonar image showing the presence of sand waves. Altered from Klein (1985).

The other approach that can be used to classify sidescan sonar data, exploits information on the grazing angle to derive the backscatter angular response. As the grazing angle needs to be calculated then this technique can only be used on sidescan sonar data that has accompanying bathymetry data (which may or may not have been collected when the sidescan data was) (Bell *et al*, 1999).

The act of classifying sidescan sonar data is normally performed in post-processing. The software packages that can perform this classification are the SeaClass module (http://www.tritonelics.com/tritonPDF/SeaClass.pdf) of the TritonElics package DelphMap, and the package Classiphi (http://www. http://www.qinetiq.com/classiphi/), by QinetiQ. Both software packages use textural based approaches.

Once sidescan sonar data has been classified and the locations of rocks and man-made objects have been identified, then tasks like identifying routes for laying telecommunications cables and pipes, and merchant traffic, can proceed with confidence. The factors which need to be taken into account when identifying routes for cables and pipes laying include: (1) where is there rock, (2) where do steep slopes exist, (3) and by considering these two factors where can the burial safely and economically proceed. An important factor which needs to be considered when choosing safe shipping lanes, during times of conflict, is where is the bottom made up of rock. This characteristic is important because this type of sediment has high backscatter characteristics, which makes locating mines difficult. Hence, a shipping lane should be placed in an area where the sediment has low backscatter characteristics.

2 Physical Setup

This chapter outlines the individual components that are normally used at DSTO to conduct a sidescan sonar survey and describes how to connect them ready for operation. In particular, section 2.1 outlines the characteristics of the Klein 5500 sidescan sonar. Section2.2 is a basic summary outlining all the hardware that is required to acquire data and how to set it up, but with no navigation or cable-out inputs to the software. In this case, the system will function and display data, but for most purposes, navigation and cable-out are required for geo-referencing the imagery. Section 2.3 describes the hardware required in the acquisition computer and outlines the components of the ruggedised Isis® PC. Section 2.4 describes the hardware needed for obtaining accurate position information, and section 2.5 discusses cable-out measuring.

2.1 The Klein 5500 Sidescan Sonar At DSTO

In 1995 DSTO acquired the Klein 5500 sidescan sonar (see Figure 17) with the aim to evaluate its performance. This sonar was manufactured by the comparatively well-known sidescan sonar manufacturer, Klein Associates, Inc. (http://www.kleinsonar.com) in the U.S.A. Twice Klein Associates, Inc. has upgraded the Klein 5500 with the last in 1991 being extensive and upgrading the sonar from the Mark I to a Mark II.

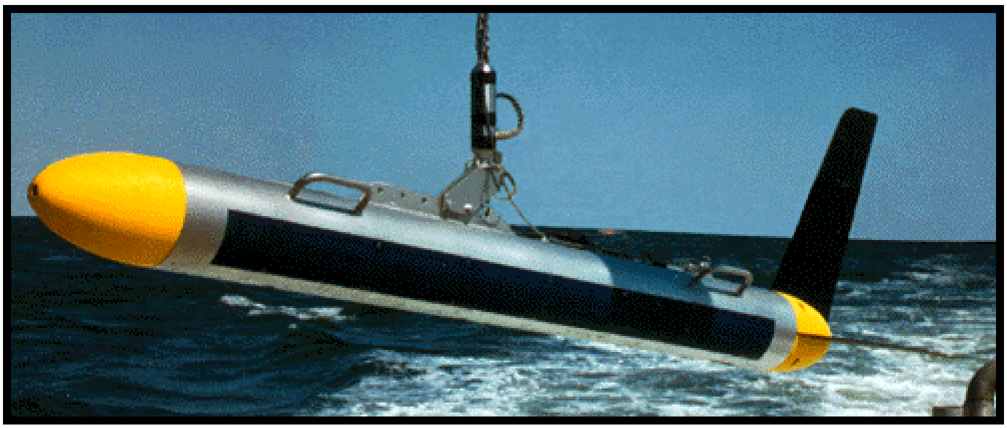


Figure 17 The Klein 5500 sidescan sonar shown in its "towed" configuration.

2.1.1 The Klein 5500

The Klein 5500 is coined a multi-beam sidescan sonar because, depending upon the speed of the towfish, up to five acoustic beams on the port and starboard side of the towfish will be generated. These beams, instead of forming a beam which is less focussed across the track (see Figure 7), as is normally the case, generate a beam which is more focussed as slant range increases, and it is this feature which permits the Klein 5500 to achieve the high resolution of 20cm up to survey speeds of 10 knots. The towfish has a depth rating of 200m and has sensors outputting hydrostatic pressure, water temperature, pitch, roll, yaw and altitude above the seafloor.

The Klein 5500 has three fins, which stabilise the motion of the towfish when it is being towed. An operator can easily remove these fins and to reduce the possibility of snagging, and losing the towfish on unforeseen objects. The back yellow nose cone, where the fins are housed, is designed to separate and break-off from the towfish when under extreme load. Figure 18 shows this feature in detail.

The fins should be removed when the sonar is being used in its bow-mounted configuration. The reasons are that it would place a lot of unnecessary stress on the tail fins and they are not needed as the sonars yaw and pitch characteristics are already stabilised by the sonar being directly attached to a large platform.

Figure 18 The Klein 5500 sidescan sonar showing where the rear yellow nose cone, housing the tail fins, will separate (indicated by a red line) from the stainless steel body when the tail fins become snagged on any bottom objects.

The Klein 5500 must be used in conjunction with a sophisticated computer known as the Transceiver and Processing Unit (TPU) (see Figure 19). The TPU has several major functions. These are (1) multiplexing the commands, and sending them, to the sonar, (2) controlling the number of transducers to be used in beam forming, (3) demultiplexing the data coming from the towfish (5) parsing the sonar data through a digital signal processor and (6) data format generation.

The TPU does not have a hard disk and needs to download its operating system from another computer. This computer is normally the acquisition computer with the operating system being a single file called vxworks. The location of this file and the correct set up of the host computer to enable the TPU to download it are outlined in section 3.3. Although it has not been normal practice to use the latest version of vxworks, this is possible, with the latest version encompassed within the latest compressed version of the acquisition software SonarPro, which is downloadable from the web site (http://www.kleinsonar.com/tech/sonarpro#.#html). In the past Klein has provided upgrades to SonarPro and vxworks free of charge to the DSTO sidescan sonar group. Old versions of vxworks should be kept until the operator is satisfied that any new versions boot and execute the TPU correctly.

(a)

(b)

Figure 19 The (a) front view and (b) back view of the Klein 5500 TPU.

As the TPU controls the number of beams to be activated in the Klein 5500, then the TPU needs to know the speed of the towfish (or the platform). To achieve this GPS navigation data needs to be routed into the TPU using the serial port on the back of the unit marked "navigation". The form the GPS data takes is outlined in section 2.4.3. If the TPU does not receive any GPS data then the TPU will activate all five beams on the port and starboard side of the towfish and oversample the seafloor's backscatter characteristics. This will cause the data files to be over-saturated and larger than necessary.

2.2 Basic hardware setup

Physical Components of the basic Klein 5500/Isis Sidescan System	
Hardware	*Function*
1. Klein 5500 towfish	Generate and receive acoustic signal at 455kHz
2. Fins for towfish	Stabilise towfish motion
3. K-wing depressor for towfish	Stabilise motion, increase ratio of towfish depth/cable-out
4. Transceiver Processing Unit (TPU)	Controls towfish, send information from towfish to Isis computer
5. Armoured cable	Transmit signals between towfish and TPU
6. Isis computer	Record sonar and navigation data, controls TPU and controls data display.
7. Isis dongle	Allow access to the Isis software.
8. LAN/Optical cables and hubs	Transfer data between TPU and Isis computer. (See below for standard configuration, and Appendix 1 for other options)
9. Slip ring for winch	Allow winch to turn while data is being transferred.
10. Short black cable	Connect slip ring to deck cable
11. Deck cable (blue – 20m)	Connect short deck cable to TPU
12. Power cables, for 3, 5, 6, 7. Power boards and extension leads	Supply 240V power to equipment as required

A schematic of the basic physical setup is shown below. For optimal positioning of the towfish, navigation inputs and cable-out information are required. The hardware for navigation inputs is discussed in 2.3, and correct software settings are discussed in Sections 4 and 5.

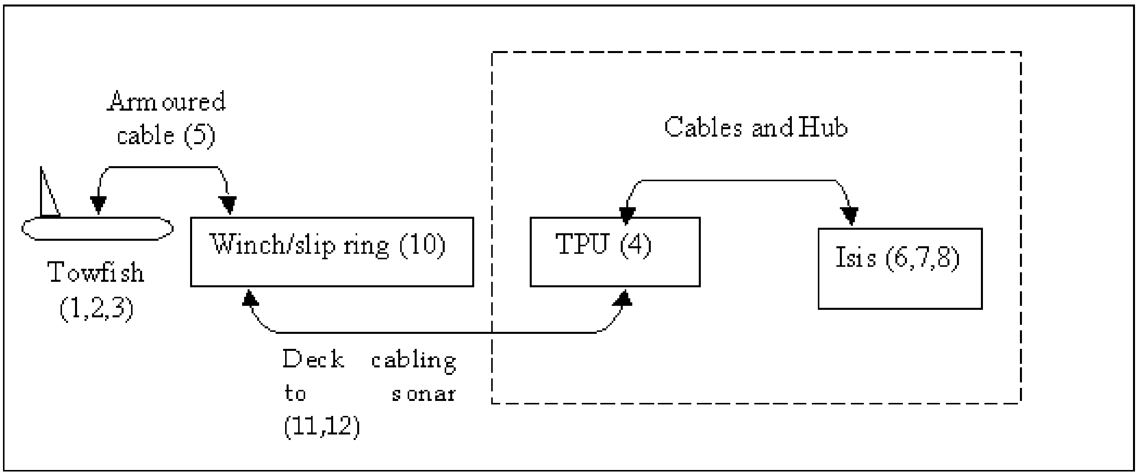


Figure 21 A flow diagram showing the hardware setup for the Klein 5500 sidescan sonar.

2.2.1 PC Hardware

This section outlines what computer hardware is required in the acquisition PC to obtain data from the Klein 5500 sidescan sonar, and if necessary, how such hardware needs to be set up and tested. This section is broken up into two sections. The first outlines hardware that is required by any computer so that it can acquire data, with the second section outlining the hardware that is present in the ruggedised Isis PC, and how some of this specialised hardware is installed and tested.

2.2.1.1 General PC

To accept data from the Klein 5500 sonar a 100Mbit Ethernet network card is required in the acquisition PC. If the software acquisition program Isis is being used then the second hardware that is required is the Isis dongle. Isis is produced by Triton Elics International (TEI).

The Isis Rainbow dongle (serial #PR-1/97100) is needed so the Isis data acquisition software can be executed and needs to be attached to the printer port of the acquiring PC. Under Windows NT and Windows 2000 the Isis dongle will not be recognised and the correct drivers must be installed before it can be used. This is achieved using the program RainbowSSD5.39.2.exe, which can be located at (X:\Drivers and Third Party Applications\Sentinel Driver\, where X is the drive name of the CD) on the Isis Installation CD. If the dongle is not in place, the connection is faulty or the appropriate drivers have not been installed, then the Isis software will not be able to detect the dongle and as a result Isis will run in demonstration mode: Data acquisition during this time will not be possible although data file playback is possible.

TEI, in addition to making Isis, makes a ruggedised Isis PC that has been designed to withstand the large knocks and bump that are common with the marine environment. If the acquiring PC is the ruggedised Isis PC, then the Isis dongle can, in addition to being attached externally to the printer port, be attached internally. This can be used to protect the dongle from being accidentally broken off during transit and normal operations, and can also be used to hinder the dongle being stolen. The ruggedised Isis PC will be outlined in more detail in the next section.

Note, if the dongle is lost or stolen, TEI could request DSTO to purchase another software licence and not to simply post a replacement free of charge.

Other than the Isis dongle and a 100Mbit Ethernet network card it is beneficial if the acquisition computer has:

- a video graphics card that supports a second virtual monitor or a second monitor.
- two serial ports.
- 256 megabytes or more of RAM.

- A second hard disk for data collection. It is a recommendation from Triton Elics International that the Isis acquisition program be executed from a different hard disk than that where data is being stored.
- removable media, such as removable hard disk bay, or a magnetic optical disk drive.
-

2.2.1.2 Isis PC

The Isis PC is simply a ruggedised PC made by Triton Elics International (http://www.tritonelics.com/) and runs the Windows 2000 operating system. Figure 21 shows this PC. This PC was purchased in 1998 and in the past has been the main PC used in DSTO to acquire sidescan data in conjunction with the software Isis® (http://www.tritonelics.com/isissonar.html), although SonarPro (http://www.kleinsonar.com/sonarpro/index.html) has been used to a small degree. Any PC can be used to acquire sonar data provided the PC's processor is fast enough and there is an Ethernet network card.

Figure 21 an illustration of the ruggedised ISIS PC which has been the main PC used by DSTO to acquire sidescan data.

The Isis PC has a number of peculiarities which the general PC would not have and which may not be evident to a new user. Most of these are evident by looking at the back of the unit (see Figure 22). From Figure 22, scanning from the right to left, the operator should notice the following characteristics:

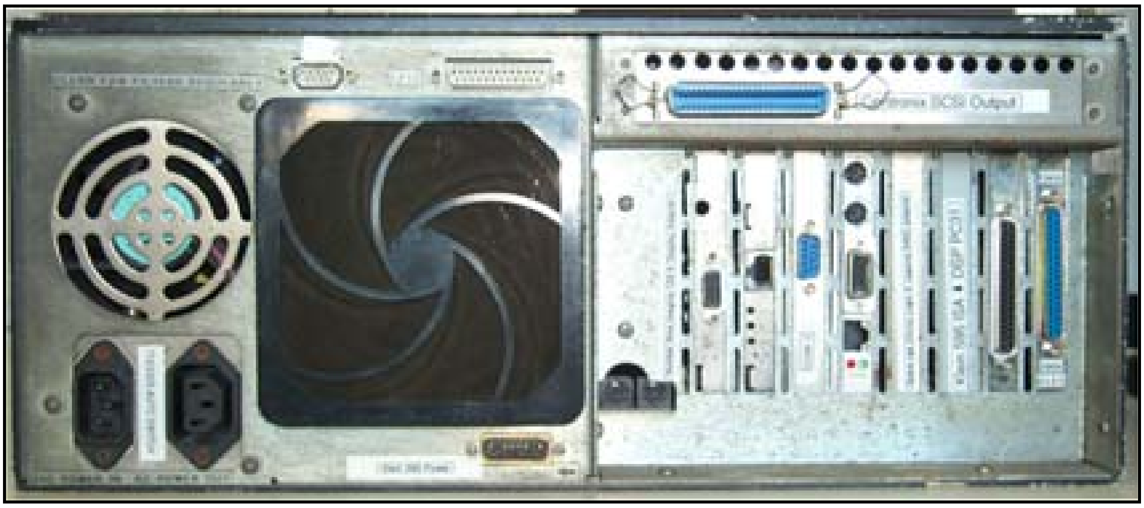


Figure 22 The back of the Isis ruggedised computer.

(1) Serial Input (Com2). This is used for NMEA (National Marine Electronics Association) 0183 string inputs from gyro or Leica GPS.
(2) Parallel Port (LPT1). This is used almost exclusively to attach the Isis dongle (or sentinel).
(3) DB-15 DC power output for the Klein 595 Sidescan Sonar SIU4 (Signal Interface Unit). Note: to power the SIU4 this way requires a DB 15 male to 3.5mm stereo plug cable.
(4) Centronix SCSI (Small Computer System Interface) output. Useful for attaching a magnetic optical disk drive, when extra storage space is required.
(5) Two PS/2 connectors in the bottom left hand corner of the back panel of the Isis PC. These connectors are not used on our PC (personal communication Geoff Shipton, Triton Elics International, 2002)
(6) "Number Nine Imagine 128" video graphics card (http://www.nine.com/). This card allows for a second virtual screen but does not permit the attachment of a second monitor.
(7) 3com 10Mbit and 100Mbit Ethernet LAN Card. This was installed so the Isis PC could accept data from the Klein 5500 sidescan sonar, which requires a 100Mbit connection.
(8) Serial Connection (Com1).
(9) Exchangeable Motherboard Card. Unlike normal PC's, the Isis PC has a motherboard which is orientated upright and which fits into one ISA and one PCI slots on a backpane whose only role is for placement of PCI and ISA slots. On the motherboard card, looking at the back of the Isis PC, there is:

- NIC 10Mbit Ethernet LAN network adapter.
- a Cirrus Logic Laguna 4564 video adapter. This video card was the original video card that came with the Isis PC and has been left in the off chance that the more functional Imagine 128 malfunctions.

The Cirrus Laguna video adapter is automatically disabled by the operating system when the Imagine 128 is in use and this is evident by an exclamation mark next to this device in the Device Manager (see Figure 23). If the Imagine 128 does malfunction, the Cirrus Logic video card can be used. This can be achieved by removing the Imagine 128 card as well as the flange around the DB12 connection of the Cirrus Logic Video card. The operator should be aware however, that the Cirrus Laguna video card has less video ram than the Imagine 128 and does not support a second virtual screen. The flange around the DB15 connection of the spare Cirrus video card is to prevent an operator unintentionally using this spare VGA adapter when the Imagine 128 is functioning correctly.

Figure 23 The device manager display for the Isis PC under the windows2000 operating system.

- Two PS/2 connections which can only be used with a "Y" adaptor (personal communication Geoff Shipton, 2002)

(10) 40pin PC31 DSP (Digital Signal Processor) card for retrieving data from the Klein 595 sidescan sonar. See Appendix A for details about this card.

(11) 40pin adaptor (connected to the PC31 card by an internal ribbon) for retrieving data from the Klein 2000 sonar. This input adaptor was installed in 1999 so that the Isis® PC could acquire data from the analogue, Klein 2000 sidescan sonar (the successor of the Klein595 and the precursor of the Klein 5500) for the Shallow Survey Conference in 1999. As DSTO does not have a Klein 2000 sonar then this adaptor has not been used since 1999.

2.2.2 Network Hardware

The hardware required to set up the Local Area Network (LAN) between the TPU and the acquisition computer, for the Klein 5500 sonar, in addition to the network card in the acquisition computer, is either:

- one, cross-over, twisted pair, category 5 (Cat5), network cable, or
- two, straight, twisted pair, Cat5 cables with an Ethernet hub. The use of a hub is simply to stop the data packets and retransmit them along the cable. Hubs are

useful when long cables are needed, as attenuation can be a problem and Klein recommends to always use a hub, even for very short cables. Hubs have also been used successfully at DSTO to circumvent jittery waterfall display speeds.

At DSTO two hubs have been used in conjunction with the Klein 5500 sonar. There is the Intel InBusiness, which has been the hub used most often at DSTO, and there is also the Dual E-Switch. Both hubs can output data to 8 ports and accept baud rates of 10 or 100Mbits/s. Figure 24 shows these two hubs in detail.

(a)

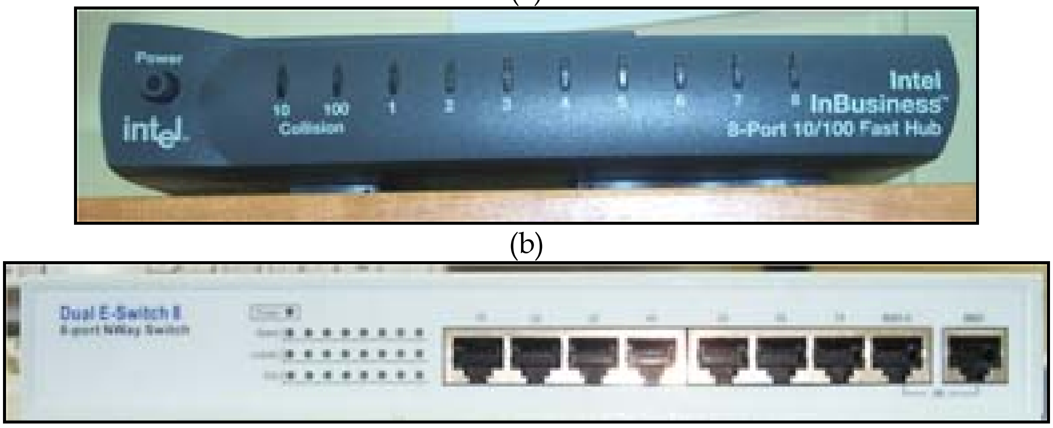


Figure 24 The (a) Intel InBusiness and (b) Dual E-Switch hubs used at DSTO in conjunction with acquiring sidescan sonar data from the Klein 5500.

To use a hub(s) between the TPU and the acquisition computer, either a cross-over cable is used between the TPU and the hub, in which case the RJ45 plug of the cable needs to be placed in the slot marked "X"[1] at the back of the hub, or a straight cable can be used between the TPU and the hub, but in this case the RJ45 plug can be placed into any slot of the back of the hub except that marked with the "X". Figure 25 shows a picture of the back of the Intel hub showing the slot marked with an "X". Whether a straight or a cross-over cable is used between the TPU and the hub, a straight cable must be used between the acquisition computer and the hub. This requirement is because of the construction of the two hubs used at DSTO. As hubs accept incoming data packets on any port (except when using a cross-over cable, as then only accept input from the "X" port) and re-transmit these packets on any other port, then the RJ45 plug of the straight cable between the hub and the acquisition computer, can be placed in any spare slot of the hub, except that marked with an "X". The baud rate of the data entering and exiting the hub is indicated on the front of a hub by the colour of the port indicators, with green indicating 100Mbits/s and orange indicating 10Mbits/s. During data acquisition these indicators will flash indicating data packets are being transmitted to the acquisition computer.

[1] The marking "X" means that this slot is compatible with the usage of a cross-over cable.

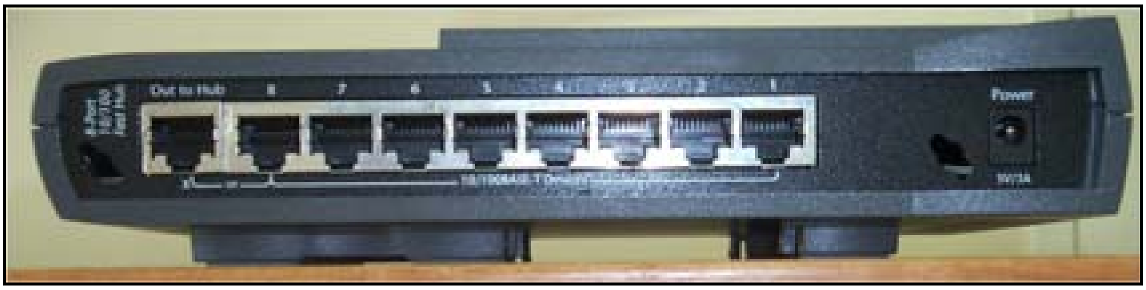


Figure 25 The back of the Intel In-Business hub, showing the "X" RJ45 input slot, which accepts input data from a cross-over cable.

- two fibre-optic to Cat5 network cable media converters (see Figure 26). These converters were made by IMC (http://www.imcnetworks.com/products/mcbasic.asp) and are used to replace LAN cables with fibre optic cables in areas of high electromagnetic radiation conditions, such as exists on sea going vessels. These converters can accept sonar data from both cross over cables or straight LAN cables, using the switch to the left of the RJ45 plug.

Figure 26 A fibre optic to Cat5 network cable media converter.

2.3 Acquiring Accurate Position Information

One of the fundamental roles played by a sidescan sonars is to be able to determine the locations of any features or objects detected by the sonar. If it is not possible to specify the location of any objects then the usefulness of the data gathered by these expensive pieces of equipment is much reduced, and for some roles (for example object locating) the data is not worth collecting.

This section discusses what is needed to set up the initial hardware to make sure position information of a towfish is of a high quality. In particular, it will discuss how to set up the hardware for serial inputs of position information to the sidescan system (eg position, heading, cable-out and water depth). Correct set up of the acquisition software is also required and this is discussed in chapter 5.

Serial information can be input to the system in real time via serial ports. Differential Global Position System (DGPS) information is necessary for sidescan operations, while gyro, is desirable. Echosounder data can be very important if the depth or altitude readings from the towfish are not accurate, but is otherwise unnecessary. With a device such as Over the Stern Cable-out Device (OSCAD), cable-out information can also be added via serial ports although as the cable-out values rarely change it is sometimes simpler to keep a paper record of the cable-out, and only utilise this information during post processing.

2.3.1 Hardware Required

- Rs232 serial cables of appropriate lengths with appropriate connectors.
- Digiboard card (in recording computer, if required)
- Digiboard 8 serial port cable (if required)
- Digiboard driver disks and instructions (if required)
- PCMCIA dual serial port
- Oscad cable measuring device and accessories
- Measuring tape
- Electrical tape in different colours

2.3.2 Towfish Position

In order to accurately calculate the location of any objects or features observed in the waterfall display, the location of the sidescan sonar (in the Cartesian co-ordinate system) needs to be accurately known in relation to the Differential GPS Antenna.

In order to estimate the location of any sonar relative to the Differential GPS antenna, two sets of measurements are needed if the towfish is being towed and one set of measurements if the towfish if bow-mounted. As most of these measurements do not change from one survey to the next then it was deemed advantageous to document them, so they don't have to be made again.

2.3.2.1 Towed Sonars

For towfish which are being towed behind a survey vessel the two different measurements which are needed are the location of the last point of contact of the towcable with the survey vessel, this being the fairlead or shieve, and the second is the location of the sonar in the water column relative to this point.

The position of the fairlead relative to the GPS antenna on the DSTO workboat is outlined in Table 2. Figure 27 is a schematic diagram illustrating these quantities. The height of the GPS antenna on the workboat above the waterline is 2.77 meters.

Table 2 The position of the fairlead rollers on the DSTO workboat 440.

Variable	Towed
X (port or starboard)	0m
Y (along vessel)	-4.3
Z (height, negative=> below antenna)	-1.47

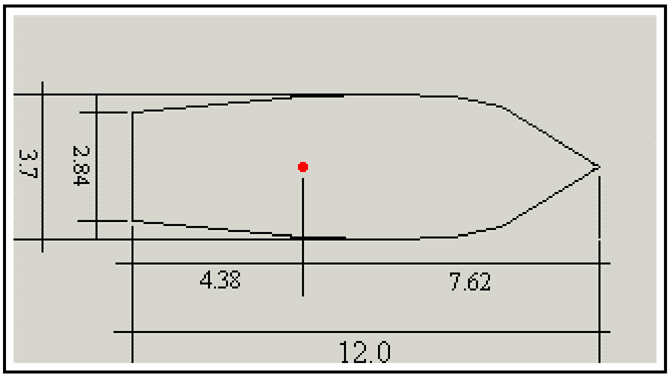


Figure 27 Schematic diagram of the DSTO workboat "440", showing the major length and width attributes (in metres) in comparison to the GPS antenna (marked by the red dot).

Note: Most DGPS equipment can be set up to output the position of any point whose position relative to a DGPS antenna is known. Hence, instead of entering the location of a fairlead or shieve into an acquisition or post-processing software, it can be entered as zero, and left with the GPS equipment to calculate.

To set up the Leica MX420/8 GPS receiver to perform such a function, go to the configuration screen and use the cursor key to scroll down to the Datum item. It is here that the "Position offset relative to WGS-84" can be entered.

There are advantages and disadvantages of using the GPS equipment to give you a position on the survey vessel other than that of the antenna. The advantage is that it limits the set up of the acquisition or post-processing software, but the disadvantage is that it increases the amount meta data and documentation level.

To calculate the position of the towfish from the fairlead involves using the Pythagorean Theorem, but the operator does not need to worry about this, because most of the time the acquisition or post processing software package computes the position automatically as long as it has been set up correctly.

As the Klein 5500 has an inbuilt pressure sensor then its depth below the water line is already known. The only piece of information that is required to calculate the horizontal distance the towfish is behind the workboat (which is termed layback) is the amount of cable-out from the last point of contact with the vessel. By knowing the amount of cable-out and the depth of the towfish in the water column one can calculate the layback. Figure 28 shows this principle in detail.

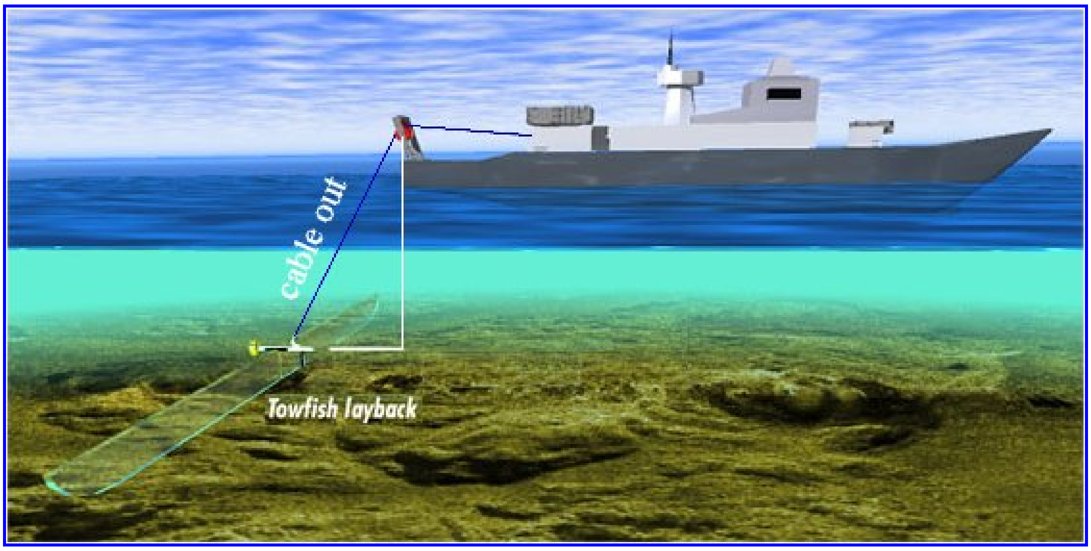


Figure 28 Estimating the layback of a towfish using the cable-out value, the depth of the towfish and the height of the fairlead above the waterline. Adapted from (http://www.naval-minesonar.com/optips/optips.html)

In addition to using the cable-out and towfish depth to deduce layback, it is sometimes necessary to take the type of cable into account, as this will influence the curvature of the cable. The affect of the type of cable on layback calculations is minor and the operator need not be concerned with the fine details, only that some software packages can take the effect into account.

2.3.2.2 Bow-mounted Sonars

For a bow-mounted towfish, there is no cable-out value and the towfish is fixed to the survey vessel. Because of this, bowmounted towfish can generate very accurate position information and are normally used for latency measurements. When the Klein 5500 is bow-mounted on the DSTO workboat “440” its position relative to the GPS antenna height is outlined in Table 3

Table 3 The position of a bowmounted towfish on the DSTO workboat 440.

Variable	Bow-mounted
X (port or starboard)	0m
Y (along vessel)	7.8m
Z (height) (negative => fish below antenna)	-3.72
Height of GPS antenna above waterline	2.77
Static depth of towfish below waterline	0.95

2.3.3 Navigation Inputs

There are two forms of navigation data that need to used when acquiring sidescan sonar data, if the data is to be of any use. These are Differential GPS data from the Leica MX420/8, and gyro data (which represents the orientation of the survey vessel) from the KVH Fluxgate Compass. Although there is a compass inside the towfish, the fluxgate compass is used because the magnetic compass is not very accurate.

It is recommended from Klein that GPS data be sent to the TPU by placing the RS232 cable from the Leica MX420/8 GPS unit into the 9 pin male serial plug on the back of the TPU labelled "navigation". The main reason for this is that the TPU uses the speed information in the GPS data to control the number of beams that are generated in the towfish, and hence to keep the along-track resolution at 0.2m. If GPS data is sent to the acquisition computer instead, then the TPU will activate all five beams, and sample the seafloor at its fastest rate. This causes the data files being collected to be over-saturated and much larger than they would otherwise need to be. The second reason why GPS data should be sent to the TPU is that the data fusion of GPS and sonar pings occurs more quickly than if GPS data was sent to the acquisition computer. The longer it takes for the GPS data to be fused with the ping data the longer will be the latency and it also introduces another computer into the data acquisition, that being the acquisition computer.

The gyro data is sent to com1 or com2 of the acquisition computer and like GPS data being sent to the acquisition computer, the acquisition software needs to be set up appropriately to receive the gyro data. See sections (4.1, 4.6, 4.8) for specific software requirements for correct operation (4.1, 4.6, 4.8).

GPS and gyro data are transmitted to the TPU and acquisition computer using 9 pin, RS232 serial cables, with a Baud rate of 4800 bits per second, with 8 data bits, no parity and 1 stop bit (8N1). If the operator wishes the TPU and the acquisition software can accept data at different Baud rates; (1) the Baud rate the TPU accepts GPS data at is determined by the variable "set BAUDRATE" in the startup.ini file, (2) with the Baud rate the acquisition computer accepts gyro data at being set inside the software before acquiring data. The different values the BAUDRATE variable can take are 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, with the default value being 4800 bits per second.

The format of the GPS and gyro data is called NMEA0183. This format has been in use since the 1980's and is an ASCII format made up of many different data strings, each representing different marine data. Some of the marine data that can be represented as NMEA strings include position, heading, waypoints, depth and date (see http://www.xs4all.nl/~erkooi/YL/nmea0183.html for a more complete listing). NMEA strings begin with a dollar sign ($) and end in a carriage return linefeed (<CR><LF>).

The GPS data sent to the TPU is comprised of two strings and the gyro data of one string. The GPS data is made up of the two strings, GGA and VTG, although the string GGA could be replaced with the string GGL, with Klein stating that the single string RMC could be used instead of GGA and VTG. The gyro data is made up of the single string HDT. The format of these strings is outlined below.

GGA=Global Positioning System Fix Data
$GPGGA,hhmmss.ss,llll.ll,N,yyyyy.yy,W,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh
hhmmss.ss = UTC of position
llll.ll,N = latitude of position
yyyyy.yy,W = Longitude of position
x = GPS Quality indicator (0=no fix, 1=GPS fix, 2=Differential GPS fix)
xx = number of satellites in use
x.x = horizontal dilution of precision
x.x = Antenna altitude above mean sea level M = units of antenna altitude, meters
x.x = Geoidal separation M = units of geoidal separation, meters
x.x = Age of Differential GPS data (seconds)
xxxx = Differential reference station ID

GLL=Geographic Position latitude, Longitude
$GPGLL,lll.ll,a,yyyyy.yy,a,hhmmss.ss,A
llll.ll = Latitude of position
a = N or S
yyyyy.yy = Longitude of position
a = E or W
hhmmss.ss = UTC of position
A = status: A = valid data

RMC=Recommended Minimum Specific GPS/TRANSIT Data
$GPRMC,hhmmss.ss,A,llll.ll,N,yyyyy.yy,W,x.x,x.x,ddmmyy,x.x,W*hh
hhmmss.ss=Universal Time Co-ordinate of position fix (hourminsec)
A=Data Status (V=navigation receiver warning)
llll.ll,N=Latitude of position
yyyyy.yy,W=Longitude of position
x.x=speed over ground in knots
x.x=track made good in degrees true
ddmmyy=Universal Time date
x.x=Magnetic variation degrees (Easterly variation subtracts from true north)
W=East or West
*hh=Checksum

VTG=Actual track made good and speed over ground
$GPVTG,t,T,,,s.ss,N,s.ss,K,*hh
t=Track made good
T=Fixed "T" indicates that track made good is relative to true north

s.ss,N=speed over ground in knots
ss.s,K=speed over ground in Kilometers per hour
*hh=checksum

HDT=Heading Degrees True
$GPHDT,x.x,T
x.x = Heading, degrees true

If any other serial data (for example echosounder data) is to be recorded, it also needs to be input to the recording computer via an appropriate RS232 cable. If there are no spare communication ports on the recording computer then one of the following scenarios will need to be implemented:

- Install a PCI (Peripheral Computer Interface) card which has one or more serial ports,
- Purchase a USB (Universal Serial Bus) to serial adapter.
- Purchase a USB hub with a built in serial port built.
- Install the ISA "digi classicboard" card (http://www.digi.com/solutions/mportserialcards/classicboard.shtml). This card provides eight 25-pin male ports, available through an "octopus" cabling (see Figure 29a). As any computer will number the 8 digiboard ports after all the other serial ports, then the port number assigned to each port by the computer may not match the numbers on the cabling. This means the digiboard cable labelled 1 will not usually be com port 1 on the computer. However once you know what number the computer has assigned to the first digiboard serial port, those remaining are numbered consecutively.

  Note that the installation of this board into a PC running Windows2000 was attempted but failed. It was hypothesised that its installation would have been simpler if it was a PCI card instead of an ISA.

- If the acquisition computer is a laptop, then there exists a "Socket" PCMCIA (Personal Computer Memory Card Interface Accessory) card with two serial ports (see Figure 29b).

(a)  (b) 

Figure 29 (a) Digiboard Classic, 8 serial port PCI card. (b) Dual serial PCMCIA card from Socket Communication (http://www.socketcom.com/product/serial_dual.htm).

Under the Windows 2000/NT operating system, if an RS232 cable is connected to the serial port when the operating system is booted then the operating system thinks the operator is trying to attach a mouse and will try and install the appropriate drivers. The operating will also, most importantly, lock the serial port so it can no longer be used and unpredictable mouse behaviour may result. This idiosyncrasy of Windows2000/NT usually happens if the serial cable being used is not fully implemented. For example, there are only two, or three wires connected (Pin2, Pin3 and Pin5/7). The solution is to wire the serial cable so that it does not "look" like a serial mouse. This modification must be done at the computer end of the cable, by making the following alterations on the back of the serial connector:

For DB-25 (25 pin) solder a link between these pins.
  pins 4 - 5
  pins 6 - 8 - 20
For DB-9 (9 pin) solder a link between these pins.
  pins 7 - 8
  pins 1 - 4 - 6

After jumpering the serial cable remove the extra "Pointing Devices" using the device manager in the Control Panel and the serial port should now be capable of accepting data (Triton Elics International CD, Winter02).

2.3.4 Cable Type

In order to estimate the towfish position whilst it is being towed, some software programs require the type of the cable to be entered (see section 5.3.4 for an example). There is one type of cable used at DSTO although it comes in two versions. The tow cable is a 10.5 mm (0.413 inches) coaxial copper, Kevlar reinforced cable which has a breaking strength of 2270kg and a working load 454kg. This cable is termed a Lightweight Coaxial Cable, is easily identified by its blue polyurethane jacket and is useful for low stress situations, such as when the sidescan sonar is bowmounted to the workboat. When the sidescan sonar is being towed, however, a stronger form of this cable needs to be used. On the workboat there is a drum of this cable in which the blue jacket has been covered by a double layer of counter helical, galvanized plow steel. This cable is termed an Armoured Coaxial Cable and has the much higher breaking strain of 4990kg and the working load of 1247kg.

In the past, the first thirty to forty centimetres of armoured cable leaving the towfish has experienced considerable rusting when the cable has been left in seawater for more than a day; This normally occurs when the towfish is being towed or tested over several days and is left in its deployed configuration behind the DSTO workboat to save deployment time each day. Figure 30 shows an example of such corrosion.

The corrosion to the towcable causes the strength to be severely reduced and eventually the corroded part of the cable needs to be removed. As this is a specialized job (last performed by Mr Collin Mason) then efforts need to be made to reduce the severity of the corrosion of the towcable. It has been suggested by Klein Associates Inc. that the reason for the tow cable corroding quickly when it is left in seawater is because the tow cable or the TPU have not been properly electrically connected (via the drum) to the ships ground. If the TPU and the armoured cable were electrically connected to the ships earth then all the equipment would be at the same potential and corrosion would not occur (personal communication Vince Horan, 2002). Efforts should be made to investigate whether or not the grounding of the steel drum to the ship's ground could be improved.

Figure 30 Corrosion of the armoured coaxial cable (black rectangle) which is used to tow the Klein 5500 sidescan sonar on the workboat.

2.3.5 Cable-out Values

Cable-out information is used to calculate how far the towfish is behind the vessel. This horizontal distance is termed layback. The simplest method of measuring cable-out is to mark the cable with electrical tape at known distances from the towfish, for example, every 5 metres. Then as the cable is payed out, the length can be estimated or measured from the markings. The value of cable-out should be the taken as the length of cable from the towpoint (for example the fairlead or sheath) to the towfish. A paper record of the cable-out as it is changed over time (or relative to data file and ping number) should be kept. This information can then be taken into account in post-processing of data.

The Over the Stern Cable Angle Device (OSCAD) is a tool that can be used to measure cable-out automatically. A small wheel resting on the cable measures the length of cable-out. If mounted properly, it also measures the angle of the cable, giving very good positioning of the towfish. OSCAD comes complete with mounting diagrams and instructions, but fitting it can be difficult. The advantage of using OSCAD is that it automatically measures cable-out, and this information can be input to the data files in real time via a serial port. It is a wise practice to keep a paper record of cable-out as a backup, for verification of the OSCAD data.

For further information on OSCAD, contact

Dr Roger Neill
Maritime Platforms Division
(03) 96268651

3 Host Computer Setup

3.1 Introduction

There are a number of settings that need to be made to the host computer before data can be recorded. If a dedicated data-logging computer is being used then these settings do not need to be altered for each survey. However, if the data logging computer has been used for other purposes since a sidescan survey, then it is wise to check and make sure that the settings described in this chapter have not been altered before starting a survey.

This section will outline the correct settings when using Windows 95 and Windows 2000, as well as giving some explanation as to why these settings are required, how the different software involved works, and how the different parts of the sidescan system interact.

Most of the settings that need to be made to the computer acquiring the data relate to setting up the Local Area Network between the TPU and the host computer. As the TPU does not have its own hard disk, then when it is switched on it requests its operating system file (called vxworks) and also a file that changes the default settings of the operating system (called startup.ini). The file vxworks must be downloaded by the TPU from the host computer for it to boot properly. If the file startup.ini cannot be found then the TPU will still boot, but all of its settings will take on default values. It turns out that all the default settings of the operating system on the TPU correlate with the needs of DSTO and the file startup.ini is not needed.

As the file vxworks is very important, Klein Associates Inc. is continually fixing bugs and updating old versions. Although it is not necessary to use the latest version of this file, if the user wishes he/she can find it at http://www.kleinsonar.com/tech/download.html.

An FTP (File Transfer Protocol) server is required on the host computer to control the initial transfer of the boot files from the computer to the TPU. For correct transfer, the IP (internet Protocol) and FTP settings on the host computer must be compatible with the TPU configuration settings. If the operator wishes, the setup of the TPU as well as where it looks for its operating system on the host computer can be changed (see Chapter#4).

3.2 Host Computer IP Address

The computer which the TPU will try and log onto needs to be assigned a specific IP address. In the past this address has been 160.64.181.221. If the host computer does not have an IP address assigned or the IP address that it has been assigned is not compatible with what the TPU expects, then data transfer of the boot files will not be possible, and the TPU will not boot. The following two sections will outline how to set the IP address of the host computer for the two operating systems, Windows95 and Windows2000.

3.2.1 Windows 95

To set the IP address of the host computer under the Window 95 operating system, select Start | Control Panel | Network. Select the "Identification" tab, and make a note of the "Computer name", which should be "Survey". If it is not, select "Edit | Change" and rename as "Survey.

To set the IP address, select the "Configuration" tab of the "Network" window, and select the TCP/IP (Transmission Control Protocol/Internet Protocol) link from the network components list. Click the "Properties" button below this list, and then in the new window select the "IP address" tab. "Specify an IP address" should be checked. Make a note of the IP address. It should be **160.64.181.221**, and the subnet mask should be **255.255.255.0**. If it is necessary, this is the place where you could change the IP address of the host computer. To do this, click "Let me specify my own address", and type in the address 160.64.181.221. Now the IP address of the host computer has been set to what the TPU expects. The IP address of the TPU is set at 160.64.181.222.

3.2.2 Windows 2000

To set the IP address of the host computer under the Windows 2000 operating system, go to the **Control Panel** and click on **Network and Dial-up Connection**. Then right-click on **Local Area Connection**. This will make the Local Area Connection Properties window to be spawned and it is here that the IP address of the host computer can be set. Figure 31 shows the Local Area Connection Properties Window.

Once the Local Area Connection Properties window has been spawned then highlight TCP/IP (Transmission Control Protocol/Internet Protocol) and click on **Properties**. Then the Internet Protocol (TCP/IP) Properties window is displayed. To set the IP address of the host computer click on "**Use the following IP address**" and enter in the IP address of the host computer as 160.64.181.221 with a subnet mask of 255.255.255.0. Leave the Default gateway window empty. Figure 32 shows the Internet Protocol (TCP/IP) Property window with these necessary settings. Click on OK and the IP address and subnet mask of the host computer will now be set.

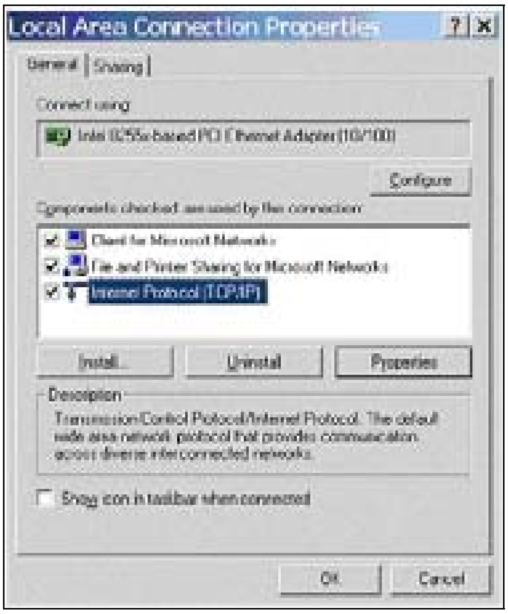


Figure 31 The Local Area Connection Properties window under Windows 2000.

Figure 32 The Internet Protocol (TCP/IP) Properties window and the necessary settings needed by the host computer.

3.3 FTP Servers

3.3.1 Windows 95

Of all three computers in the sonar group that have been used to acquire sidescan sonar data only one has the relatively old Windows 95 operating system. This PC is the Isis workstation. Under Windows 2000, no FTP server is installed when the Windows

95 operating system is installed. Hence, so the TPU can download its operating system file vxworks, the Windows 95 operating system will need an FTP server program to be installed onto it.

In the DSTO Environmental Assessment group, the preferred FTP server is called Serv-U 4.0. This ftp server is available from Rhinosoft (http://www.rhinosoft.com) and because the DSTO group in Sydney was one of the first customers of this software package then all upgrades are free of charge. There is a site licence for this product of 20, held by Lesley Hamilton, MOD, Sydney. Upgrades and information about this software are available on the web at http://www.serv-u.com/. Instructions for installing and/or upgrading ServU are given in Appendix A. Information provided about Serv-U is taken from emails from the software company, documents from their website, and experience.

3.3.1.1 FTP server "ServU"

The discussion that follows assumes Windows 95 as the operating system, although Serv-U can be installed and used on Windows NT and Windows 2000. Information and recommendations for setting up Serv-U come from the documents "System 5000 Host/TPU Setup and Configuration" provided by Klein Associates Inc and "LAN Configuration Notes, Klein 5000 with LAN, Triton Isis workstation with NT 4.0" provided by TEI.

3.3.1.2 Setting up Serv-U

When a PC is booted that had Serv-U installed on it (see Appendix A for installation details) Serv-U should start by itself and be shown, minimised, in the taskbar by the green icon . This indicates that Serv-U FTP server is running in the background and capable of FTP logins by any networked computers provided Serv-U and the networked computer have been set up appropriately.

To set up Serv-U 4.0 so the TPU can retrieve its operating system file, vxworks, first the Serv-U main application window needs to be visible (see -). This can be achieved by either double clicking on the green "U" icon on the task bar or, if there is no such icon, use the Windows Start menu to spawn the application by selecting Start | Programs | ServU FTP Server | ServU, or, thirdly, browse for and run "servu32.exe" using the Start Menu|Search|For Files or Folders.

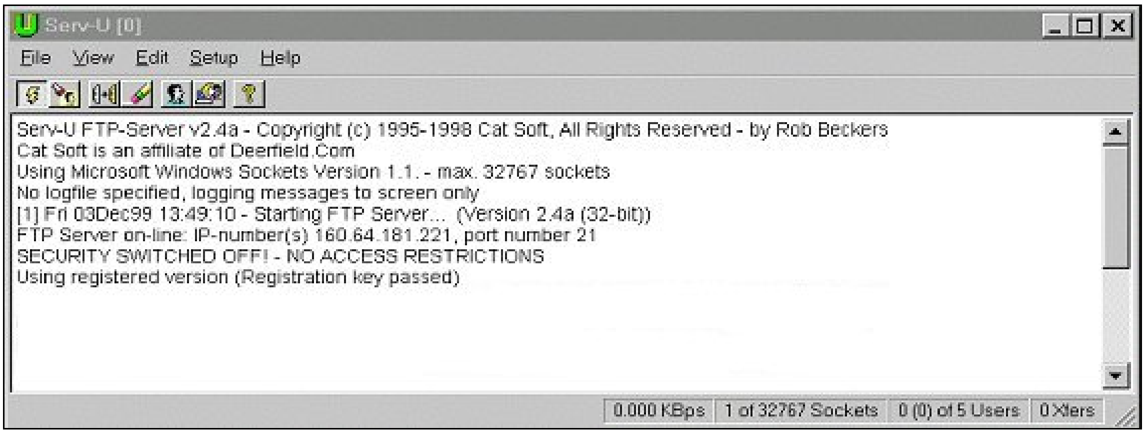


Figure 33 The Serv-U main window.

Once the main window of ServU has spawned, select the "Setup" menu and choose "FTP Server". This brings up the Setup FTP Server window (see Figure 34). Here four settings need to be made. First set the FTP **port number** to 21. This is the TCP port number that all computers, including the TPU, use for FTP transfers. If a different number is set the TPU will not be able to download its operating system file. Secondly check the **maximum transfer speed** (Kbytes/sec) to make sure it's set reasonably high, eg 1200. If the boot files are being transmitted to the TPU very slowly, it could be because of this setting. The time that it takes the TPU to download the files vxworks and startup.ini is indicated in the Serv-U main window and should be approximately one or two seconds. Time values more than this should be considered excessive and efforts made to increase the speed. It is recommended to set the **number of users** to 10, and in the U/D (Up-Side/Down-Side or (Potential Gain versus Risk of Loss)) ratio options to set **timeout** to at least 200 sec. Once these four settings have been entered click on the OK button.

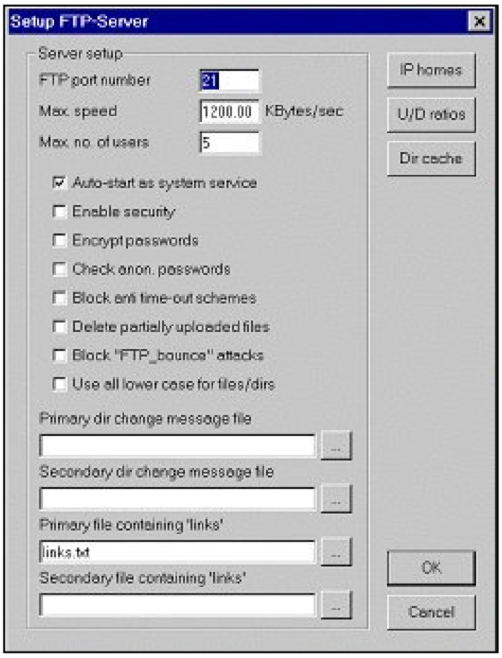


Figure 34 The ServU FTP Server window.

The next settings that need to be made relate to informing Serv-U what the username is that the TPU will try and log in as and where its home directory is located. To enter these details or to check previously entered values, click on Setup|User and this will spawn the User Setup window shown in Figure 35.

If Serv-U has just been installed then there will be no entries in the Users window and the username the TPU will log in as, as well as the password that will be supplied, will need to be entered. To do this, click the "new" button in the right hand column and add the username **SONAR**, with the password of **klein**. Also set the home directory to "**C:**" with the file directory access set to this as well. The home directory is the directory on the host computer that the TPU will be placed as soon as it has logged in. **When the TPU cannot find its operating system file vxworks, it is often caused because this variable has been set incorrectly.** Table 4 outlines the settings that need to be made to Serv-U so the TPU can log in.

Table 4 The four settings that need to be made to Serv-U so the TPU can log into the host computer and retrieve its operating system file.

User name	SONAR
Password	Klein
Home directory	Pathname of the directory containing the boot files 'vxworks' and 'startup.ini', eg C:\klein or C:\ .
File/Directory access rules.	As above

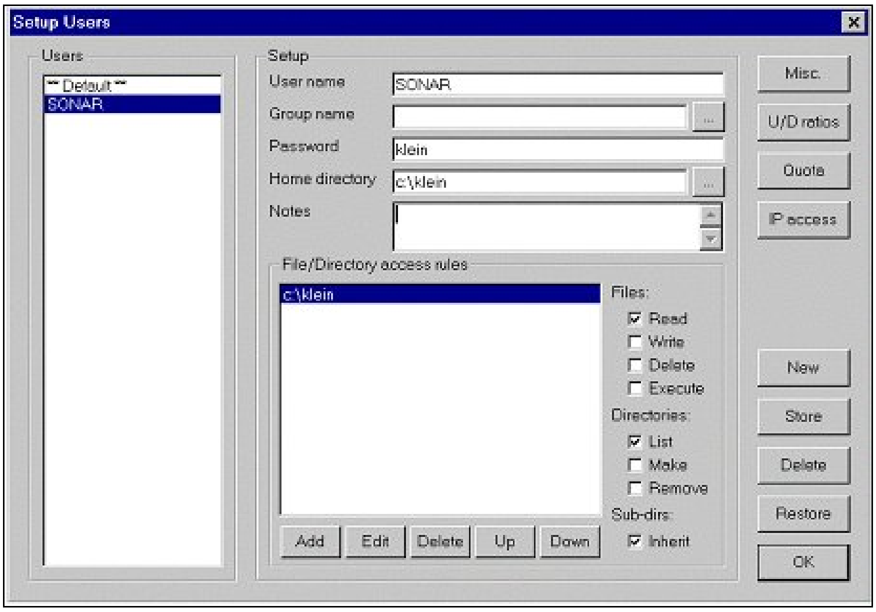


Figure 35 The settings that need to be made to the Setup Users window in ServU that allow the TPU to log into the host computer and retrieve its operating system files.

The username that the TPU will use to log into the host computer, the password that it will supply, the default directory for its operating system file vxworks, and the file name of its operating system file, are all set within the TPU and can be altered, if so desired. The names quoted above for the login variables are the default, factory settings, set when the TPU was returned to Klein Associates, Inc. in 1991. In Chapter#4 details will be given which will outline how to change the values of these variables if the operator so wishes. The operator is warned however, that any changes should be clearly marked on the TPU, as new users may not know how to check the TPU to establish how it has been set up.

From experimentation with the directory settings, it seems that the Home directory field cannot be left blank; otherwise the TPU will not be able to log in to the Isis computer. The directory containing the files "vxworks" and "Startup.ini" must be either in the directory listed under "File/directory access rules", or in a subdirectory of it. Without this, the TPU will be denied permission to access the file. For example, if the file "vxworks" is located in C:\klein, the file/directory access rules must include either C:\ or C:\klein.

3.3.2 Windows 2000

For any PC running the Windows 2000 operating system, there is a built in FTP server, however it is not installed by default and most of the time needs to be installed from the original CD. The ability to use a built in FTP server is very beneficial because it saves time having to purchase such servers from external companies and then having to worry about compatibility setup irregularities as well as upgrades.

If a "Default FTP Site" does not appear under Internet Information Service, under Computer Management, then it needs to be installed from the original CD. If this is the case then refer to Appendix A Section 4.

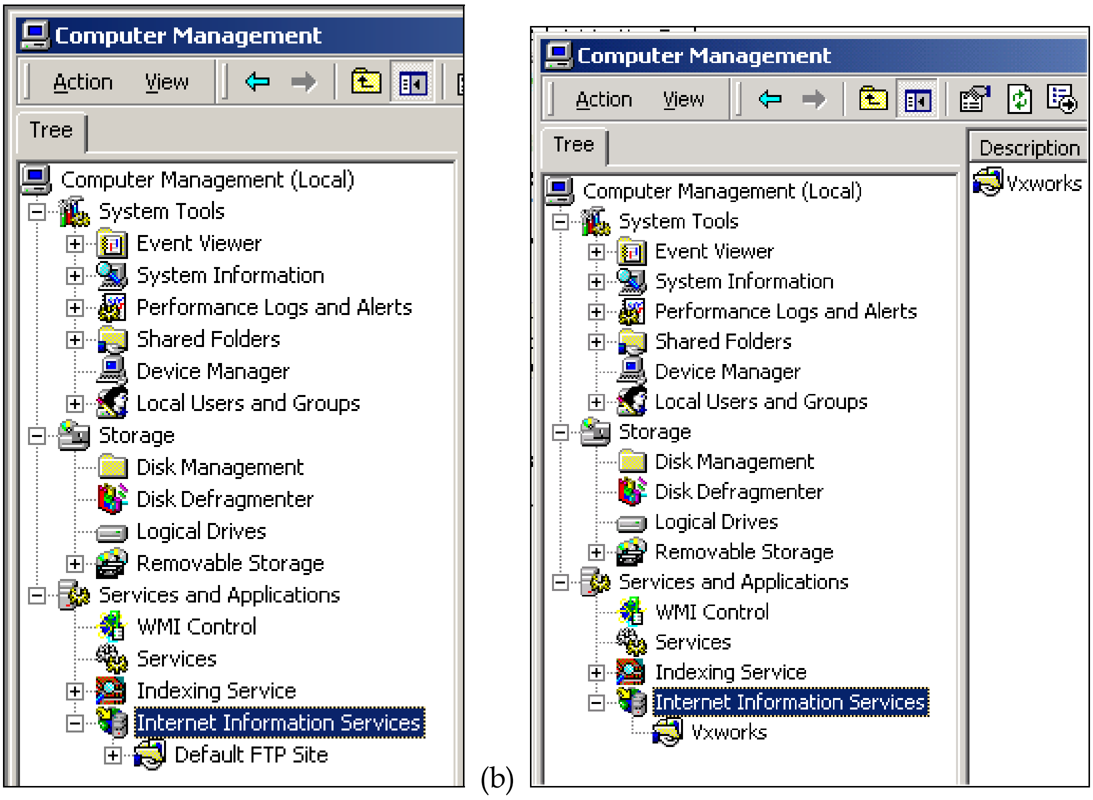
Once the Windows 2000 FTP server has been installed then it needs to be set up appropriately. To do this, go to the **Control Panel** and click on **Administrative Tools|Computer Management**. This will spawn the **Computer Management** window, and if the FTP server has been installed correctly, then under the **Internet Information Service** icon  the **Default FTP Site**  should be visible. Figure 36(a) shows the Computer Management window with the Default FTP Site.

To set up the FTP server so the TPU can retrieve its operating system file (Vxworks), right click on the default FTP Site icon and click on properties. This will spawn the Default FTP Site Properties window (see Figure 37). In this window click on the **FTP Site tab** (see Figure 37a) and in the **Identification** section, enter in VxBoot in the **Description** area, 160.64.181.221 in the **IP Address**, and 21 for the **TCP Port**. Then click on the **Home Directory** tab (see Figure 37b) and for the **option "When connecting to this resource, the content should come from**:" click **on "a directory located on this computer**". Then in the **FTP site** directory set the local path to C:\ with read and log visit attributes set. Then click on OK and the FTP server has been set up correctly (see Figure 36b).

The last settings which need to be made before the TPU can use the FTP server is to create the user "**sonar**" with the password "**klein**". This user is needed because the

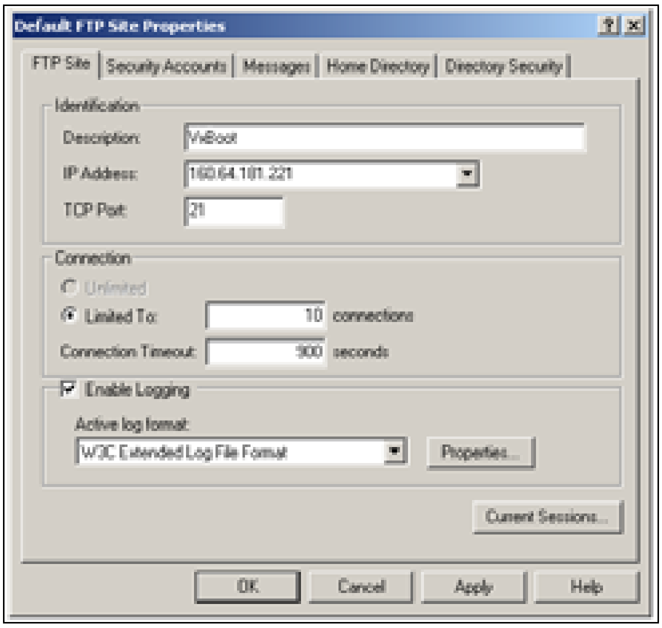
TPU will try to log into the FTP server as this user with this password and unless this user exists the TPU will not be able to log in.

Note: the Klein document (Klein Series 5000 Trouble Shooting Guide) specifies that the user is klein instead of sonar, but this is incorrect.



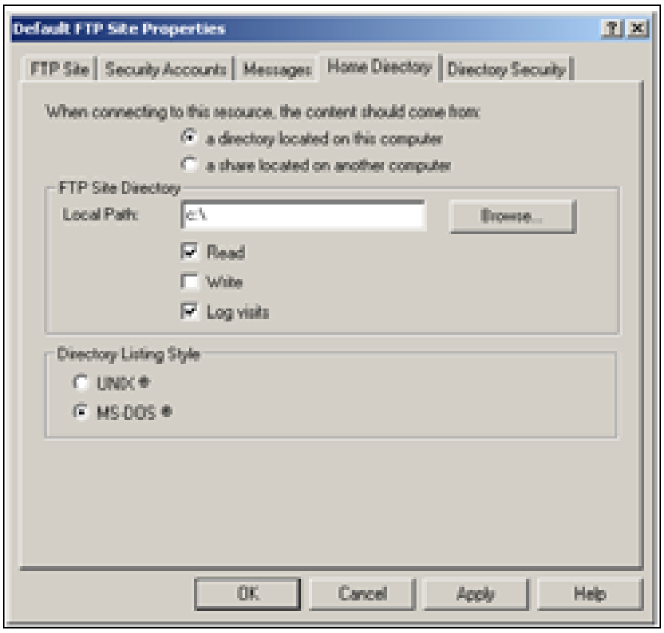
(a) (b)

Figure 36 The Computer Management window under Windows 2000 (a) before and (b) after the Default FTP Server has been set up for the TPU.



(a)

Figure 37 The Default FTP Site Properties window under the Windows 2000 operating system showing the settings that need to be entered to the (a) FTP Site tab and (b) the Home Directory tab, in order to set up the FTP server on the host computer for the TPU to log into.



(b)

Figure 37 (Continued) The Default FTP Site Properties window under the Windows 2000 operating system showing the settings that need to be entered to the (b) Home Directory tab, in order to set up of the FTP server on the host computer for the TPU to log into.

To create the user **sonar** with the password **klein**, leave the Computer Management window active (Figure 36b) and expand the **Local Users and Groups** icon . Then right click on **Users** and click on **New User…** This will make the New User dialogue box be spawned and it is here that the new user can be created. Figure 38 shows the New User dialogue box with these details entered. Once the new user **sonar** has been created then the TPU should be able to download its operating system using the FTP server set up above.

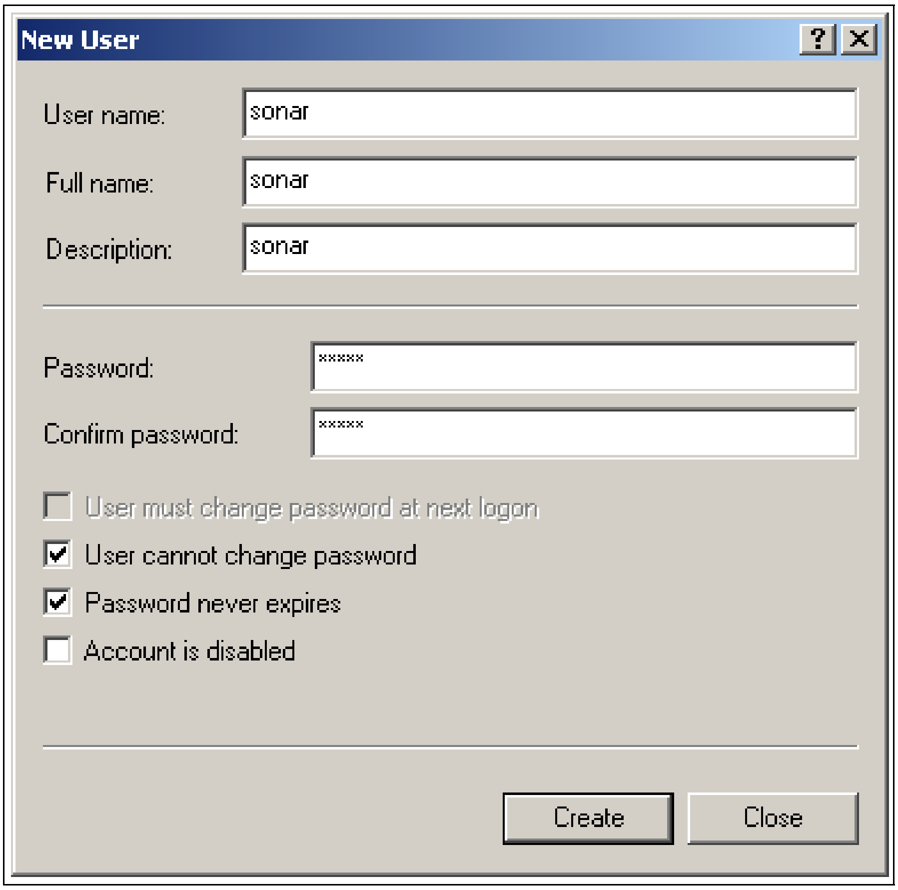
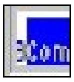


Figure 38 The New User dialogue box under Windows 2000 creating the new user sonar.

3.4 Network Duplex settings

Duplex settings affect how data is transferred through the network that exists between the recording computer and the TPU. Full duplex means that communication can take place in both directions through the Ethernet cable at the same time, which can cause collisions and data loss. Half duplex limits data transfer to one direction at a time, which suits this system, as the bulk of the data flow will be in one direction, from the TPU to the Isis. **Triton Elics recommends that half duplex should be used.**

3.4.1 Isis PC Network Settings

To change or check the network settings of the Isis computer running Windows 95, double click on the "3Com" icon  on the task bar. Alternatively, use the windows start menu and click on Start | Programs | 3Com Nic Utilities | 3nicdiag. Click "yes" to disconnect from the network and run diagnostics.

Both of these methods have the same result, which is to spawn the dialog box shown below (Figure 39). Select the "Properties" tab as displayed, click on "duplex" in the left hand menu, and set it to "half" in the right hand drop down menu, not full or auto. Then click on OK and the settings have been made.

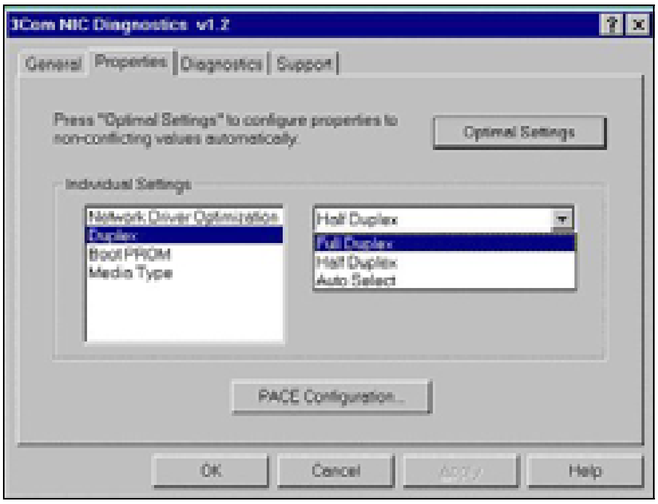


Figure 39 The network settings for the 3com network card in the Isis ruggedised PC under Windows 95.

3.4.2 Windows 2000

The network settings under the Windows 2000 operating system can be altered using the Control Panel. In the Control Panel click on the System icon  and then under the Hardware tab click on the Device Manager. Then expand the Network Adapters and right click on the network card you want to use to communicate with the TPU. Here click on properties and under the Advanced tab, choose the property "Link Speed and Duplex" and select a value of **100Mbits/sec Half Duplex**. Figure 40 shows the connection properties dialogue box and how to alter the duplex settings.

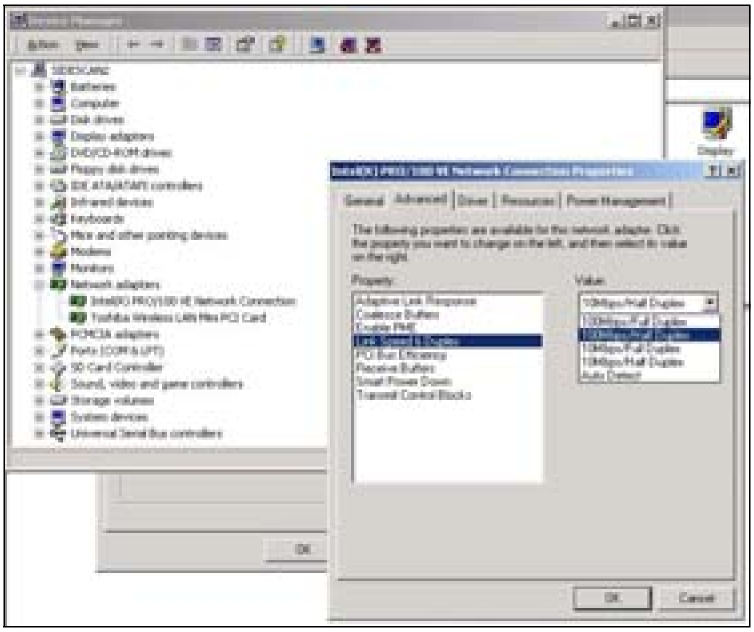


Figure 40 The duplex settings window under Windows 2000.

3.5 Virtual Memory Settings

"Virtual memory" is the space on the hard disk that the Windows operating system is allowed to write to when "memory" (Random Access) is full. The Virtual memory settings define the amount of space allowed to be used, and the way this memory is managed.

If you allow Windows to manage your virtual memory, then Windows will resize the virtual memory allocation as necessary, using some processor time to do this. Managing your own virtual memory settings allows you to set the minimum and maximum size to the same value, which prevents Windows from resizing the virtual memory allocation. This reduces the amount of processor time Windows is using, leaving more resources available for data transfer and storage.

Managing your own virtual memory also allows you to use a drive other than C for virtual memory. This is important if there is not sufficient space (250 Mb) available for virtual memory on C drive (the Windows default). Managing your own memory can also be useful if there are 2 physical hard drives available (not just partitions of the one hard disk). Then you can use one hard disk for virtual memory and the other for data recording, allowing 2 hard disk heads to be working for you simultaneously, rather than the one hard disk head being used both for writing data to virtual memory and writing to data files.

Triton Elics recommends "Let me specify my own virtual memory settings", with min and max both set to the same value, of at least 250Mb.

To access the virtual memory settings under Windows 95 or Windows 2000 follow the following procedures:

Windows 95: Click on "Start|Settings|Control Panel|System, and select the "Performance" tab from the system properties window. Click on the "Virtual memory" button to access virtual memory settings and select "Let me specify my own virtual memory settings". Type in "250" next to "Minimum" and "Maximum", and choose a drive from the drop down list that has at least 250 Mb of space available (This is usually D:\ on the Isis computer).

Windows 2000: Click on "Start|Settings|Control Panel| System", and under the Advance tab click on the "Performance Options" button. Then in the performance options window click on the change button in the Virtual Memory area. Then in the Virtual Memory window choose the drive you would like to be partially used as virtual memory and enter "250" next to "Minimum" and "Maximum".

If available, choose a drive that is on a different hard disk than that on which data is being recorded. Once you have made your selections click "OK". You will be given a warning message that managing your own memory settings can be problematic, and "Are you sure you want to continue?". Click "Yes". If you have made changes to the settings you will be asked to restart your computer. Make sure you do this before trying to record data.

3.6 Screen settings:

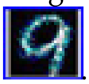
3.6.1 Sonar Acquisition Software

Unlike SonarPro, which does not require the user to set the screen resolution or colour depth to any specific values, early versions of Isis did. In particular, Isis version 4.54 and earlier required the colour depth to be set to 256 colours or 8 bit. If it was set to the commonly used much higher values of 16 bit or 32 bit then an error message would have been spawned when Isis was first executed. Figure 41 shows this error message. This quirk in Isis was fixed after version 4.54, so it is no longer a problem. However, as version 4.54 is still being used by DSTO then it was thought beneficial to highlight this problem.

Figure 41 The error spawned by the Isis® software, version 4.54, when the colour depth has not been set to 256 colours.

3.6.2 Dual Screen Mode

As the software acquisition packages, Isis and SonarPro, use up a lot of screen area, then it is beneficial to use two monitors or invoke a second virtual screen. A second virtual screen is when one monitor has access to the screen area which would normally be available if two monitors were in use, with the area of the second monitor accessed by simply moving the mouse to the right hand side of the screen and continuing to move the mouse towards the right until the user can see the screen background slide towards the left.

As a virtual second screen is not as beneficial as two monitors then it would rarely be chosen if the latter was available, but unfortunately the Isis PC's video graphics card (Number 9 Imagine 128) does not have the capability to output to two monitors and the ISA Matrox graphics card, which was purchased to circumvent this limitation, was not compatible with the Windows 95 operating system installed on the Isis PC. The Number 9 Imagine 128 graphics card currently installed on the Isis PC however, does support a second virtual screen. To access this, go to the bottom right hand corner of the screen and click on the Hawkeye for Windows 95 icon . Hawkeye for Windows 95 is a software package which came with the Number 9 Imagine 128 graphics card and provides more features than would otherwise be available (Appendix A Section#2 details the installation instructions). To invoke the second virtual screen option click on the Resolution Exchange tab and choose the virtual screen that is desired. Optimum results have been obtained by setting the virtual screen to 2048 by 768 and the monitor resolution to 1024 by 768. Figure 42 shows an example of the Hawkeye for Windows 95 graphics card enhancement software. **Note, the Isis PC sometimes crashes when the Hawkeye software is being used.**

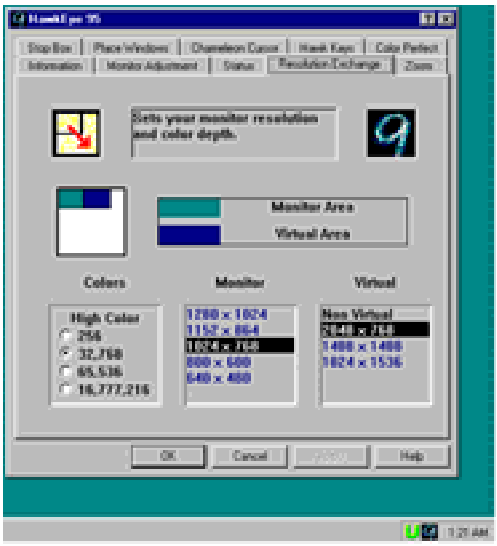


Figure 42 The Hawkeye for Windows 95 enhancement software and how the settings of the second virtual screen are set.

The other newer computers used to acquire sidescan sonar data in DSTO's Environmental Assessment group use the Windows 2000 operating system and this permits the usage of the high quality Millennium G450 Matrox Dual Head Graphics Card. These types of graphics card permit two monitors to be attached to any computer simultaneously. To invoke the usage of two monitors from the matrox cards, click on Display in the Control Panel, then click the Settings tab in the Display Property window and then click on "Advanced". Then click on the "Dual Head" tab and click "Dual Head Multi-display" (see Figure 43). Then click on OK and it should be possible to attach two monitors to the acquisition computer.

Figure 43 The Millennium Matrox G450 Dual Head graphics card setting dialogue box.

4 TPU Operations

As outlined in section 2.1, the TPU (Transceiver and Processing Unit) is a fairly sophisticated computer that is essential to the operation of the Klein 5500 sidescan sonar. There is normally only one concern with the TPU and this is to make sure that it has downloaded its operating system file vxworks from the host computer and to make sure that it has booted properly. Although it has never been performed in the past it is also possible to alter the setup or configuration of the TPU.

This chapter will begin by outlining the procedure that needs to be followed to observe the boot sequence of the TPU and this chapter will end by outlining the procedure to change the set up of the TPU. As it is harder and more daunting to interrogate and alter the set up of the TPU, coupled with the fact that any incorrect setups that cannot be fixed will require the TPU to be sent back to Klein Associates. Inc., then it is ill advised to change any settings on the TPU. But, if it is necessary to perform this function then the procedure outlined in section 4.2 can be followed.

4.1 Boot Sequence of TPU

The TPU is set up so that the progress of its boot sequence is output to the Com1 port at the front of the TPU (see Figure 44). By using a terminal emulation program and an external computer, the bootup sequence of the TPU can be viewed. Such a sequence is very helpful because it shows if the TPU is acquiring its bootup files vxworks and startup.ini. Figure 45 shows an example of the bootup sequence of the TPU and how it would appear in a terminal emulation program.

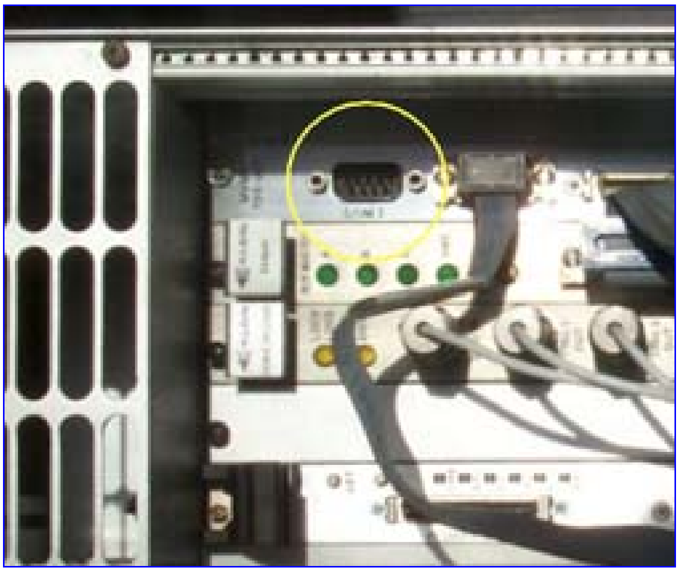


Figure 44 The Front panel of the TPU showing the Com1 serial input port (marked with a yellow circle).

```
                            VxWorks System Boot

Copyright 1984-1996  Wind River Systems, Inc.
CPU: Motorola MVME2600 - MPC 604e
Version: 5.3.1
BSP version: 1.1/4
Creation date: Feb  3 1998, 11:23:14

Press any key to stop auto-boot...7,6,5,4,3,2,1,0

auto-booting...

boot device          : dc
processor number     : 0
host name            : survey
file name            : \klein\vxWorks
inet on ethernet (e) : 160.64.181.222
host inet (h)        : 160.64.181.221
gateway inet (g)     : 255.255.255.0
user (u)             : sonar
ftp password (pw)    : klein
flags (f)            : 0x0
target name (tn)     : VxTarget
startup script (s)   : \klein\startup.ini

Attaching network interface dc0... done.
Subnet Mask: 0xffffff00
Attaching network interface lo0... done.
Loading... 1378116
Starting at 0x100000...

Attaching network interface dc0... done.
Attaching network interface lo0... done.
NFS client support not included.
++++++++++++++++++ Wicked Excellent Sonar ++++++++++++++++++++
+                                                            +
+   *****   *     *   *****   *********  *******  *       *  +
+  *     *   *   *   *     *      *      *        * *   * *  +
+  *           *     *            *      *        *  * *  *  +
+    *         *       *          *      *****    *   *   *  +
+      *       *         *        *      *        *       *  +
+        *     *           *      *      *        *       *  +
+  *     *     *     *     *      *      *        *       *  +
+   *****      *      *****       *      *******  *       *  +
+                                                            +
+          5555555555   000000000    000000000   00000000    +
+         5            0        0   0        0  0        0   +
+        5            0        0   0        0  0        0    +
+       5            0        0   0        0  0        0     +
+      555555555    0        0   0        0  0        0      +
+              5   0        0   0        0  0        0       +
+             5   0        0   0        0  0        0        +
+            5   0        0   0        0  0        0         +
+   5       5   0        0   0        0  0        0          +
+  555555555    000000000    000000000   000000000           +
```

```
+                                                              +
++++++++++++++++++ Wicked Excellent Sonar ++++++++++++++++++++
$M
$TA1
$TA1
$TA1
$TW0
$TW0
$TW0
$TDF
$TDF
$TDF
$TR7
$TR7
$TR7
```

Figure 45 The boot-up sequence of the TPU as it would appear in a terminal emulation program on an external computer which is connected to the Com1 port of the TPU.

In the seabed mapping group the external computer that is normally used to view the boot sequence of the TPU is an old laptop. Although it is certainly possible to use the acquisition computer to view the boot sequence this has not been adopted in the past because the computer which the TPU downloads it operating system file from is normally the acquisition computer, and on this computer it is beneficial to leave the com ports free for auxiliary data such as gyro or depth data. This approach is also not adopted because it is likely to mean that the null modem cable connecting the TPU to the computer will need to be removed before data can be collected.

The terminal emulation software which is often used to view the boot sequence of the TPU and which can also be used to interrogate and alter the setup the TPU, is HyperTerminal (Windows 95, NT, 2000) although Procomm (http://www.symantec.com/procomm/) has sometimes been used. HyperTerminal has the advantage that it comes with Windows and so is free but has the disadvantage that it takes slightly longer to set up compared with Procomm. HyperTerminal also has the disadvantage that on several occasions it has inexplicably not been able to communicate to a com port and Procomm has had to be used. The advantage of Procomm is that it is easy to setup but has the drawback of not being free of charge. The following procedures will assume HyperTerminal is being used to investigate the TPU.

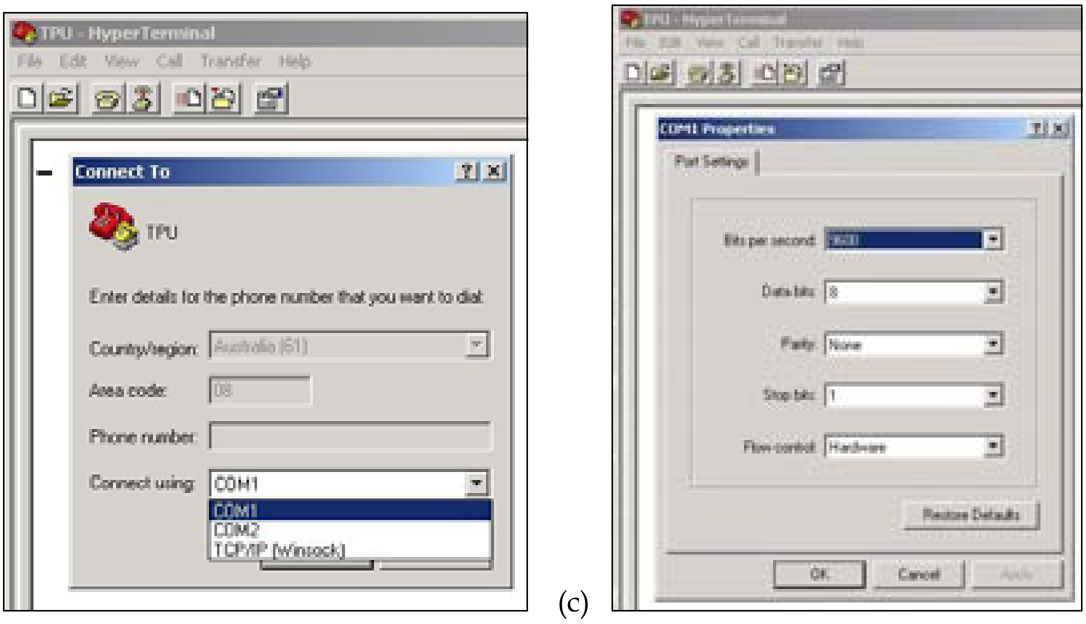
To spawn HyperTerminal, either click on Start | Programs | Accessories | Communications|HyperTerminal or browse for, and run the executable, hypertrm.exe. Before HyperTerminal can be used to display data arriving at a com port it needs to be setup for the com port in question. Making a note of the com port that the null modem cable is connected to on the computer that is connected to the TPU, spawn hyperterminal. When this is performed a prompt will appear asking if a new connection will be made (see Figure 46a). This is simply requesting a name to be given for the connection to the com port (assuming one has never been made) that is receiving data from the TPU and to enter the attributes of the data being received.

Figure 46a The "New Connection" dialogue box in HyperTerminal.

If a connection has previously been created, click on Cancel in the New Connection window and simply open the connection to the com port by clicking on File|Open and selecting the session file. If a connection does not exist then type in a name for the new connection in the New Connection window, such as TPU, and click on OK. Then the Connect To window will be displayed (see Figure 46b). As it is one of the com ports that Hyperterminal is trying to retrieve data from and not an outside telephone, then click on the "Connect using" variable and select the com port that the null modem cable from the TPU is connected too. Click on OK and the last, and most important window to be displayed, is the Com Port settings window (see Figure 46c). It is here that the baud rate, data bits, parity, stop bits and flow control of the data coming from the TPU need to be set.

By default the baud rate of the data coming out of Com1 on the TPU is set to 9600 bits per second, although this can be changed using the variable SET BAUDRATE in the file startup.ini. For the other variables in the Com Port settings window these must take the values of 8 data bits, no parity, 1 stop bit (abbreviated to 8N1) and with the flow control being Xon/Xoff. If these settings are entered incorrectly then the data will not be legible, but data will still be displayed. Once the attributes of the data have been entered into the Com Properties window click on OK and immediately HyperTerminal will try and connect to the com port just chosen. If data is being sent up from the TPU then it should be visible on the screen. When all the necessary data has been received from the TPU, then click on the disconnect icon  and if this was a new connection then save the settings that have just been made by going to File|Save As and chose a name that will make it clear what the reason was for the connection.

For simplicity TPU could be chosen but this is not compulsory. Now that a hyperterminal session file has been created then the next time the boot sequence of the TPU needs to be displayed then it is a simple matter of going to File|Open and choosing TPU.ht.



(b) (c)

Figure 46 The (b) Connect To and (c) Com Properties windows in HyperTerminal.

Even though a HyperTerminal session may display the message shown in Figure 45 and indicate that the TPU has booted up correctly there is more convincing evidence that the TPU is working correctly. Such evidence is by the flickering of the light labelled "vme[2]" located at the front of the TPU on the DSP board, irrespective of whether or not the Klein 5500 has been connected to the TPU. If the Klein 5500 sonar is attached to the TPU then when the TPU boots up the light sequence on the TPU's DSP board should proceed as A on and then off, then B on and then off, then C on and then off, then all will light and will stay on whilst the vme light starts flickering. The green light emitting diodes labelled A,B,C and vme can be seen in Figure 44 on the DSP printed circuit board.

It has been known for the TPU to sometimes crash during a survey. Such crashes will be indicated by blank waterfall displays as well as the vme light, either staying on permanently or being completely off. If this does happen the TPU will need to be rebooted. This can be easily achieved by depressing the white reset (RST) button at the front of the TPU on the CPU board, or the TPU can be fully rebooted using the green on/off switch.

---

[2] VME is defined as VersaModule Eurocard and is a computer bus network just like ISA and PCI. See (http://www.ee.ualberta.ca/archive/vmefaq.html) for more details.

4.2 Altering TPU Setup

The procedure used to interrogate and if necessary alter the setup of the TPU is very similar to the procedure used to view the TPU's boot up sequence.

When it is desirable to interrogate, and if needed alter the settings of the TPU, then instead of viewing the TPU's boot sequence, the approach needed is to stop the TPU from successfully booting. This is because the TPU is set up so that if it is either stopped from booting or cannot boot, the prompt "[VxWorks Boot]:" appears in the terminal emulation program and the TPU is placed in edit mode, ready for its settings to be changed. The TPU can be stopped from booting by simply hitting any key when the message "Press any key to stop auto-boot" appears in the terminal emulation program or the TPU will be placed in edit mode if it cannot download its operating system file vxworks.

When the prompt "[Vxworks Boot]:" appears, the setup of the TPU and how to alter it can be displayed by typing "c" and hitting the enter key. Hit "Enter" to move the cursor through the various fields. To change a field, type in the new value and hit enter. When you have seen all the options you will again see the [VxWorks Boot]: prompt. Type "@" then enter to resume booting, or type "c" then enter to access the settings again.

When you have finished viewing and changing settings, and have typed "@" and hit enter, the TPU will continue booting. If everything is set correctly, file transfer of "vxworks" and "startup.ini" should occur and the HyperTerminal window on the laptop or acquisition computer will scroll information about the booting sequence, as shown in Figure 45. The TPU lights should light correctly, and the acquisition software should be able to record data from the sonar.

The following table describes what seems to be the most reliable way of configuring settings on the TPU. The settings on the TPU must match the settings on the acquisition computer as described in 6.1 and 6.2.1. In particular, note that the "filename" field on the TPU is set to "vxworks", with no pathname.

Table 5 The variables which need to be set on the TPU and the acquisition computer and the correct values that they need to be set to.

Field name on Acquisition computer	*TPU field name*	*Field value*
Computer name (in Control Panel | Network | Identification)	Host name	Survey
IP address (in ControlPanel | Network | Configure | TCP/IP | Properties | IP address)	Host inet new name	160.64.181.221
Subnet mask		255.255.255.0

	Address of TPU	
N/A	File name	Pathname of the directory containing the file 'vxworks', C:\ .
User name (in ServU | Setup | Users)	User	sonar
	Location of startup.ini	
Password (in ServU | Setup | Users)	ftp password	klein

5 Configuring and Running the Acquisition Software

5.1 Introduction

At the time of this report there were two software programs being used at DSTO to acquire sidescan data from the Klein 5500 sonar. There was the Isis package, which has been used for several years, and then there is the less used, Klein software package, SonarPro. Isis has been used very successfully for several years but it has the flaw that the data file formats, namely eXtended Triton Format (XTF), cannot be read by SonarPro. This makes liasing with Klein regarding sonar problems difficult.

To aid communication with Klein it was thought beneficial if some expertise was gained in using the software package that Klein supports. This software is SonarPro http://www.kleinsonar.com/sonarpro/index.html and has been used successfully since mid 2001.

Particularly for Isis, there are many settings that affect the quality of the data being acquired and the stability of sonar system. These settings do not normally need to be re-entered for each survey, unless a different sonar is being used than was used previously or if newer versions of the software are being used.

This chapter discusses the rudimentary settings which need to be made to Isis and SonarPro so high quality data can be acquired and saved. This chapter however, does not cover all the intricacies of how to setup and tweak these two software packages. Such a chapter is not needed as both Isis and SonarPro have very good manuals covering all facets of usage. Full details of Isis and SonarPro are given in their respective manuals (see **Isis Sonar User Manual, Volume 1.pdf** and **Sonarpro version 5.3 cd manual.pdf**).

5.2 ISIS Setup

Isis can be launched by either double clicking on the Isis icon on the desktop, or clicking on Start|Programs|TEI|Isis or use Start|Search|For Files and Folders and search for the executable Isis.exe.

Once Isis has spawned its main window, if an error message is displayed informing the operator that Isis is in demo mode (see Figure 47) then this means that Isis has not detected the Isis dongle (outlined in section 2.2.1.1). It is important to head this warning because in demonstration mode Isis cannot save data to disk and can only play data files back. This error message comes about because either the Isis dongle has not been attached to the printer port (LPT1) or is attached but does not sit correctly (which has occurred in the past). For the first scenario simply attach the dongle whilst for the second, remove the dongle and reattach it firmly. Both scenarios must be followed by rebooting the acquisition computer. If, upon rebooting the acquisition computer with the Isis dongle attached, Isis does not detect it, either keep on removing and reattaching the dongle, or if the Isis ruggedised computer is being used then mount the dongle internally. Again the acquisition computer must be rebooted. Only after Isis has detected the Isis dongle correctly and Isis has been spawned with the error message in Figure 47 not appearing, can Isis be setup.

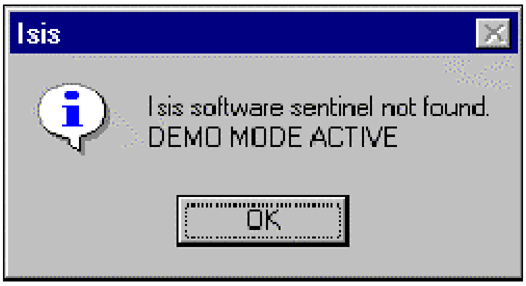


Figure 47 The warning that Isis generates when it is first spawned and cannot detect the Isis dongle.

To set up Isis so that it knows which sonar it will be acquiring data from, which data channel from the selected sonar it needs to display backscatter and which channels need to be saved to disk, click on the File menu and select the Record Setup. This will cause the Record Setup Options window (see Figure 48) to be spawned. In this window there are three choices: Sonar Setup, Serial Ports, and File Format. These three dialogue boxes are fundamental to setting up Isis ready for data collection, because they control:

- The sidescan sonar or multibeam echosounder that Isis will be receiving data from.
- Channel setup for the sonar chosen (each channel represents a particular frequency on either the port or starboard side of the towbody. For example the dual frequency, Klein 595 sidescan sonar has four channels, whilst the single frequency, Klein 5500 only has two.
- The serial ports (com1, com2, etc.) that auxiliary data needs to be acquired over as well as the attributes of this data.
- The file format that will be used, if any data is to be saved.

Figure 48 The Record Mode Setup window in Isis.

These three options will now be outlined in detail.

5.2.1 Sonar Setup

To inform Isis which sidescan sonar data it will acquire data from, click on Sonar Setup in the Record Setup Options window and in the Select Sonar dialogue box that is spawned (see Figure 49) click on the sonar of choice. In this dialogue box the sidescan sonar that is likely to be chosen is the Klein 5000. As Isis saves its setup from the previous session then it may happen that in the Currently Selected sonar box, located in the bottom left of the Select Sonar dialogue box, the sonar that is going to be used appears in this window (for example "Klein 5000-Digital Mulitbeam Sidescan (5 beams)). If this is the case then it is superfluous to still select the sonar from the list available. It should be noted that it sometimes happens that the button "Standard Analogue" is highlighted in the Select Sonar dialogue box even though the sidescan sonar an operator wants Isis to display data from appears in the Current Selection. This scenario is just a quirk of Isis and an operator need only be concerned with the sonar displayed in the Currently Selected Sonar.

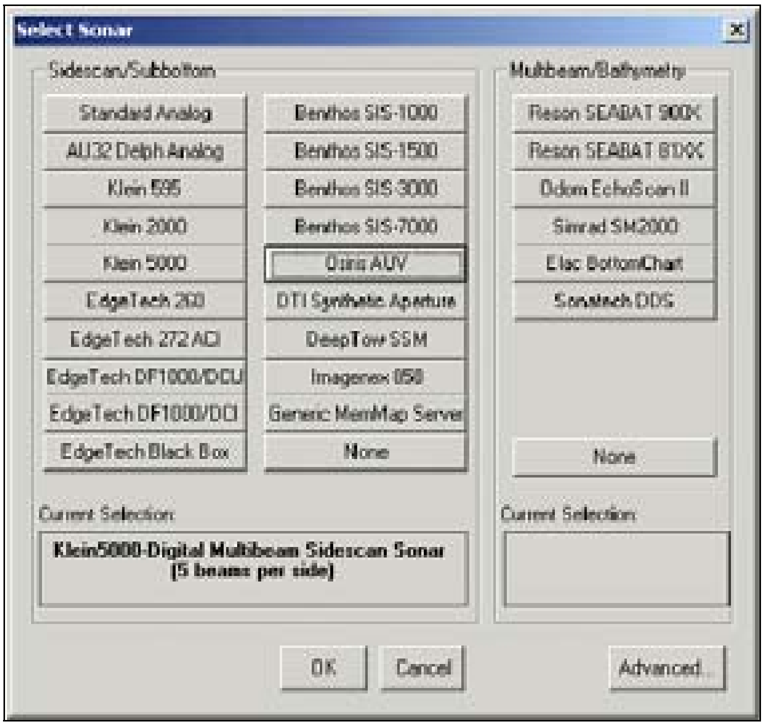


Figure 49 The Select Sonar dialogue box in Isis.

When the Klein 5000 series of sidescan sonars is chosen from the Select Sonar dialogue box a second window will be displayed asking if bathymetry will be logged (see Figure 50). This query arises because the Klein 5000 series of sidescan sonar could have been purchased with an interferometric bathymetry option. As the Klein 5500 sidescan sonar at DSTO does not have this option then click on NO.

Figure 50 The dialogue spawned by Isis asking if the Klein 5500 will be used to log bathymetry.

After the bathymetry logging option for the Klein 5500 has been cancelled, Isis will spawn the Sidescan Sonar Information dialogue box (see Figure 51). This new dialogue box is somewhat misleading because although it lends the operator into thinking that it has some control over the waveform output of a sidescan sonar, it does not. The information supplied in the Sidescan Sonar Information dialogue box should reflect what the current settings are for the sonar and as at DSTO the same sonar is used then it has never needed to be altered. The only time the information in this dialogue box may need changing is when the characteristics of the sonar have been altered (external to Isis) and the information that appears in the Sidescan Sonar Information dialogue box reflects the settings used in a previous session. Click on OK and control will be returned to the Record Mode Setup window.

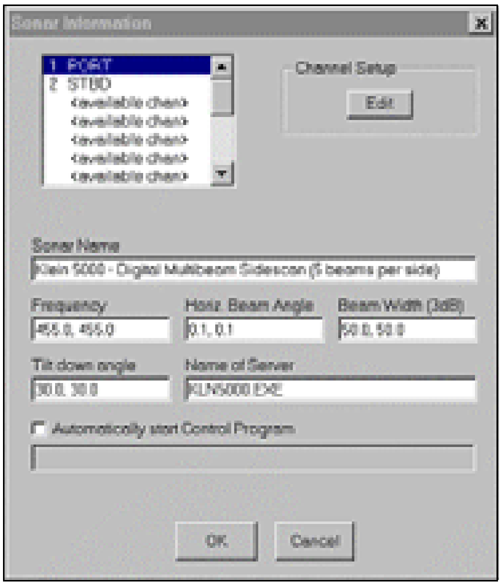


Figure 51 The Sidescan Sonar Information dialogue box used in Isis.

5.2.2 Serial Port Setup in Isis

When sidescan sonar is being collected there is peripheral data that, either needs to be incorporated into the data files if the data is to be useful, or is peripheral data that is normally not saved with sonar data but is needed for a particular occasion. Examples of the first type of data would be GPS. Without this type of data the sidescan sonar data would be useless. Examples of data which is sometimes needed to be saved with sidescan sonar data files could be gyro data, cable-out data or echosounder data.

The first step in incorporating non-sonar data into a sidescan sonar data file is to set up their respective instruments so that they output their values over a serial cable and to connect such cables into a spare serial port on the acquisition computer. The next step is to set up Isis so that it knows what type of data to expect, from a particular com port and the baud rate of the data being sent.

As each form of peripheral data being routed to the acquisition computer requires a spare com port coupled with the fact that the computers used in the seabed characterisation group either have one or two com ports, then the situation which commonly arises is that there is no spare com ports available. As outlined in section 2.4.3, the avenues available to circumvent this problem are to use the Digiboard Classic (see Figure 29a), which has 8 serial ports, or a PCI board could be purchased which has one or two serial ports or, if a laptop is being used, then the dual serial port, PCMCIA card of the Environmental Group (see Figure 29b) can be used.

The first step in configuring Isis so that it will interrogate a particular com port, decipher the data arriving on it, and then incorporate the data into the sidescan sonar data file, is to click on the “Serial Ports” tab in the Record Setup window (see Figure 48). When this is done the Serial Port Setup window is spawned (see Figure 52) and it is in this window that the settings are made.

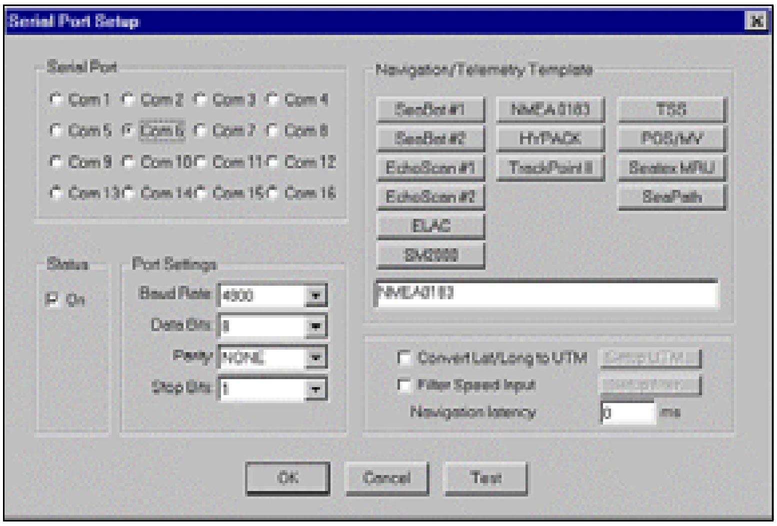


Figure 52 The Serial Port Setup window used in Isis.

For each port on the acquisition computer that data is coming in on, the following steps need to be followed for the Serial Port Setup window:

- Click on the radio button next to the com port over which data is being received.
- Then click in the "on" box under the status area of the Serial Port Setup window. This enables the rest of the Serial Port dialogue box to become active. NOTE: In some older versions of the Isis software, for ports that have status selected as "on" but either do not exist, or have no serial inputs, a message that the serial port is not available will be given when Isis is opened. To stop these messages occurring, turn off any serial ports that are not in use.
- Then, using the drop down lists in the Port Settings area, set the baud rate, data bits, parity and stop bit of the data in question.

These settings are very important. The reason for backscatter data needing to be discarded is often because these values have been incorrectly entered.

For GPS and Gyro data the Port Settings are normally 4800 bits per second, with 8 data bits, no parity and one stop bit.

- Now choose the appropriate Navigation/Telemetry Template. Templates inform Isis of the format of the data being received and either a predefined template can be used or one can be constructed. Constructing a template is particularly needed when cable-out or echo sounder data is being read. Section#5.2.2.1 will outline the construction of templates in detail.

  There are a number of predefined templates available and the one that needs to be used for the GPS and Gyro data is the NMEA0183. This is because the GPS and Gyro data being incorporated into Isis are in the NMEA format. The structure of this format for the GPS and gyro strings were outlined in section 2.3.3.

  If a predefined template is selected then it will appear in the white edit box at the bottom of the Navigation/Telemetry panel. If a template needs to be constructed then click in the white edit box and enter it.

- There are two other check boxes in the lower right of the dialog box. Leave these unselected.
- The last setting is the navigation latency. For details on how to calculate navigation latency, see multibeam training course notes. If Latency has been calculated then it can be entered here.
- If data is being transmitted to the com port then it is possible to test that the settings made above will save the data appropriately. This is possible by either clicking on the Test button in the Serial Port Setup window or clicking on "Com Port Test" from the "Tools" menu in the main Isis window. This displays the Com Port Test window (see Figure 53) in which a panel exists for each com port showing the activity on it and how Isis is deciphering this activity. The panel will display "Com port not set up" if the status box for the port is not checked

as on. For the serial ports that are on, any data being received is displayed and should be legible. If the data that needs to be recorded is not being displayed or is, but is not legible, then click on the OK button in the test window and check the settings made in the Serial Port Setup.

- At this stage the operator can complete the setup for each com port using the Serial Port Setup window and then click on the Test button to make sure all the settings made are correct.
- When each com port has been setup correctly click the OK button in the Serial Port Setup window (Figure 52).

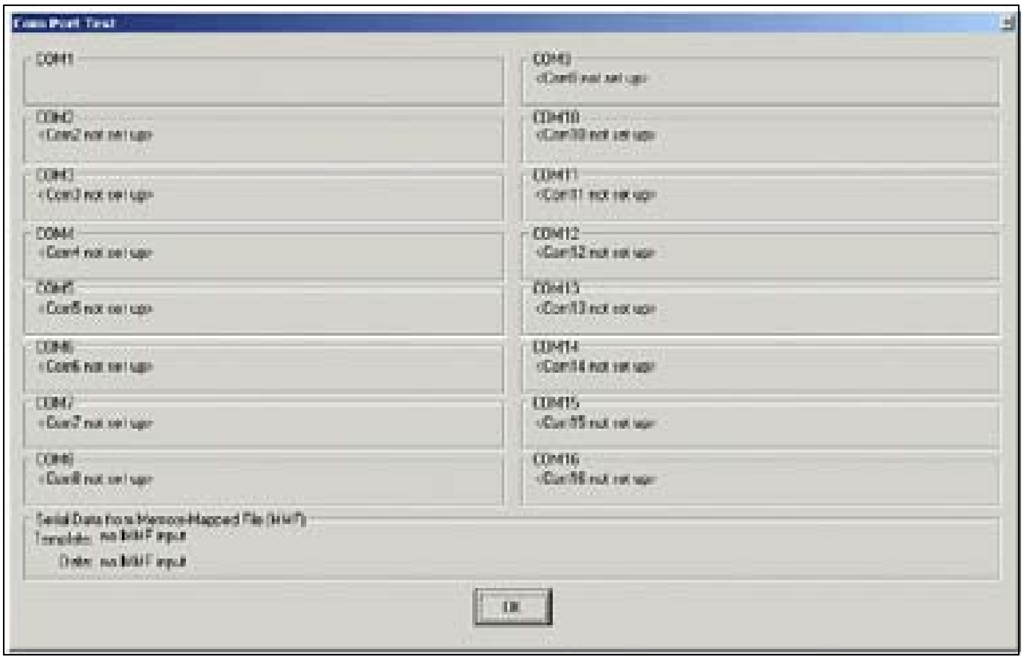


Figure 53 The Com Port Test window in Isis.

5.2.2.1 *Isis Templates*

(Taken from emails and Isis Sonar Volume 2:Appendices to the User's Manual February 20, 2002)

Templates are created so that Isis understands which variables in a data string need to be saved and which ones, if any, need to be discarded. Each piece of data in the incoming string that an operator wants to be saved requires a corresponding token or letter in the template. The tokens that are commonly used include:

D day, M month, Y year, H hour, I minute, S second, N northings, E eastings, h Fish Heading (in degrees),J Julian Day, o cable-out, l layback, Y, x ship latitude and longitude in degrees, G boat heading or course made good (depending on whether a gyro is used or GPS data), 0 (zero) sonar depth in meters, ship speed v, towfish speed V, 8 sonar pitch, 9 sonar roll, (w) water temperature, a auxiliary altitude.

If a variable in a data string does not need to be saved then this can be indicated in the template by putting an "X" in that position. Although each sentence in NMEA data starts with the code $GPxxx, indicating the data type to follow, an X does not need need be in the template to tell Isis to ignore this. If no further data fields need to be saved from a data string arriving on the com port then Isis can be informed of this by leaving the rest of the template blank.

For gyro serial input, a special template should be created instead of using the NMEA0183 template. The reason is that Isis will alternate between gyro input and course made good from GPS data if the predefined NMEA0183 template is used. This creates the illusion that the sonar is yawing when a data file is played back even though the sonars yaw characteristics may be quite smooth.

In the Environmental Assessment group at DSTO, templates have also been created so cable-out or layback can be incorporated into sonar data files. Cable-out values have been obtained in the past using the cable measuring device OSCAD (Over-the-Stern Cable Angle Device). To inform Isis that cable-out or layback needs to be saved use the tokens "o" for cable-out and "l" for layback. In some versions of the Isis software, these data fields can only store integers. To store lengths including decimetres, create a template that multiplies the incoming value by 10 before storing. Then, a cable-out of 10.3 metres, for example, will be stored as 103. Remember to convert back to metres when post-processing.

In addition to creating templates to read all or part of any data string arriving at a com port, it is also possible to create templates that perform mathematical operations on serial data. To perform this, each separate operation is enclosed in curly braces (for example {}) and placed in the template immediately before the token that it will be operating on. The operators that can be used are the common "+","-","/" and "×".

As an example, if an operator wishes to convert magnetic heading from a magnetic compass to true heading in the region they are located, an offset of +13° must be applied. If the serial string starts out as

"$GPHDM, 36.4, …."

where the magnetic heading is 36.4°, then the required template to convert the magnetic value to true north is then

"{+13.5}G".

If an entire serial string needs to be saved then this is accomplished by adding "{saveraw}" to your template. In this situation the serial string will be written to the data file as a separate data packet, after Isis has performed any functions outlined in the template string. Another role this option can play is to store depth from an echosounder. This is because the best option when wanting to store echosounder serial input data is to simply use "{saveraw}" as the template. It is possible to create a template to store the echosounder depth as fish depth, but the echosounder depth value will not usually correspond to fish depth.

The serial ports receiving NMEA navigation input, which contains time information, should also have the string "NOCLOCK" added to the end of the template (in capitals, no quote marks). This prevents the computer clock from syncronising its (local) time to the (Greenwich Mean) time in the NMEA signal.

Similar to testing the set up of each com port when a predefined template is used, to test that a template has been created correctly, click the "Test" button in the Serial Port Setup window (Figure 52) or select "Com Port Test" from the "Tools" menu of the main Isis window. This displays the Com Port Test window (see Figure 53) in which the data Isis is obtaining for each com port is shown. The panel will display "Com port not set up", if the status box for a port is not checked as on, whilst for the serial ports that are checked, any data being received is displayed. If the data needing to be recorded is not being displayed then either the template has been incorrectly constructed, or the port settings have been set incorrectly.

If sidescan sonar data is not going to be saved to disk, then no further steps need to be taken and this completes the basic setup of Isis. Click on OK in the Record Setup Options and Isis is ready to display data in the waterfall display. If sidescan sonar data is also going to be saved to disk then another step needs to be taken. This is to set up the file format of any data files, however as the format used at DSTO has not changed in the past several years as well as its attributes, then this step is rarely taken and assumed to have not changed from a previous session when data was saved to disk. It has been outlined here for completeness.

5.2.3 File Format

To set up the file format that will be used if any sonar data is saved to disk, click on the File Format button in the Record Mode Setup window. This will cause the File Format window to be spawned (see Figure 54). As outlined in the above paragraph the settings in this dialogue box will normally not need changing from one Isis session to the next and it is common for an operator to quickly glance over these settings and not make any alterations. At DSTO the settings which have been employed in the past have been to use the XTF (eXtended Triton Format), with 16 bits per pixel and no downsampling. Once the file format specifications have been either checked or entered then click on OK in the File Format window and control should be returned to the Record Mode Setup window. Click on OK in the Record Mode Setup window and this completes the basic setup of Isis. It should now be possible to acquire data from the chosen sidescan sonar, as well as save it to disk in the format chosen.

Note: Although a lot more shades or grey can be saved using 16 bits per pixel instead of 8 bits per pixel, Isis will only display 8 bits per pixel in the waterfall display. The number of data bits Isis displays in the waterfall display is controlled by the Threshold slide bar in the waterfall display.

Although the downsampling option has not been invoked at DSTO it arises because the Isis analogue-to-digital processors usually digitise a greater number of samples than Isis writes to disk and the number of data samples needs to be downsampled or reduced. If the downsample option is invoked then the choice needs to be made as to how the replacement samples are computed, with the choices being to take the maximum pixel value in a group or to calculate the root-mean-square. If a sidescan sonar is being used in a search capacity, which dictates that small, bright[3] objects are not erased by a filtering process, then the Max option should be chosen. If a sidescan sonar is being used in survey capacity then RMS should be chosen.

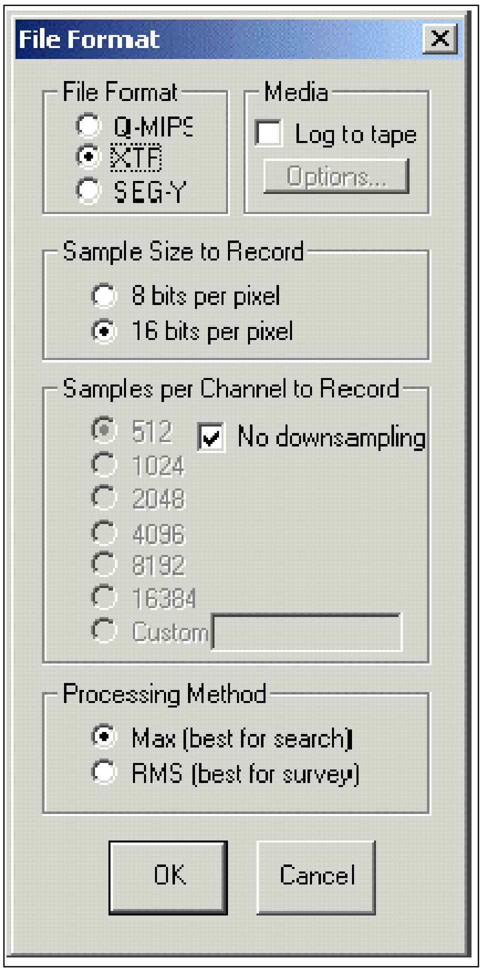


Figure 54 The File Format dialogue box used in Isis.

5.2.4 Sentinel Querying

As Triton Elics International has developed many software packages then sometimes one of their dongles (or sentinels) will need to be interrogated to investigate which software packages it will permit to run. A dongle would also need to be interrogated if it was required to provide access to a software package or module that it was originally not purchased for.

In Isis, a dongle can be interrogated by clicking on Configure|Security… When this is performed the software a dongle will permit access to as well as any modules, is listed in the Security dialogue box. Figure 55 shows this security box for the Isis dongle purchased by DSTO. It can be seen that this dongle most importantly permits the usage of Isis, with the sidescan sonars Klein 5000, Klein 2000 and the analogue Klein 595. Other sidescan sonars can be used with this dongle as well as the packages Target Utility, Delpmap with Isis mosaic (with realtime mosaicking and classification).

[3] Keep in mind that objects exhibiting strong acoustic returns will be displayed as dark objects in a waterfall display. If inverse video mode is employed, however, then they will appear as white.

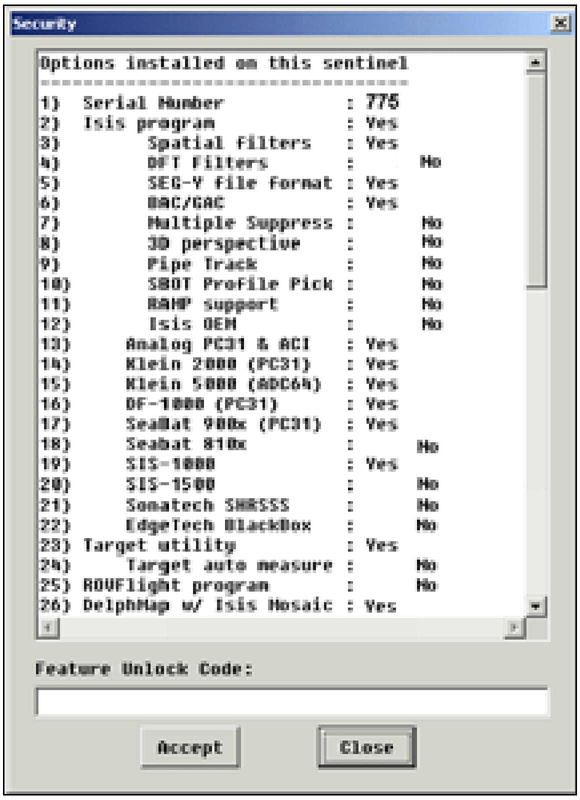


Figure 55 The security dialogue box for the Isis dongle PR-1/97100 which resides at DSTO, Sydney.

If access is needed to a software package or a module that TEI constructed but the dongle was not originally purchased for it then TEI will need to be contacted and a key obtained. This key will be a long ASCII string that needs to be entered into the security dialogue box in the Feature Unlock Code area (see Figure 55). If the key has been successfully entered then the software package or module that the key should provide access to should change from No to Yes in the security dialogue box. If this is not the case then either the key has been entered incorrectly or the key is incorrect and TEI will need to be contacted. A key only needs to be entered successfully once, not each time an Isis session begins.

5.2.5 Keeping a Log in Isis

In the first instance that data is being written to disk, during an Isis session or when the filename changes, the settings that control the way data is stored are appended to the end of the log file survey.log, located in the same hard disk in which sonar data files are being generated. The information being appended includes date and time, Isis version in use, system serial number, file name, name of sonar, number of sonar channels, number of samples per channel and their configuration, number of bathymetry channels, and the template for each serial port. Such information can be very helpful when the settings that were employed in a previous session need to be checked.

5.2.6 Isis Server Software

In addition to the kernel of the Isis software, Isis also has server programs for each sidescan sonar and multibeam echo sounder (MBES) Isis can display data from. These programs were constructed by TEI and act as barriers between the sidescan sonars or multibeam echo sounders and Isis, alerting Isis that new data is available for downloading, processing and displaying. For the Klein 5000 series of sidescan sonar this program is the KLN5000.exe program.

Although not all server programs have their own dialogue boxes, the Klein 5000 does (see Figure 57). These dialogue boxes dialogue boxes allow easy testing of the servers because if these servers are double clicked and their dialogue boxes are spawned then this means they are working. All server programs which have their own dialogue boxes, can be called from within Isis. Those server programs that do not have their own dialogue boxes cannot be called from within Isis and run in the background.

Some server programs, one being the Klein 5000 server, also have controller software programs. These programs augment the server programs, and play the important role of enabling an operator to directly control a sidescan sonar or MBES although have the quirk that they were constructed by the companies that made the instruments and not TEI. That which exists for the Klein 5000 is the "Klein 5000 System Control" (ss.exe). Figure 57 and Figure 56 shows the dialogue boxes for the KLN5000.exe server and the Klein 5000 System Control (ss.exe) software, respectively. The peculiarities of these two programs will be outlined in the following sections.

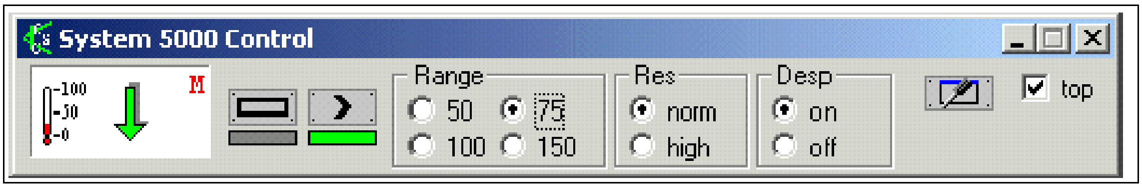
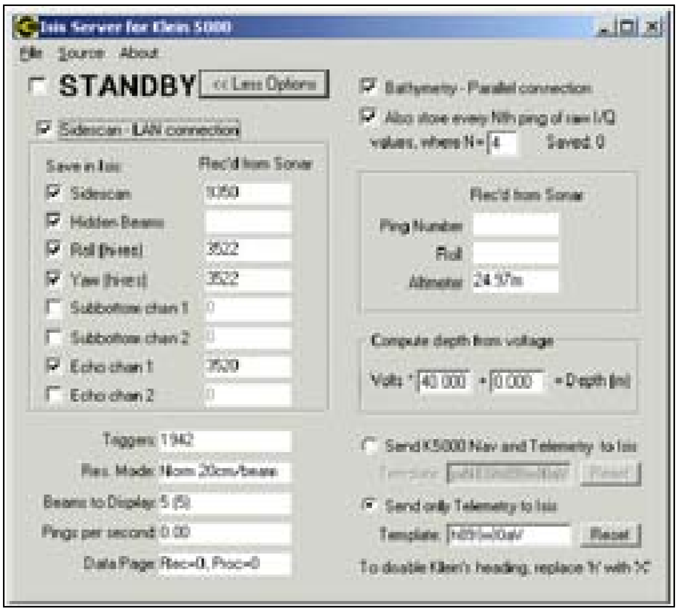


Figure 56 The Klein 5000 system control dialogue window.

5.2.6.1 Isis Server software (Klein5000.exe) for the Klein 5000

The dialogue box spawned by the server software which enables data to be delivered from any one of the Klein5000 series of sidescan sonars to Isis, is normally spawned as soon as Isis is and located to the right of the main waterfall display. Depending upon the configuration of this dialogue box in the last Isis session, just prior to Isis being closed, this dialogue box may appear in its condensed version (see Figure 57b). If this occurs then the normal view can be activated by clicking the button "More Options >>" located in the top left hand corner of the dialogue box.

(a) 

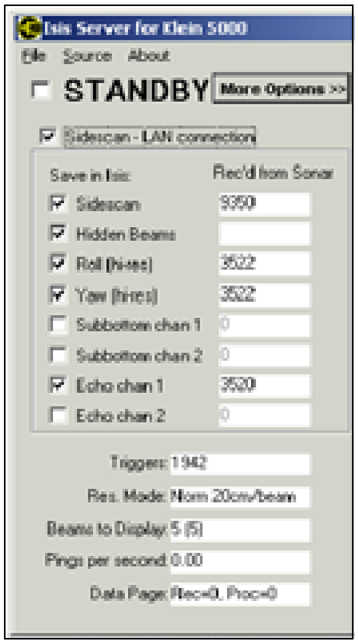
(b) 

Figure 57 The dialogue box for the Klein 5000 server in (a) normal display and (b) condensed.

From Figure 57 it should be noticeable that because this dialogue box is located to the right of the main window of Isis, then very little of it is viewable by an operator when only one monitor is being used. This problem of not being able to see much of the Klein 5000 server dialogue box when one monitor is being used is the reason why two monitors or a second virtual monitor is used at DSTO. Section#3.6.2 outlines the hardware and settings needed to set up a second monitor or a second virtual screen.

Although the role of the server programs is to deliver data from their respective sonars to Isis, the dialogue boxes that some spawn need to have particular settings made to them. The settings which need to be made to the Klein 5000 server dialogue box will be outlined below.

Activate the following radio buttons:

- Sidescan-LAN Connection. This is needed as a Local Area Connection has been created (if Chapter#3 has been followed successfully) between the TPU and the acquisition computer.
- Under the "Save in Isis" section, the radio buttons for Sidescan, Roll, Yaw and Echo channel 1 (as only the first echo is ever used). The radio button for hidden beams can be activated. These are the beams that are not being used because the sonar is moving less than its top speed of 10 knots. If the hidden beams are saved the data files will be larger than normal. Those radio buttons for sub-bottom data should not be activated, as the sonar at DSTO does not have this option.
- "Send K5000 Nav and Telemetry to Isis". This radio button is normally chosen instead of "Send only telemetry to Isis" because, as outlined in section 2.1.1,

navigation data should be routed to the TPU. If navigation data is routed to the acquisition computer then the radio button "Send only telemetry to Isis" needs to be activated. The template to use for navigation data is yxNEX and that for telemetry are h89(w)0aV. Refer to section#5.2.2.1 for token definitions.

It is important to note that Isis needs to be informed that it should ignore the course made good, derived using the changes in GPS positions. If it does not then Isis will be receiving two types of sonar orientation data, one being from the KVH Gyro on the workboat and the second from the course made good. These two forms of data will be recorded by Isis and in post-processing it may appear as though the sonar was yawing badly. This can be seen by the value of Gyro in the Ship window of the Parameter window oscillating between two values, one being the course made good and the other being the orientation of the platform. To stop this from happening the X token is needed in the navigation template and not a G.

Deactivate the following radio buttons:

- Bathymetry-Parallel connection. This button should be deactivated because the Klein 5500 did not have the ability to simultaneously collect sidescan sonar data and bathymetry data. Only the Klein 5400 and maybe the Klein 5800 could have been purchased with this ability. An acquisition computer requires the parallel board DT3010 (http://www.datx.com/dahwdetail.asp?Family=DT3010+Series), which is made by Data Translations (http://www.datx.com/), to be able to receive interferometric bathymetry data from the Klein 5400 or Klein 5800. Only several Klein 5000 sidescan sonars exist for which activating the radio button Bathymetry-Parallel would result in bathymetry data being collected (personnel communication Geoff Shipton, TEI).
- "Also store every Nth ping of raw I/Q"
- if the sonar Standby button is activated then deactivate it. When activated this simply stops the server kln5000.exe accepting data from the controller program. The controller program ss.exe will be outlined in the next section.

The last setting which needs to be made is to enter the correct depth formula in the area labelled "compute depth from voltage". This formula in the Klein5000 server dialogue box controls the Depth value in the Telemetry component of the Parameter display window and arises because there is a pressure sensor inside the Klein 5500 sidescan sonar. If the pressure sensor has been recalibrated (see Appendix C for the procedure), then enter the new coefficients calculated, otherwise use the values calculated from the last calibration. These were:

Voltage * 13.730 -10.370 = Depth.

During data acquisition the fields for Sidescan, Roll, Yaw and Echo Chan 1 in the "Received from Sonar" area of the kln5000.exe dialogue box will be increasing, as will the Trigger commands to the sonar. The number of beams the Klein 5500 is using at any time will be displayed in the "Beams to Display" area of the dialogue box. The number of beams will be determined by the speed of the sonar and will be between 1 and 5, the last occurring at 10 knots and the first at 1 knot.

The k5000.exe control program needs two dynamic link library files for it to function correctly with the Klein5000 series of sonar and these are not normally installed with a Windows installation. These files are OLDAAPI.DLL and OLMEM.DLL. The version of these libraries is different under Win95/98 and WinNT/Win2000, although the correct version of these files should be installed when Isis is installed. If these files are not present then contact Klein Associates for them.

5.2.6.2 *Klein 5000 System Control (ss.exe)*

Up to this point, there have been no avenues by which the waveform generated by the Klein 5500 could be changed from within Isis. Even the Sidescan Sonar Information dialogue box (Figure 51) could not be used to alter the settings of the sonar, although an operator could have mistaken it to do this. The only piece of software that enables the settings of the Klein 5500 to be changed when Isis is running is the Klein 5000 system control dialogue box. This dialogue box is really three condensed into one, as illustrated in Figure 58, and was created by Klein Associates Inc. and not TEI.

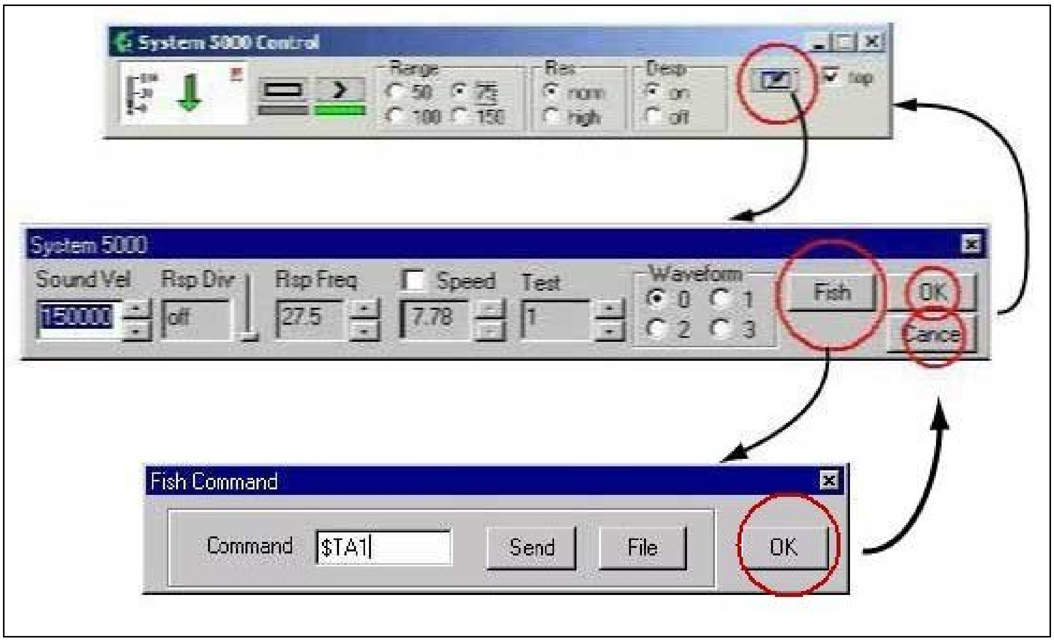
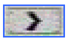
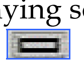


Figure 58 The three dialogue boxes of the controller software program ss.exe and how the last two are spawned.

At DSTO the system control dialogue box is mostly used to perform the functions:

- Play or and stop playing sonar data from the Klein 5500 using the start and stop buttons,  and  respectively. Although these two buttons control whether or not sonar data is displayed in a waterfall display, they do not influence whether or not the data is saved to disk. How Isis is set up so it saves data to disk will be outlined in the following section.
- change the slant range
- change the pulse length (or waveform being used). This means changing the pulse length of the chirp being output by the sonar. The values which correspond to those outlined in the dialogue box are: 0 for the 50 microsecond pulse length, 1 for the 100 microsecond pulse length, 2 for the 200 microsecond pulse length, and 3 is a 200 microsecond pulse length two tone hop.

  The waveform that the TPU will request the sonar to produce is determined by the variable "set WAVEFORM" in the file startup.ini. The variables the file startup.ini can set, so they do not need to be set from within the acquisition programs, are outlined in Appendix B.

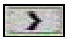
The system control dialogue box can also be used to perform the functions.

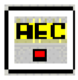
- Select resolution.
- Activate or deactivate the despeckle filter.
- Enter sound velocity in the water column (Note that the units are cm/sec and not meters/sec).
- Responder division is the output frequency rate compared to the sidescan sonar ping rate. This should be set to off as no responder is used with the Klein 5500 at DSTO.
- Responder frequency. This is irrelevant. See responder division for details.
- Manually enter the speed of the sonar. This would be needed if a GPS unit was not available and appropriate if the speed of the sonar was relatively constant and known.

The System 5000 Control dialogue box has the strange behaviour that to remove it at the end of an Isis session an operator needs to click on it and instead of clicking the close window cross hairs, the escape key needs to be used. Operators often forget this peculiar feature. If an operator tries to close this window using the close window function with the right mouse button or the close window cross hairs in the top right hand corner this dialogue box will not respond and will be even harder to remove using the escape key!

If the program ss.exe stops receiving sonar data then any error message will be spawned stating, "DoPing event error". It is important to understand that this message is generated by the Klein 5000 system control program ss.exe and not the Klein 5000 Isis server kln5000.exe. A likely reason why the program ss.exe stops receiving sidescan sonar data is because the TPU has crashed, and although the architecture of the TPU is designed to be very stable, crashes have been observed after a few hours of continuous operation. If the TPU has not crashed (indicated by the vme indicator light on the digital signal processor board still flickering) then data is not being received by the acquisition computer. The remedy is to check LAN cable connections.

5.2.7 Displaying/Saving Data in Isis

After the sonar has been selected, the serial ports over which auxiliary data is being sent have been chosen and configured, and the data format chosen, by using File-> Record Setup…, Isis is ready to record data. By clicking on the OK button in the Record Mode Setup window (Figure 48) this window will disappear and the Start Recording button under the File menu will become active. Click on File-> Start Recording and a window will be displayed asking whether data will be displayed only or whether data will be displayed and also written to disk. If the button Display only is clicked then this window disappears and the dialogue window for the Klein 5000 controller software should be spawned at the bottom of the screen (if it does not appear, then locate program ss.exe and double click on it). If the button Record Data is clicked then prior to the Klein 5000 controller dialogue box being spawned Isis requests a filename to be specified. When this is entered then data can start to be displayed, and if requested, saved to disk, by clicking on the play button  in the system 5000 control dialogue box. When this is performed the indicator beneath the play button should change from grey to green and that beneath the stop button  will change from green to grey. At this stage the waterfall display should be displaying sidescan sonar data for the port and starboard side.

Only the Klein 5000 System control dialogue box should be used to start and stop acquiring data and not the record  or stop button  in the Isis tool bar. If these buttons are used to acquire and stop acquiring data from the Klein 5500 instead of their corresponding buttons on the system dialogue box then the stability of Isis as well as the system control dialogue box cannot be guaranteed.

5.2.8 Optional Settings

All of the above settings are settings which need to be made to Isis before it can be used to collect meaningful data from the Klein 5500 sidescan sonar. There are however settings which are optional. Some of these aid the collection of data, whilst others relate to sonar deployment. The optional settings that have been used at DSTO and deemed helpful are outlined below.

5.2.8.1 Bow-mounted Sonar Depth

As the depth of a sonar when it is bowmounted or hull mounted does not change then it can be beneficial to instruct Isis to ignore the sonar depth indicated by the pressure sensor and to use a known value. To do this in Isis, click on the Configure menu and select "Transducer Depth…". This will make the Transducer Depth window be spawned (see Figure 59) and it is here that the depth of the sonar needs to be entered. As outlined in section 2.3.2.2, the depth of the Klein 5500 below the water surface when it was bowmounted to the DSTO workboat "440" was 0.95meters. When the correct depth has been entered into the Transducer Depth window and the OK button clicked, a test that the value has been entered correctly as it should appear in the Depth field of the Parameter display window.

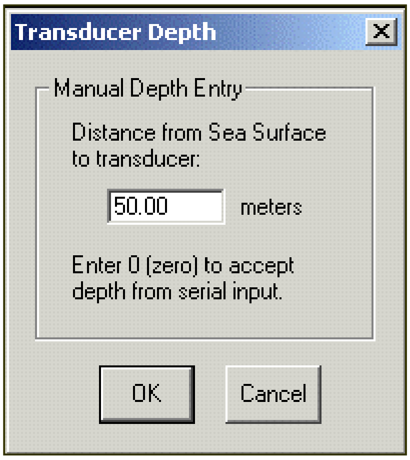


Figure 59 The Transducer Depth window in Isis.

5.2.8.2 Layback Setting

Whether a sonar is being towed behind a ship or mounted to its hull, there is a strong likelihood that there will be a finite distance between the location of the GPS antenna on the boat and the location of the sonar. As it is very important for a sidescan sonar or a multibeam echosounder to be able to accurately specify the location of any objects it ensonifies, then there is a real need to account for this distance.

In Isis, provision is made to specify the position of the fairlead relative to the GPS antenna and to also calculate the layback of the sonar relative to the fairlead. Isis will take into account Layback only when data is being acquired. Isis cannot be used to alter incorrect layback values in data files already collected.

Although there is a provision in Isis to take into account the displacement of a sonar from the GPS antenna and this approach can be used with bowmounted sonars by using negative laybacks, TEI does not recommend this approach. They recommend the GPS equipment be set up to output position at the bowmount location and not where the antenna is located. Refer to the GPS manuals on how to set up the GPS equipment this way.

To set up Isis so it calculates the layback of the sonar from a fairlead as well as accounting for the position of a fairlead from the GPS antenna, click on View | Layback. This will make the Layback Correction dialogue box be spawned (see Figure 60). In this window there are two options for specifying the location of the sonar. Either a responder is placed on the sonar and a pinger is attached to the boat and Isis is informed via NMEA strings where the sonar is preciously. This approach is very accurate, although it has been rarely applied successfully at DSTO. It is believed this limited success was due to the turbulence (low signal-to-noise ratio) of the survey vessel. Another drawback of this approach is that it increases the complexity of a survey. To implement this option, the radio button "Apply Delta X,Y (usually from Trackpoint)" (http://www.ore.com/trackpoint.htm) needs to be chosen.

The second approach is slightly less accurate but has the advantage of being much easier to implement. This approach uses layback to determine the location of the sonar and has the distinction from the first approach in that the underlying assumption is made that the sonar is following the track of the boat. The layback is either calculated externally to Isis or Isis calculates it using cable-out values. To get Isis to implement this approach choose the radio button Apply Layback. At DSTO this is the method that has been used exclusively with the Klein 5500 sonar and will now be explained in detail.

Figure 60 The Layback Correction dialogue box in Isis.

When the radio button Apply Layback has been chosen three options are available. Two of these are used at DSTO. The three options will be explained below:

Use Logged layback value. This is the default choice when the radio button Apply Layback is chosen and has been used at DSTO in conjunction with the cable-out and angle measuring device OSCAD. If this option is used, then Isis will need to be setup so it knows that layback data is being routed to the acquisition computer on a specific serial port (see section 5.2.2).

The option Enter Layback Manually, has not been used at DSTO because it would involve using the depth of the sonar in conjunction with the cable-out to calculate the layback and then enter this value into the Layback text window in the dialogue box. This option would be too time consuming because of the need to keep on re-calculating the layback each time the depth of the sonar changed.

The third and final option, "Calculate Layback from Cable Out", has been used at DSTO by measuring the cable-out and obtaining the depth of the sonar from the built in pressure transducer. To set up this dialogue box for use with the Klein 5500 sidescan sonar when it is being towed follow the instructions below:

- Click Apply Layback
- Click Compute layback from Cable out. This will make the check boxes for Cable Out and Depth be enabled.
- Click on the Cable Out check box and enter in the cable out.
- As the Klein 5500 sonar has a built in pressure sensor, then the Depth window should already display the depth of the sonar. As outlined in section 5.2.6, the template token to instruct Isis that sonar depth values should be used is zero (0).
- Enter the Height of towpoint. This is the height of the rollers on the fairlead. As deduced from sections 2.3.2.1 and 2.3.2.2, this is 1.34meters.
- Enter the offset, which is the location of the last roller of the fairlead relative to the GPS antenna location. This was also outlined in section 2.3.2.1 and is 4.38meters.
- Now click the Apply button, and using the most recent cable-out and depth values, the layback of the sonar should appear in the Current Value window.
- Although there is a chance that the cable-out value will not change for at least several minutes, the depth however, can change, almost exclusively because the speed and pitch of the vessel will change. To account for changing sonar depths and cable-out values, now click on Compute Automatically. This will instruct Isis to account for any changes in sonar depth and cable-out values. When any one of these values changes Isis will re-compute the layback.

  Note, as it is physically impossible for the cable-out values to be less than the depth of the sonar then Isis will spawn an error message if cable-out values are entered with these attributes.

  Whether the location of the sonar is being estimated by entering the layback manually or by it being calculated in Isis using pressure and cable-out values, once the Apply button has been clicked then the layback value will be used in all further data acquisition. It can be a good idea to leave the Layback Correction dialogue box spawned whilst data is being acquired, as it acts as a reminder of what the layback value is. If sonar data is stopped from being written then unfortunately the layback setup will be lost and will have to be re-entered.

5.2.8.3 Sonar Altitude Alarm

When sidescan sonars are being towed relatively close to the bottom (for example within several meters) then when the bottom shallows quickly it can happen that the sonar gets very close to the bottom and there is a chance that it will hit it. Although an operator can easily see in the waterfall display when the altitude of a sonar is becoming dangerously low, it can still be beneficial to setup Isis so an audible alarm is produced.

To set Isis up this way click on Configure|Audible Alarm|Shallow Alarm and the Shallow Alarm window will be spawned (see Figure 61). To have Isis monitor the altitude of a sonar click on the radio button Shallow Alarm On and use the slide bar to select the minimum altitude below which Isis will generate an audible warning. Obviously this alarm would only be beneficial on acquisition computers that have a sound card and speakers.

Figure 61 The Shallow Alarm configuration window in Isis.

5.2.8.4 Coverage Map

When a survey is being conducted or several tests in the one location (like latency testing) it can be very helpful to be able to see the sonar track and the coverage that has been acquired. This is because coverage maps show where gaps in the data coverage exist whilst for such tests as latency testing they enable the boat driver to repeat particular tracks.

Isis has the ability to construct maps showing the track of a sonar and if instructed to also show the coverage. This can be accomplished whether data is being recorded or when old data is being played back. The ability of Isis to play data back will be outlined in section 8.2.1. It should be emphasised that for sidescan sonars it is the slant range which is being shown in a coverage map and not ground range.

To set up Isis so it displays a coverage map when data is either being recorded or played back, click on Tools|Coverage Map and Mosiac… This will cause the "coverage map and mosaic" window to be spawned (see Figure 62) and here click on the "coverage map only" radio button and then OK. Then a coverage map will be immediately displayed (see Figure 63), the location of which may be to the right of the main window, and partially off the screen, if only one monitor is being used.

What is shown in a coverage map is the track of a sonar using the course made good data, with the coverage display generated using the slant range and the orientation of the sonar. The location of a sonar in the coverage map window will only change when a new position has been received from the TPU during record mode or when a new position has been read from a data file during playback mode. The coverage map is set up so that the colour of the sonar track will change in a round-robin fashion when either a new filename is used or when a new data file is played back. The colour used and in what order are: red, green, yellow, blue, magenta, cyan, white, dim red, dim green, brown, dim blue, dim magenta, dim cyan, gray, pale green and pale blue.

Figure 62 The Coverage Map configuration window in Isis.

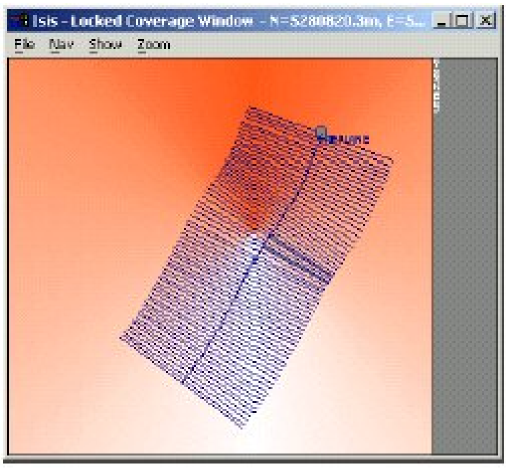


Figure 63 An example of a coverage map window in Isis. Note the menus at the top of the window.

When the coverage map window is spawned the sonar track and coverage should be displayed by default, however there are some additional settings that are not default but which can be helpful. The settings which were often used at DSTO are outlined in the table below:

Table 6 Setup parameters for the Navigation Window in Isis.

Show | Trackline | Coverage (default)/Without Coverage	Isis will by default show the coverage of a sonar, and this setting lets the coverage be toggled on or off. It can be helpful to remove the coverage when the tracks are close and cannot be distinguished from overlapping coverages.
Show | Grid	This lets a grid be placed over the coverage map with the options being, off and no grid lines shown or showing grid lines spaced at intervals of 100m, 500m, 1km, 5km or 20km.
Nav | Co-ordinate display	Lets an operator cho0se between either latitude and longitude or northing and eastings for the grid display.
Nav | Lock coverage map	This prevents new position data being added to the coverage map. This command could be helpful when a boat deviates away from a planned survey line and although data collection would be halted, unless this command is used, the coverage will continue to be updated by bad data.
Zoom | Zoom in (shotcut +)	Zooms in on the current position of the sonar. The shortcut for this operation is the plus (+) sign.
Zoom | Zoom out (shortcut -)	Zooms out.
Zoom | Best Fit (shortcut *)	This places the current location of the sonar in the centre of the window and either zooms in or out so all the coverage fits into the current window. The short cut is the asterisk key (*). It is also possible to zoom in on any part of the coverage map window using the right mouse button to highlight a particular area and then releasing it. Upon release the coverage map will be redrawn centred on the selected area with the boundaries of the selected area being remapped to the edges of the coverage map window.
File | Save coverage points	This enables the current coverage points to be saved to a file. Of the three formats available the one that has been used at DSTO is ASCII text.
File | Load coverage points	When a survey is being conducted over more than one day it can be helpful to see how the current day's data collection coverage map compares to any of the

	previous days. This can be accomplished by using this command to load the coverage map from a previous day and then beginning surveying.
File|New Coverage	Remove any track and coverage maps currently being displayed and display a new coverage map.
File|Save as tiff	Enables the current display of the coverage map to be saved as a tiff file.
Pan|Left/Right/Up/Down	Enables the arrow keys to be used to move the display in the direction chosen.

5.2.8.5 Sound Velocity

If an accurate sound velocity reading has been made during a survey in an area where it is approximately homogeneous in the vertical and horizontal then Isis can be instructed to use this value rather than a default value. This enables Isis to make more accurate slant range calculations; if the sound speed Isis uses is lower than what it really is then any objects will appear closer than what they really are and if the sound speed Isis uses is higher than what is really is then objects appear further away than what they really are. The default sound speed value Isis uses is 1500m/s unless it has been altered in a previous Isis session and the setup of such a session was saved.

To alter the sound speed value which Isis uses during data collection or during data playback, click on Configure|Sound Velocity… and the sound speed dialogue box will be spawned. Here enter the value measured. If data is being collected then this value will be used and stored in the data files. If data is being played back then this value will be used instead of that used during acquisition. In this last scenario the waterfall display will take on a more realistic look than what would have appeared during data collection, however such changes are only cosmetic with the original data file, in particular the sound velocity used during data collection, not being altered.

5.2.8.6 Save setup

When Isis starts up it interrogates the configuration file isis.cfg and sets up the current session using the information contained in it. As it is often necessary to setup Isis the same way each time it is used, for example, to use the same sonar using the same data format and the same serial ports, then it can be helpful to save the setup from one Isis session so it can be used on later occasions.

The way Isis has been set up during a session can be saved to the configuration file isis.cfg either during a session or upon the closing of a session (which occurs by exiting Isis). The setup settings which are saved to this file are all those made using the main menus. Settings made by clicking the right mouse button in any of the windows in Isis (for example the waterfall display, the voltage window, the coverage map) are normally not saved: they are lost when the respective windows are closed.

To set up Isis so it automatically requests the setup to be saved or it prompts an operator to save the current setup, click on Configure|Save Setup…This will make the save setup dialogue box be spawned. Here the options are:

- Save straight away by clicking on Save Now button.
- Save setup automatically upon exiting Isis by clicking the corresponding radio button.
- Request operator to save setup upon exit of Isis by clicking the corresponding radio button.

Note: even if the setup of the previous Isis session was saved and is identical to the setup that is needed for the current session, it is still wise to quickly check that the settings in the dialogue boxes, Sonar Information, Serial Port Setup, File Format and Klein 5000 Server, are as required.

Also note that when the isis.cfg file is read only, so the current setup cannot be written to it, Isis will not generate an error message indicating this. Hence, it is vital to check that the file isis.cfg is not read-only.

5.2.9 Isis Window Configuration

When Isis is spawned a few basic windows are shown and there will be others which some operators may require but which are not visible. Those windows which should be visible upon Isis booting up are the following:

- Isis server window for Klein5000
- Signal (Voltage) window
- Waterfall window
- Parameter display window

The Isis server display window for the Klein 5000 series of sonar has already been outlined in section 5.2.3 and its characteristics will not be repeated here. The voltage signal window is easily configured by clicking on the right mouse button when the cursor is placed over them. The dialogue box that is spawned when this action is performed on the waterfall window has a slide bar that allows the level of threshold (or contrast) to be adjusted. This changes the lightness or darkness of the displayed data. Speed and Slant Range correction can also be applied to the data display using this dialogue box, however these do not affect what is recorded.

The parameter display window is an important window critical to the collection of good sidescan sonar data. As some data fields in the parameter display window maybe unknown to a new operator as well as some of the buttons which appear in this window then it was deemed helpful if the attributes of this window were explained. The parameter display window will be outlined in the following section. Figure 64 shows a picture of the Parameter display window.

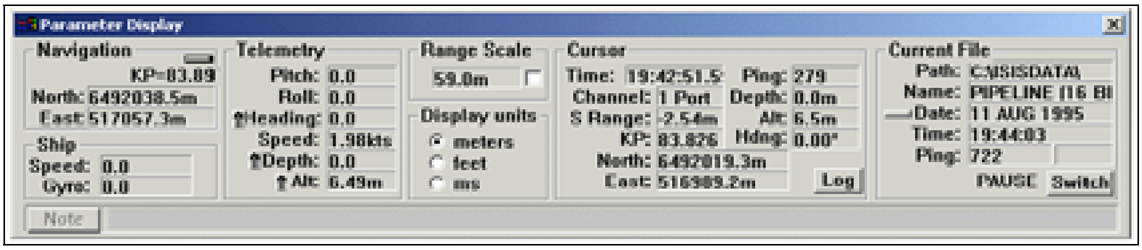


Figure 64 The parameter display window in Isis.

5.2.9.1 Parameter display window

This window is displayed as soon as Isis is started and like many sidescan sonar and multibeam echosounder acquisition software packages appears below the Waterfall window. The parameter display window displays information which has been extracted from the data that is coming in to Isis and is a very useful tool for checking that the data being acquired is what would normally be expected. If Isis has not been correctly set up, the correct data may not be recorded, and one way to detect this is to analyse some of the data fields in parameter display window. The parameter display window is made up of several panels. The data displayed in each of these panels and any settings that can be made will be discussed in the following sections.

5.2.9.1.1 Navigation

The first panel is Navigation, and displays the latest, sonar position, ship speed, and ship heading. If the recommendation from Klein is followed that GPS data is routed to the TPU and not the acquisition computer, then the latest position is extracted from data coming from the TPU, whilst the ship speed and gyro are obtained from the gyro (interfaced to the GPS), which is routed directly to the acquisition computer. It is important to check that these reflect what is actually occurring. There are a few ways to perform this, each dependent upon whether the boat is moored (prior to departure) or underway. For example when the boat is moored

- Compare the gyro data in the parameter display window and check it compares closely with that of the wharf. The orientation of wharf17 at Pyrmont is 39.7 degrees from true north, with the boat normally being between 31 and 38 degrees true. One easy way of determining the orientation of a wharf is to use the chord function in the post-processing sidescan sonar software Sonarview See Young and Anstee(1999) for a detailed account of this package.
- Check the ship's speed indicates zero or 0.1 knots.
- Check that the position data in the navigation panel compares with that displayed in the Leica display and also that they both are not changing very much.

When the boat is acquiring data the following comparisons should reveal any major errors in the collection of data:

- The orientation of the boat should be close to the course made good (which is derived using changes in position). The course made good and the orientation of the boat should be within approximately 5 degrees, but this will depend on the obliqueness and strength of any ocean currents. The course made good is displayed in the bottom left hand corner of the Leica GPS unit and can have a filter applied to it of between 2 and 10 seconds. The term crabbing is sometimes applied when an oblique current is causing a boat to move in a direction that is different from the boats orientation.
- Check the ship speed compares closely to the speed over ground (SOG) data field in the Leica display. A small time lag between these two values may be noticed and should be expected. This is because it takes a finite time for the SOG data from the GPS Leica unit to be meshed in with the sonar data by the TPU and for this data to then be sent and displayed by Isis.

The format of the sonar position depends upon the type of position information Isis is receiving. If the position data is in latitude and longitude then this data can be displayed in the three formats of decimal degrees, or degrees:decimal minutes or degrees:minutes:seconds, using the small tab key in the top right hand corner of the Navigation panel. If the position data is in northings and eastings then such data is displayed in this format in metres from an origin, with the small tab key in the top right hand corner of the Navigation panel having no affect this case.

If ship speed is zero in the navigation panel it is likely to be caused by the gyro only being set up to output HDG NMEA0183 strings and not VTG strings.

5.2.9.1.2 Telemetry

The next panel displays the telemetry information coming from the sensors on the towfish. Pitch, roll, heading (or yaw), speed, depth and altitude are all displayed.

The heading displayed here will often not be very good, as the sensor is a magnetic compass that is often not well calibrated. Instructions for calibrating it should be available from Klein Associates. The uncalibrated data should not be used.

The Depth field displays the depth as recorded by the sensor on the towfish. This is not the water depth, but the depth of the towfish below the water surface. The Klein 5500 operated by DSTO has a pressure depth sensor, and calibration values for this can be calculated and applied to give a sufficiently accurate depth value. Calibration values are entered in the "Isis Server for Klein 5000" window (section 5.2.6.1).

It can be seen in Figure 64 that there is an arrow tab pointing upwards () located to the left of the data fields Heading, Depth and Altitude. When this arrow tab is clicked next to any one of these three data fields a window is spawned showing these values much larger than they appear in the Parameter display window and these new windows can be placed anywhere on the screen. These windows can be helpful when any one of these three data fields needs to be carefully monitored and those values displayed in the parameter display window are a bit small to read often. This can be particularly helpful for altitude.

5.2.9.1.3 Range Scale

The Range Scale is the ground range that is being achieved for a sonar and is calculated using the slant range that is being implemented in conjunction with the altitude of the sonar.

5.2.9.1.4 Display Units

The units that are used to display the length calculations in the Parameter display window, are controlled by the Display Unit panel. The options available are metres, feet or milliseconds. At DSTO metres was used exclusively.

5.2.9.1.5 Cursor Data

When sonar data is being collected or played back, it may be helpful to know the location of a point in the waterfall display or what the attributes of the sonar were when a particular echo was received. In Isis it is possible to display this information by placing the cursor over the location of interest in the waterfall display and clicking the left mouse button. The location of the point of interest using the format in the Navigation panel, as well as the attributes of the sonar when the data was collected, are immediately displayed in the Cursor Panel of the Parameter display window. The location of the cursor is shown as well as the sonar attributes, depth, altitude, channel, heading, ping number, slant range, and the time the echo was received. If this data is important then the Log button can be clicked and this will make Isis save this information to the ASCII file cursor.log. Once data is copied to the cursor.log the Log button will dim. If data in the cursor.log file needs to be retrieved then this is possible using any text editor (such a Notepad).

In the past, Isis has been solely used to acquire sidescan sonar data. However, the Log button in the Cursor Data panel can greatly reduce the post-processing task of identifying the location of any suspicious objects. In the past this process has been performed shortly after the data has been collected, however this means that the data is being viewed twice, first when it is collected and then a second time when it is reviewed.

The Log button enables the locations of any objects that would normally be determined in post-processing to be written to the Log file when the data is being acquired. Then when a proper post-processing package is used to locate any suspicious objects the locations of those already detected can be read off the cursor.log file, greatly reducing the time it would take an operator to scan through the files on a second pass. In the past this functionality of the Log button has not been utilised but should be kept in mind.

5.2.9.1.6 Current (Data) File

The Current File panel displays information about the data file being acquired or played back. If sonar data is being acquired then an important button is the Switch Now button. This button controls the writing of data to files by Isis so that data is not lost when one file is closed and another begins being written to. When it is clicked on the Switch File dialogue window is displayed (see Figure 65) and it is here Isis is setup so that one of two scenarios occurs. These are:

- To synchronise the change in media on which sonar data is being saved. This would be needed when a medium becomes full, like a magnetic optical disk, and data needs to be saved to another medium.

  To set up Isis so this occurs, first type in the box “Record data to filename” the filename (without the extension) of the new file and then click on the radio button “Remaining storage less than 0.5% then ping-pong between the drives X: and Y:”, where X is the drive that is getting full and Y is the drive data will start being written to. Click on Switch Now and Isis will be instructed to perform these functions when the change criterion is valid. The dialogue box, however, will not disappear when the Switch Now button is clicked.

- The switch command is also needed when a sonar data file being written is getting large (normally 200 megabytes) and a new file needs to be created without any data being lost.

  To set up Isis so this occurs, first type in the box “Record data to filename” the filename of the new file (without the extension) and then click on the radio button “File grows larger than X MB”, where X is the size of the data files required. Then, when the current file Isis is writing becomes larger than X megabytes, Isis will create the new file using the filename entered.

  It is unwise to allow sonar data files to become too large, as if they get corrupted then it is likely that all the data in the file cannot be accessed. The nominal file size often at DSTO was 200 megabytes.

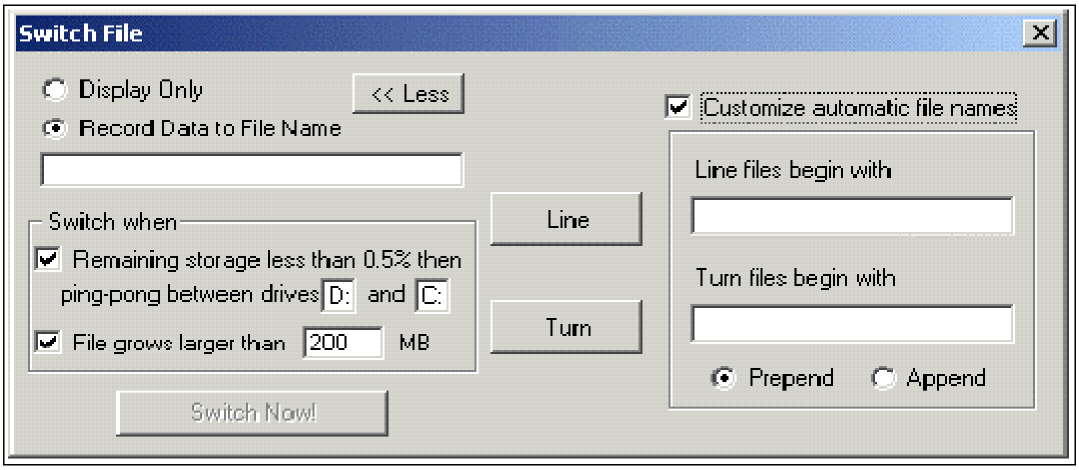


Figure 65 The switch file dialogue box.

The Note panel at the bottom of the Parameter display allows you to make a note during a recording session. The note will be recorded in the data file at the point that it is written, and reappear in the Note panel at the same position during replay.

5.3 SonarPro Setup

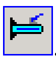
5.3.1 Introduction

SonarPro (SP) was written by Klein Associates Inc. and first released in 2000. It was given to DSTO free of charge when the sidescan sonar and TPU were fixed in August 2001 and to date, all updates have been free. SP version 5.0, 5.3 and 6.2 were downloaded from http://www.kleinsonar.com/tech/download.html.

Compared with Isis, SP is a user-friendly sidescan sonar data acquisition program. It is easy to learn, easy to set up and has the large advantage over Isis that is specifically designed for two Klein sidescan sonars, one being the Klein 5500. Also in comparison to Isis, SP has the ability to mark the location of targets in the coverage map during data collection. This can save a lot of time in post-processing. SP also has the ability to set up survey lines on top of nautical charts and import measured, cable-out values.

5.3.2 Getting Started

Many of the settings in SP rarely need altering and once they have been set for the first time they do not need to be reset for each survey.

To collect sidescan data using SP, the operator first needs to click on the towfish icon . This will cause the TPU Connection dialogue box to be spawned (see Figure 66a). Here the operator must chose the IP address of the TPU and whether or not the PC connecting to the TPU will be the master or will connect to the TPU as a slave. Then the operator must click on the "Change the Sonar Channel Configuration" widget. Once the operator has done this the "Channel and Sensor Configuration" dialogue box will be spawned. Figure 66b shows this dialogue box in detail. As the Klein 5500 towfish does not have any way of tracking bathymetry and does not have the sub Bottom profiler option added, then the only boxes which should be ticked are the Echo 1 (to receive the first echo) and Sensors yaw and roll (as the towfish does have sensors meauring these quantities. Then click "OK" and the Survey Wizard dialogue box will be spawned. The Survey Wizard was set up to guide the operator through setting up parameters for maintaining an orderly survey data file structure. It has been observed that the Survey Wizard is superfluous and is not needed. So when the dialogue box for the Survey Wizard is spawned click on Cancel. At this stage SonarPro is ready to display incoming data from the TPU.

(a)

(b)

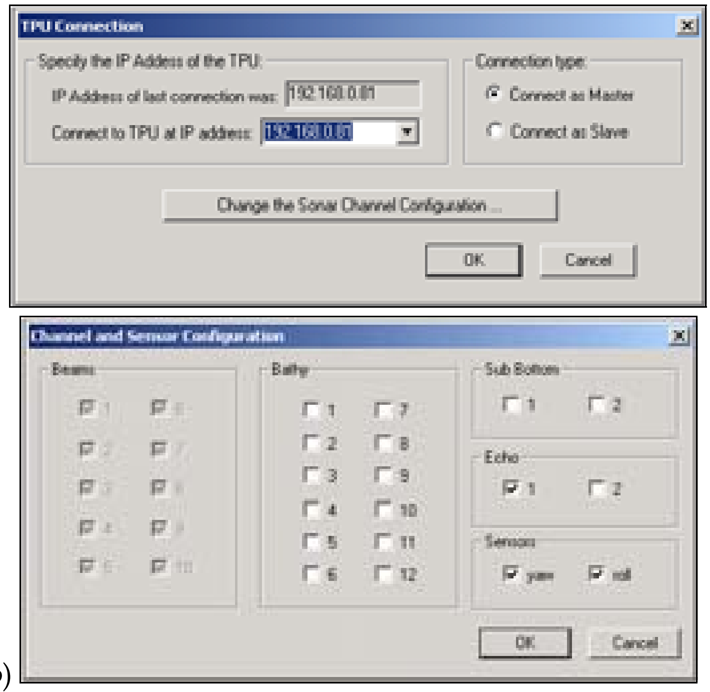


Figure 66 (a) The TPU Connection dialogue box and (b) the Channel and Sensor Configuration box, which is spawned when the "Change the Sonar Channel Configuration" button is selected in the TPU Connection dialogue box.

At this stage SP will have spawned the Scan Window (which shows the voltage returns from the port and starboard side of the towfish), the Navigation Window, the Sensor Window and the Waterfall Display Window. Although other settings can be made to SP, data can now be displayed in the waterfall display by clicking on the play button .

5.3.3 Alarms

In SP the operator can set numerous thresholds which if passed or tripped will invoke visual alarms. These alarms pertain to towfish roll and altitude and the Ping Lag of the acquisition computer. Ping Lag is the number of pings which are backing up in memory before they are displayed in the waterfall display. For computers with a lot of RAM (for example half a gigabyte) there is likely to be only a few unprocessed pings but this can increase to several hundred when only 128 or 256 megabytes of RAM is used. When the ping lag goes above 200 then there is the possibility of incoming ping data being lost and the operator should try and close unneeded windows in SP or in Windows.

To set the towfish roll and altitude alarm thresholds, right click in the altitude or roll status windows in the Information Window. Figure 67 shows where these two status windows are located in the Information Window. In doing this their respective dialogue boxes will be spawned and the user simply needs to enter in the threshold values and if wanted the user can check the audio alarm box. If at any time during data capture the altitude or roll of the towfish exceed the threshold values, the background of the altitude display will change from green to red and for the roll status window the background will change from its normal grey to red as well.

(a)

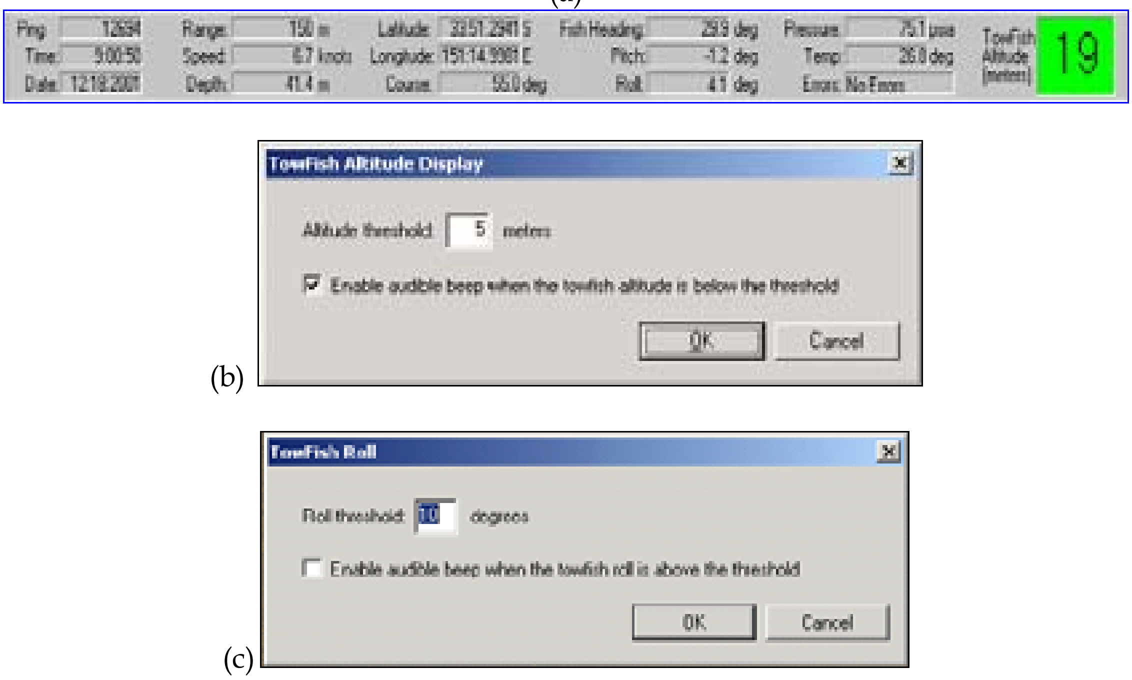


Figure 67 (a) The Information Window which is displayed in SonarPro and the dialogue boxes that are spawned when the altimeter (b) and roll (c) status boxes are right-clicked.

To set the ping lag threshold, right-click in the lag status box, which is located on the right side of the main window. Figure 68a shows the location of the Lag status box on the right-hand side of the Information Window. When the operator right-clicks in the status box the Ping Lag dialogue window is spawned (see Figure 68b). Here the operator can alter the Lag Threshold and the time interval the computer waits before it checks the threshold value.

(a)

(b)

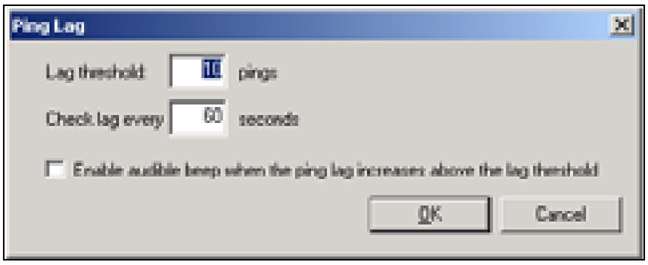
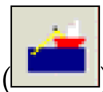


Figure 68 (a) The top portions of the main window, in particular showing the Lag status window on the right-hand side (circled in yellow). (b) The Ping Lag dialogue box.

5.3.4 Layback

If the operator wishes to know the position of targets, then the location of the towfish needs to be calculated by SonarPro. If the towfish is being bow-mounted then its position relative to the GPS antenna is relatively easy to measure using a measuring tape. If the towfish is being towed however, SonarPro, like many acquisition programs of this nature, will use the pythagorean theorem together with the cable-out values, towfish depth and fairlead (or shieve) position relative to the GPS antenna, to estimate the horizontal distance the towfish is from the GPS antenna. Such a distance is termed Layback.

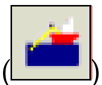
In SonarPro, the Layback icon () will only be highlighted if the data format is set to 5kd and not sdf. The data format which SonarPro (as well as ISIS) expects to come from the TPU, is set using the variable Set Oldheader in the startup.ini file; This file, the reader may recall, is downloaded using the file transfer protocol (ftp) from the Master computer by the TPU during bootup. When the variable Set Oldheader is set to zero (0) SonarPro expects the sdf format and when this variable is set to 1 the 5kd format is used.

If the data format sdf is used then the layback icon in SonarPro will be dimmed and unusable.

If the operator does need to know the location of any targets in the waterfall display then the operator will need to provide SonarPro with the location of the fairlead, or bow-mount, relative to the GPS antenna, the location of the GPS antenna above the waterline, the amount of cable-out (measured from the fairlead), the cable type and lastly the depressor type (if any). For the DSTO workboat the values of these variables for a bowmounted and towed configurations are outlined in Table 7.

Table 7 The values that should be entered into the layback dialogue box of SonarPro for the towed and bowmounted configurations. The conventions for X, Y and Z are positive in the starboard direction, positive in the direction of the boat and positive upwards, respectively.

Towfish Orientation →	Towed	Bow-mounted
Variable ↓		
Cable-out	Measured or calculated	0
Shieve Offset X	0	0
Shieve Offset Y		7.8
Shieve Offset Z		-3.72
GPS Height above water	2.77	2.77
Cable type	0.5 inches armoured	lightweight
Depressor	Probably none	none

To enter this information, click on the Layback icon () before data collection and the Layback dialogue box will be spawned. Figure 69 shows an example of this dialogue box. Any adjustments made to this dialogue box will only take-effect when the widget "Store Layback Parameters" has been clicked. This button sends the information in the dialogue box to the TPU.

In the Layback dialogue box there are two parameters which a new operator may not have much of a feel for; These are the Depressor Type and the Cable Type. At DSTO the only depressor which is available is the small K-wing and it is very rarely used. The operator is referred to section#2.3.4 for the different types of tow-cables used at DSTO.

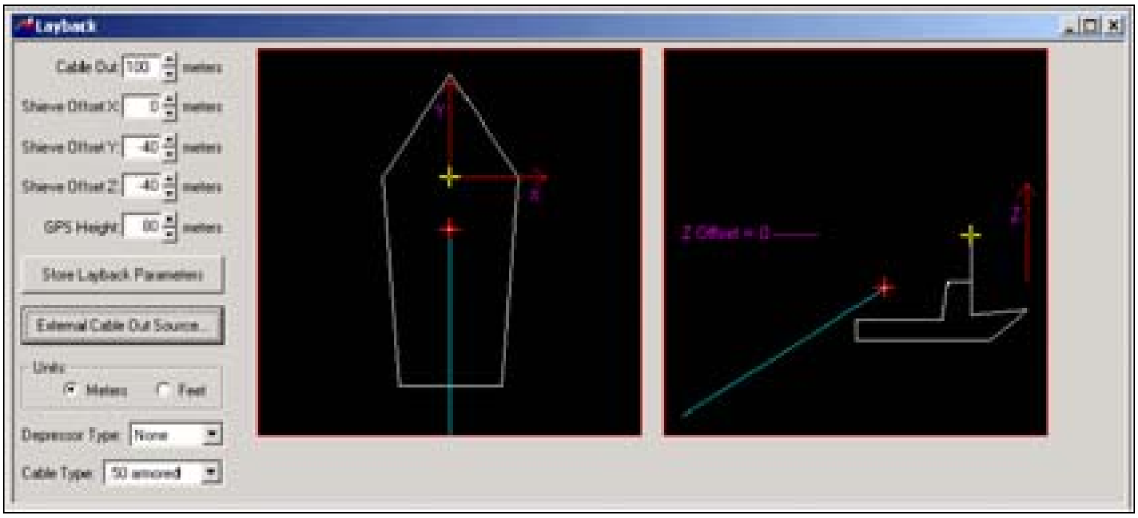
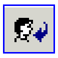


Figure 69 The Layback dialogue box used in SonarPro.

The layback information in 5kd files cannot be changed in post-processing with the layback icon dimmed  in playback mode (see section 8.2.2). If the operator needs accurate position information (which is likely to be most of the time) then they will need to accurately complete the layback dialogue box before the acquisition of any data.

5.3.5 Towfish Yaw Estimation

In addition to entering the layback correctly, the method SonarPro uses to determine the orientation (or yaw) of the towfish also needs to be entered, if position information is to be accurate. Before version 6.2, the orientation of the towfish was determined solely from the internal compass of the towfish. Unfortunately, this method is not accurate when the towfish is bow-mounted as the steel present in the platform will cause the towfish compass to be misaligned with the magnetic field of the earth.

With SonarPro version 6.2, the operator has the choice between using the internal compass of the towfish or the course made good[4], for ascertaining the orientation of the towfish. To alternate between these two methods the operator needs to click on the user preference icon  and then the Compass Preferences tab in the SonarPro User Preferences dialogue box. Figure 70 shows this dialogue box in detail. Then the operator can use the compass inside the towfish to determine the towfish orientation by activating the “Use towfish heading in point calculations” preference, or can use the

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[4] The course made good is the orientation or bearing of the track mapped out by changes in the location of the GPS antenna. This value is sometimes not the same as the output from the internal towfish compass due to tidal currents causing the sonar platform to “crab”.

course made good by activating the "Use ship heading in point calculations " preference.

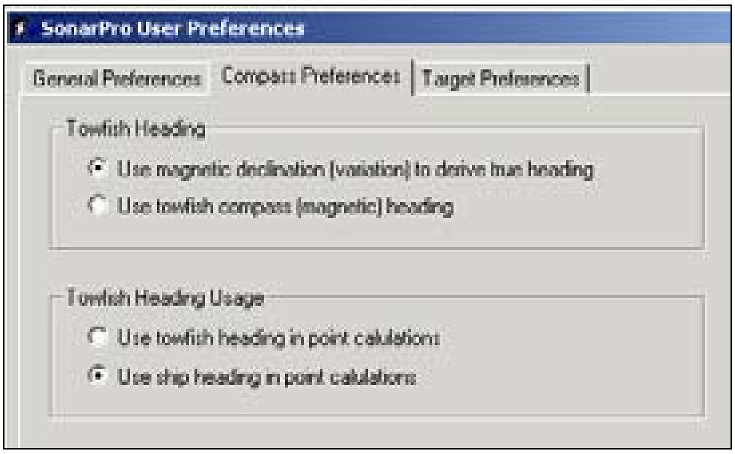
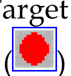
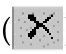


Figure 70 The SonarPro User Preferences dialogue box with the Compass Preferences activated.

This feature of SonarPro version 6.2 permitting the operator to alter how the towfish heading is calculated has not been available in earlier versions of SonarPro and unfortunately, as yet, SonarPro does not accept any input from a gyro.

5.3.6 Target Management

When data is being collected or played back (play back mode will be outlined in section 8.2) the operator can double-click in the waterfall display to mark the location of mines, mine-like objects or objects of significance. In doing so several things occur. These are that: (1) a Target Window is spawned, (2) the target is logged into a database and (3) a target mark () is placed in the Navigation Window. Of these three things it is the last one that is the most beneficial. This is because with target locations being marked during data collection (or "on the fly") then this virtually eliminates the need to methodically rescan the data files with SonarView looking for targets. It is simply a case of going to those data files in which targets were observed, playing them in SonarView and categorizing the targets for subsequent evaluation.

The Target Window spawned is a close up picture of the marked target. It displays the location of the target and permits the operator to zoom in and out, pan and derive the length, width and height of the target. If an operator wishes to delete a marked target then he/she can do so by clicking on the delete button () in the top left-hand corner of the Target Window. Lastly the data base of targets in SonarPro, although potentially very helpful (and not available in ISIS) has not been used because SonarView has been the main software package for marking and categorizing targets.

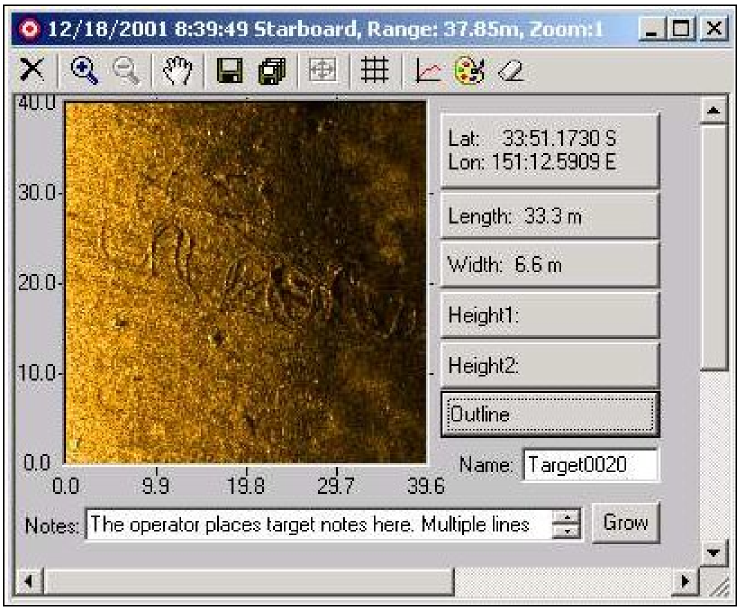
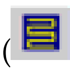


Figure 71 An example of the Target window in SonarPro. In this example the Target window is displaying the characteristics of an old chain located beneath the Sydney harbour Bridge.

5.3.7 Survey Lines

As outlined earlier, SonarPro, unlike ISIS, does have the capability to construct survey lines. These survey lines are plotted in the Navigation Window as a layer on top of any nautical charts that are being used. When data is being collected the coverage area of the sidescan sonar as well as the locations of the towfish are also plotted in the Navigation Window. This ability of SonarPro to illustrate the towfish coverage, on top of survey lines and nautical charts is a very helpful tool.

To set up survey lines in the Navigation Window, click on the survey route icon () from the Main Window or the Navigation tool bar when sidescan sonar data is being displayed or saved to disk. When this happens the Survey Route setup dialogue box is spawned. Figure 72 shows this dialogue box.

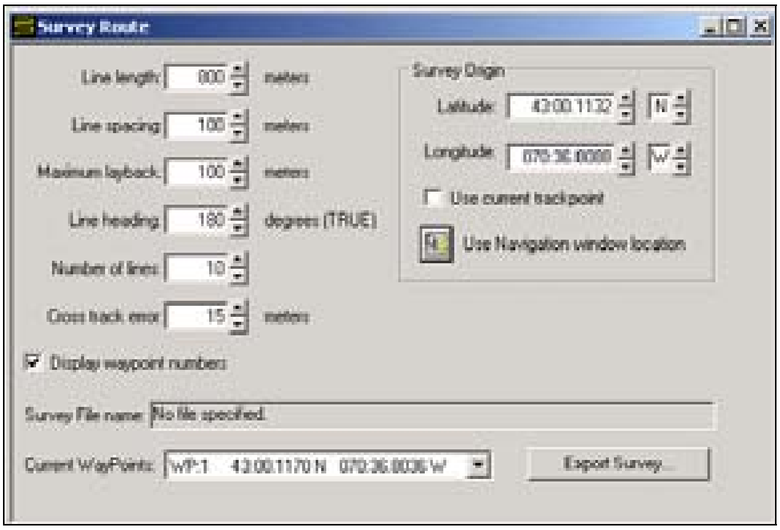
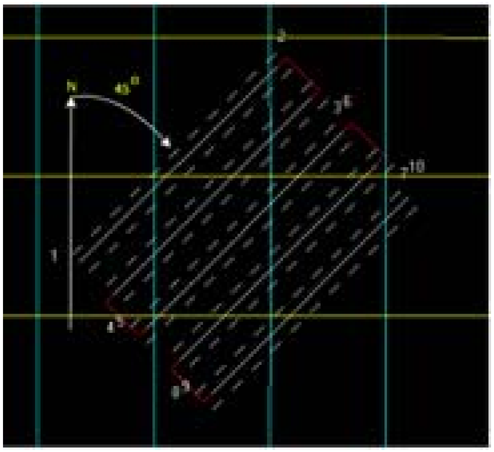


Figure 72 The survey route set up dialogue box used in SonarPro.

To set up survey lines, the operator needs to first establish the origin of the survey route. This can be accomplished by typing it into the dialogue box, checking "Use current trackpoint", which will use the current location of the towfish, or by selecting an origin using the mouse after clicking on the "Use Navigation window location" icon. Then it is a matter of entering the survey line lengths, Line spacings, Maximum Layback, Line Heading, Number of Lines and Cross Track Error. The only variables that the operator may not understand or may have difficulty estimating is the Line Heading, the Cross Track Error and the Line spacings.

- The Line Heading is the angle between true north and the direction the lines point, measured positively in the clockwise direction. As an example, if the Line Heading is zero then the origin can be thought of as the bottom left hand corner of a grid of survey lines and if the Line Heading is 180^{o} then the origin will represent the upper right hand corner of a group of survey lines. Figure 73 shows two examples of survey lines that have headings that differ by 180 degrees.



- (a) (b)

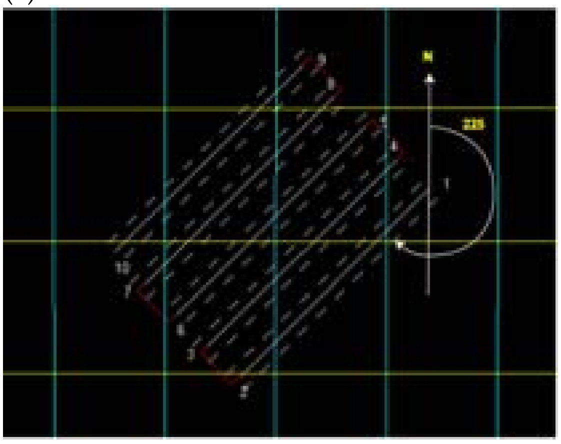


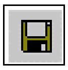
Figure 73 Two examples of 5 survey lines created with line headings of (a) 45^o and (b) 225^o, respectively. In both examples the origin (as needs to be entered into the survey route dialogue box) is at the waypoint #1, although because of the difference in line heading this origin appears in opposite places of the survey grid.

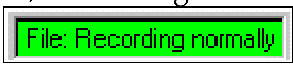
- The Cross Track Error is the maximum horizontal distance that the survey boat can be from the survey line whilst maintaining the desired coverage.
-
- The Line spacing, or horizontal distance between neighbouring survey lines, is determined by the desired coverage. As survey lines would normally be constructed for route survey work, and there is limited resolution beneath a towfish (encompassing the nadir), then operators will normally employ 100% coverage when using survey lines. This is because the low resolutions near the nadir need to be circumvented using the outer ranges of an adjoining swath line.

As the operator is entering or adjusting the variables in the Survey Route set up dialogue box, the corresponding survey lines should be displayed in the Navigational Window. If at any time an operator wishes to turn off the survey lines then this can be achieved by right-clicking in the Navigational window and then deselecting "Display Survey Route" under the General Tab.

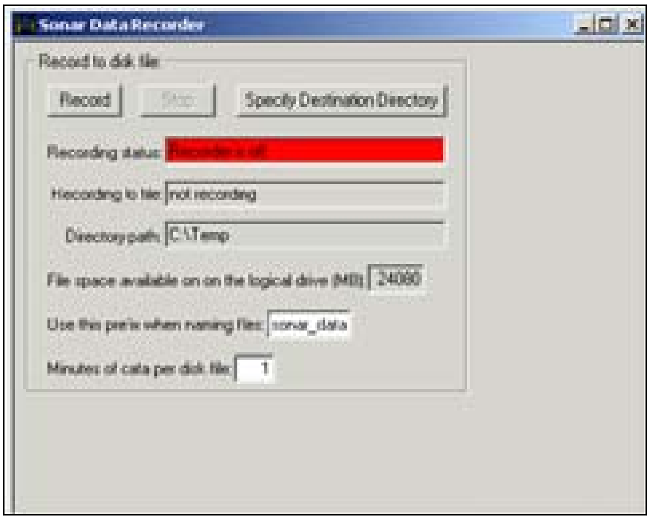
5.3.8 Saving Data

Once the operator has set up SonarPro the way they require and sonar data is being displayed in the waterfall display, then the operator can save the incoming data to file.

This is achieved by first clicking on the save icon  in the main toolbar and letting the Sonar Data Recorder dialogue box will be spawned. In this dialogue box the operator needs to specify where they want data files to be placed, the prefix to use in naming the data files and how many minutes of incoming data are placed in each file. At this stage the Sonar Data Recorder dialogue box can be used to start recording data by clicking on the Record button in the upper left hand corner or this dialogue box can be closed and data saved to disk by the operator clicking in the Recorder interface status area 

. In either case, the background colour of the recording status will change from red to green 

when data is being saved to media. The operator can stop recording at any time, by either clicking on the Stop button in the Sonar Data Recorder dialogue (which is only available when data is being saved) or by again clicking in the Recorder interface status area. Figure 74 shows two examples of the Sonar Data recorder dialogue box during set up and whilst data is being saved to disk.

(a) 

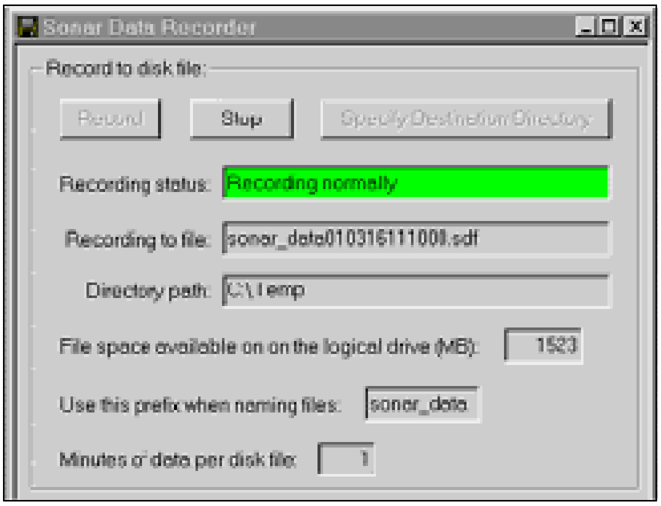
(b)


Figure 74 The Sonar Data Recorder dialogue box (a) being set up for data capture and (b) whilst data is being saved to disk.

It can be seen from Figure 74(b) that the extension of the data files is sdf (sonar data format). This format is not the only format available in SonarPro; the other is 5kd (5000 data), with both formats originating from Klein and not determined anywhere in SonarPro itself but in the startup.ini file. The variable in the startup.ini file that determines the format of the data files is SET OLDHEADER with the sdf format being used when this variable is set to 0 and the 5kd format used when this variable is set to 1. As the file startup.ini is downloaded only when the TPU boots up then if the operator wishes to change between the formats sdf and 5kd then they will have to alter the startup.ini file on the host PC and then reboot the TPU.

5.4 Master and Slave Setup

In all of the above setup configurations it was assumed that only one computer was being connected to the TPU and that obviously this computer was the master (in terms of controlling the TPU settings during data acquisition). But if an operator wishes to have more than one computer accept data from the TPU then one will have to be the Master and all the rest will have to be the Slave. Such a setup could be used to compare the different styles of data acquisition of different software programs.

In Isis the operator controls whether the computer Isis is running on will be the Master or Slave by using the Conf.exe (configure executable) file in the Isis directory. If the operator double-clicks on this executable then they will see that this executable is where the IP address of the TPU is set, whether the computer will be the Master or Slave, and some other options. When the operator has made the necessary alterations he/she should click on the "save and exit" button if they wish to save their changes, otherwise the changes can be discarded by clicking on the "exit" button. Figure 75 shows the window that is spawned when the Conf.exe file is executed.

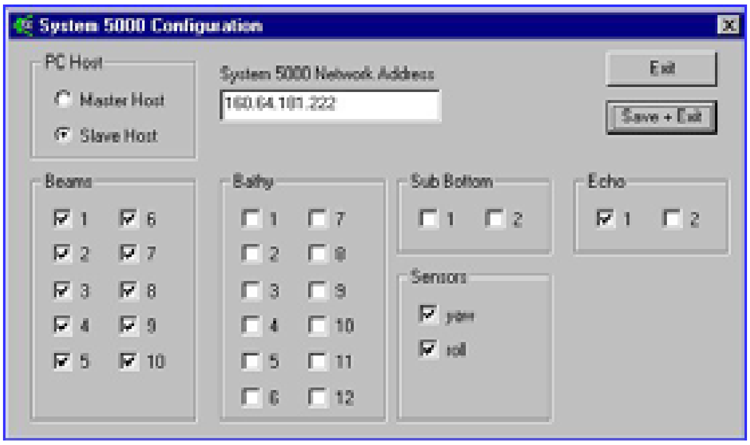


Figure 75 The window that is spawned when the Isis file conf.exe is executed.

Sometimes when the operator makes changes to the settings in Figure 75 and the save and exit button is clicked, the error message is spawned, ConfigFile::Save Data, informing the operator that the changes cannot be saved. This error occurs because the computer is trying to write the alterations to the read only file, sys5k.cfg. It is unknown why this file is read only but the operator will need to remove the read only attribute if they want to have their alterations implemented.

In addition to making alterations to the conf.exe file, if the operator follows the Klein manual then when the Master and Slave computer tries to connect to the TPU there will be an IP conflict. As the Master computer and TPU will need to have specific IP addresses then the simplest way to circumvent the conflict is to alter the IP address of the Slave computer. This is achieved by going to the control panel and altering the IP address for the TCP/IP protocol to anything other than that for the TPU and the master computer. In the author's experience it is simplest to change the IP address from 160.64.181.221 to 160.64.181.223.

Unlike Isis, which the operator must externally set up to make it the Slave, SonarPro can be made the Slave from within the software, by using TPU Connection dialogue box (Figure 66a).

The computer which is set up as the Master will have complete control over the settings of the TPU, most importantly the slant range, the wave forms implemented, the pulse length, resolution and mode of despeckle. When a change is made using the master computer the changes will be replicated in any Slaves shortly afterwards. The operator cannot make changes to the settings of the TPU from any Slave computers.

6 Connecting TPU, Acquisition Computer and sonar

6.1 Introduction

This chapter will explain how to test that the TPU and the acquisition computer are networked correctly. It will then go on to explain how to prepare the sonar for deployment, test the connection from the sonar to the acquisition computer and then explain how to deploy the sonar. It will be assumed that the setup procedures outlined in Chapters#2,3 and 4 have been successfully implemented.

6.2 Connecting Acquisition Computer and TPU

6.2.1 Power

Make sure the TPU, acquisition computer and monitor, and any hubs you may be using have power cables connected, plugged in and the power is on. Turn on any navigation equipment (eg GPS, gyro) if it is not already and connect the TPU, acquisition computer, and GPS and gyro serial cables, as outlined in chapter#2.

Switch the acquisition computer on. Remember that in with virtual resolution, the display area is larger than the screen size. So if a window cannot be seen that should be open, move the mouse to the edges of the screen. This will make other parts of the virtual screen be displayed. See section 3.6.2 for details of how to set up a second virtual screen.

Warning do not connect or disconnect the towcable to or from the TPU while the TPU is on. Serious damage may occur to the sonar system electronics and/or any operators of the sonar may be injured.

6.2.2 TPU Bootup

When the acquisition computer has been turned on and the operating system (either Windows 95 or Windows 2000) has finished booting, turn the TPU on using the green switch at the front of the TPU. Immediately the TPU should log onto the acquisition computer and try to download, first its operating system file vxworks, and then the initialisation file, startup.ini. This should take about a 25 seconds to conclude but it may take up to 5 minutes, or not occur at all if the ftp server is not properly configured (3.3). The operating system file vxworks is essential to the successful bootup of the TPU whereas the TPU will still bootup successfully and be correctly networked to the Klein 5500 sonar even if the initialisation file startup.ini is not downloaded.

There are several ways to determine whether the TPU has successfully downloaded the file vxworks and booted up correctly. These will be outlined in the following sections. The TPU will still boot correctly if the file startup.ini cannot be downloaded.

6.2.2.1 TPU Evidence

If the TPU boots correctly then the lights labelled A,B,C and VME on the DSP (Digital Signal Processor) printed circuit board will light up in one of two sequences depending upon whether the sonar is connected to the TPU or not.

If the sonar is not connected to the TPU and just the LAN cable is connected to it then when the TPU is switched on the following light sequence should be observed.

On the DSP board:
- A light first on and then off
- Then B will light and then go off
- Then C will light and lights A and B will flicker

On the Demultiplexer Board:
- Lock Loss light be off.
- Error light will light and stay on. This will be because the towcable is not connected.

If the TPU boots successfully then
- all three DSP lights A, B, C will flicker.
- and the VME light will light and flicker at the towfish's default ping rate.

If the sonar is connected to the TPU however, then when the TPU is swithed on the following sequence should be observed:

On the DSP board
- Light A will light and go off
- Light B will light and go off
- Light C will light and go off
- All three lights will then light

Demultiplexer Board
- Lock Loss light will be off.
- Error light will be off.

If the TPU boots successfully then
- the VME light will also light and pulse at the towfish ping rate.
- Lights will A, B, C will almost be constantly lit.
- The error and lock loss lights should still be off.

6.2.2.2 Terminal Emulation Software

If a terminal emulation program is being run on a computer that was attached to the com1 port on the front of the TPU using a serial cable, then the boot process should be clearly evident and correspond to that shown in Figure 45.

6.2.2.3 *Evidence on the Acquisition PC*

Although not as conclusive as observing the boot sequence on the terminal emulation, there are two pieces of evidence that the TPU has received the files vxworks and startup.ini. Obviously these pieces of evidence do not show that the TPU has booted, only that the TPU has received these necessary files.

If Windows 95 is being used to acquire sonar data, then in the Servu FTP server four lines should be displayed for each of the files vxworks and startup.ini, indicating that the TPU has downloaded these files successfully. Figure 76 shows these four lines for the file vxworks. Each of the lines tells us that one part of the process of the TPU downloading these file has occurred successfully. An explanation for each of the four lines appears in Table 8.

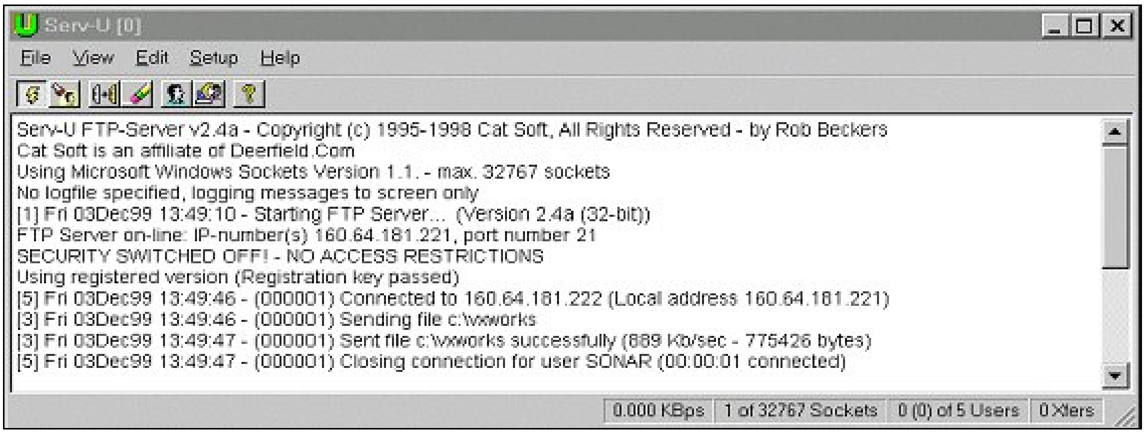


Figure 76 Evidence in Serv-U that the TPU had downloaded the file vxworks.

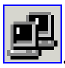
Table 8 An explanation of each of the four lines in the Servu display window

Statement	Explanation
"Connected to 160.64.181.222 (Local address 160.64.181.221)"	indicates that the TPU has logged into the Servu FTP server on the local computer. NOTE 1: There is sometimes an extra line after this line saying "User SONAR logged in", which means that the login details for the TPU are correct. This line seems to appear if the login details are correct, but the required file(s) cannot be found on the Isis computer.
"**Sending file c:\klein\vxworks**" (or c:\klein\startup.ini)	shows that the TPU has located the requested file "vxworks" (or startup.ini) in the folder "c:\klein" and has started downloading it. NOTE 2: There are sometimes errors in the transfer, with an error message displayed in

	ServU. There may be several attempts made at file transfer. However, as long as the next line "Sent file successfully" is displayed, error lines can be ignored.
"**Sent file c:klein\vxworks successfully (889Kb/sec – 775426 bytes)**" (or c:\klein\startup.ini)	provides the baud data rate of the transfer and confirmation that the transfer is complete.
"**Closing connection for user SONAR (Connected 00:00:01)**"	indicates that the TPU has successfully downloaded the file vxworks and closed the FTP connection, which was open for 1 second.

If these four lines do not appear in the ServU window for the given file, then that file has not been sent correctly. Although the TPU will boot correctly and be usable with the Klein 5500 sonar, if the file startup.ini is not downloaded, the TPU will not boot without its operating system file vxworks.

If Windows 2000 is being used on the acquisition computer and the built in FTP server is being used for the TPU to download its two files vxworks and startup.ini, then unlike ServU, the Windows 2000 FTP server does not display whether the TPU has successfully or unsuccessfully downloaded these two files. Hence although the Windows 2000 FTP server has worked very well in the past, unlike ServU it does not display any information regarding file transfers.

If the Windows 2000 FTP server is being used then although there is no evidence of the server communicating to the TPU there is evidence that the TPU is logging into the acquisition computer. The evidence is first the message "LAN plugged" following a few seconds afterwards by the message "LAN unplugged". These messages appear as cartoon captions in the bottom right hand corner of the screen, just above the network icon . These messages correspond to when the TPU has logged into and out of the Windows 2000 operating system.

If the above tests are successful then it can be safely assumed that the LAN between the TPU and the acquisition computer has been set up correctly, that the TPU is locating its operating system file vxworks, and that the TPU has no hardware malfunctions and is booting correctly. The next step is to get the sidescan sonar ready for deployment. As outlined in Chapter#2, the Klein 5500 sidescan sonar at DSTO is deployed either in a bow-mounted configuration or in a towed configuration. As the set up procedures for these two configurations have a lot more differences than similarities then each will be outlined separately below.

6.3 Towed Configuration

6.3.1 Moving Sonar onto back of boat

As the Klein 5500 sidescan sonar weighs 78 kilograms in air then this dictates that to relocate it from any wharf to a boat will involve the use of a crane. As cranes have a limit on the amount of cable they can deploy, then prior to arranging a boat to be wharf side, it is important to make sure that the tide is not so low that the sonar cannot be successfully lowered to the boat. Although the clearances required for a bow-mounted or towed sonar will be different, the concept is the same. Information outlining tidal predictions for major Australian and South Pacific ports can be found at the National Tidal Facility web page (http://www.ntf.flinders.edu.au/TEXT/TIDES/tides.html). There is also a software package at MOD, Sydney which shows the same information this web page provides.

To relocate the Klein 5500 from any wharf to a boat using a crane follow the steps below:

- Remove the top half of the blue foam end pads from the Klein 5500 wooden stowaway box and place these on the stern of the boat, in the location where the sonar is to be rested on the deck (see Figure 18). If it is a windy day, then place the foam ends in a nearby recess, until they are needed.
- Attach the crane's hook to the steel cable lanyard of the Klein 5500. As the lanyard the crane will use is attached at the centre of the sonar then there have been several occasions when the sonar has pitched badly when it was being moved onto a boat. To prevent this happening, a rope should be attached to one of the handles of the towfish (see Figure 17).
- After finding a crane operator who has a licence, lift the sonar out of its stowaway box and place it on the stern of the boat, on top of the blue foam pads just placed there. Use the attached rope to control any pitching that develops in the sonar during this relocation. To make deployment easier, when the sonar is being lowered onto the foam pads, align it with the boat. That is, have the front of the sonar closest the bow and the rear of the sonar (where the tail fins and altimeter are housed) closest the stern of the boat.
- Detach the crane's skyhook from sonar's steel lanyard and remove the rope that was being used to inhibit any pitching. The sonar is now ready to be connected to the TPU and be prepared for deployment.

6.3.2 Sonar Deployment Setup

Once the sonar resides on the stern of a boat there are only two more tasks to be performed before it can be deployed. In a simplified version these two tasks are to attach the tail fins and to attach the tow-cable. These two tasks will be outlined in detail in the following two sections.

6.3.2.1 Attaching Tail Fins

To attach the three tail fins to the sonar, use a long 4mm Allan key and an 8mm a/f socket to remove the six bolts (two per fin) from the rear yellow nose cone of the sonar and attach the fins one at a time. Figure 77 shows these two specialist tools at DSTO. To inhibit the chance of a side fin working free during deployment, insert the two bolts for the two side fins downwards instead of upwards. If this recommendation is followed then if the nuts work free there is a lot less chance the bolts will drop out.

If downward or upward pressure is exerted on the dorsal fin then it may be enough to cause the rear yellow nose cone to separate from the stainless steel sonar body. Such a scenario should not raise alarm as the rear nose cone is designed this way. See section 2.1 for more details.

Figure 77 The 4mm Allan key and 8mm socket used to attach the three tail fins to the Klein 5500 sidescan sonar.

6.3.2.2 Attaching Coaxial Sonar Cable

Before the shackle of the co-axial steel tow-cable can be attached to the body of the sonar, the steel securing brace plate (see Figure 18) needs to be screwed onto the top of the sonar using nylon threaded steel screws and any two of the four available holes. Once the brace plate is in place the shackle can be attached.

Before the co-axial steel tow-cable is attached to the securing plate check for any broken wires, which often occur as a result of corrosion. Broken wires will place those left under a lot more strain and there is a chance the tow-cable will break.

Make sure the pin is inserted at the end of the steel rod holding the shackle in place. Coat the three pins on the tow-cable's male Subconn® (http://www.subconn.com) plug with silicon grease before connecting the Subconn plugs. If the Subconn plug leaks then the silicon grease will act as a barrier between the contact points and any seawater. The next step is to secure the steel lanyard to the co-axial steel tow-cable using strong cable ties. This will create a loop at the top of the steel lanyard which will be used to deploy and retrieve the sonar. The last step is to connect the safety steel cable from the back of the sonar to the sock on the tow-cable. This attachment is a backup in case the shackle works free. It should be noted that the sock of the steel tow-cable should not be handled without a good set of gloves. The sock has a lot of steel burrs protruding from it and running a hand along it can result in serious injuries to an operators hands. Figure 78 shows the sonar setup ready for deployment.

Figure 78 A picture showing the correct set up of the Klein 5500 sidescan sonar. See text for details. Operator Mr Collin Mason, formerly from MOD, DSTO.

Before the sonar is deployed the connection between the TPU and the sonar needs to be checked for electrical continuity.

6.3.3 Testing Connection Between TPU and Sonar

6.3.3.1 Acquisition software

When the TPU has booted, start Isis or SonarPro by double-clicking on their respective icons on the desktop, or find and run their executables, sonarpro.exe and isis.exe from the folders klein and Tei, respectively.

The Isis and Klein software (see chapter#5) on the acquisition computer control communication with the TPU, which in turn controls communication with the towfish. Follow the directions outlined in chapter#5 so that the waterfall display is showing the data being received by the sonar whilst it is in air sitting on the back of the boat.

6.3.3.2 Rub Test

To make sure the sidescan sonar is working correctly before it is placed in the water a test known as a Rub Test is performed. With the TPU pinging the towfish and the acquisition program generating a waterfall display have someone rub their hand or a piece of cloth up and down one side (one transducer stave) of the towfish. The corresponding side of the waterfall display should show the presence of the sound generated by the rubbing (see Figure 79). Perform this test on the other side of the towfish to make sure the sonar is receiving data correctly. If the sonar does not appear to be receiving any sound from the rubbing then right-click in the waterfall window, increase the “Threshold” setting and repeat the rubbing. If the sonar fails the rub test then this implies that although power is being transmitted to the sonar, the transducers are not working. This can indicate one or more hardware or software components in the sonar needs fixing. The first approach when this happens is to contact the manufacturer, Klein, and seek advice on how to implement further tests on the sonar or enquire as to whether the sonar should be returned to them for fixing.

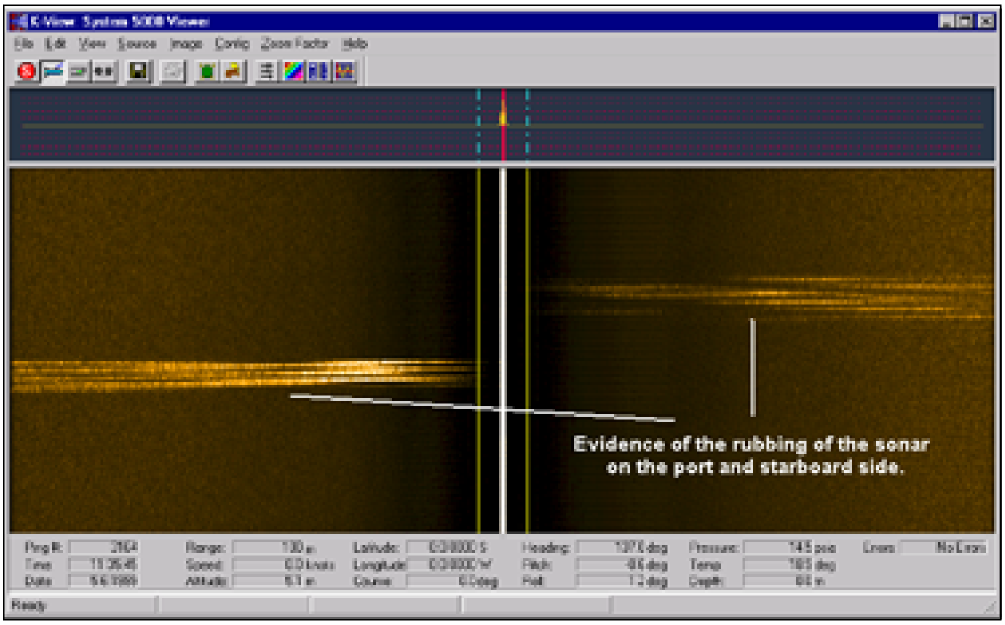


Figure 79 A waterfall display in SonarPro showing the presence of a rub test. Adapted from (KLEIN SERIES 5000 SYSTEM TROUBLESHOOTING GUIDE).

After the rub test is complete, the activation of the sonar does not need to be stopped if the towfish is being placed into the water straight away, however if the towfish is going to be left use the stop button to stop the towfish operation and then restart the towfish pinging when it is placed into the water at a later time. The reason for not leaving the towfish running in air is because it is designed to be run in a water environment, which has a much larger heat capacity than air. Hence, it is not unusual for customers to damage the electronics inside the towfish by leaving them powered up for too long whilst in air. Although the manufacturers of the towfish actually do not normally power up the towfish in air (personal communication Vince Horan, 2002), they do recommend that as a rough guide the towfish should not be run in air for more than 10 minutes. Leaving the towfish on the back of the boat during the summer months can also make the towfish body increase in temperature considerably. So it is recommended to cover the towfish with a tarpaulin when it is resting on the boat and not being used.

6.3.4 Towfish Deployment

If the rub test is successful then deploy the towfish. The TPU can be left on at this stage with the towfish pinging. There is no need to stop the towfish pinging whilst it is being lowered into the water.

The process of deploying the Klein 5500 sidescan sonar requires a minimum of two people: One experienced and suitably qualified person to operate the A-frame and the winch and a second person to aid the sonar as it is placed into the water.

To deploy the Klein 5500 follow the procedure outlined below:

- Attach the snap shackle to the loop at the top of the steel lanyard and after wrapping the rope around the winch raise the sonar off the stern deck. During this time use the handle grips to stabilise the sonar and stop it pitching and yawing.
- With one person controlling the winch and A-frame and a second supporting the sonar, extend the A-frame so the sonar is slowing lifted over the fairlead and over the water. Care should be taken that the belly of the sonar does not scrape the fairlead rollers as the height of the sonar is comparable to that of the fairlead.
- Making sure not too much tow-cable has been deployed out from the winch, lower the sonar into the water. Before doing this however, slowly rotate the sonar, otherwise when it is being lowered the yellow nose cone will hit the back of the fairlead.
- Making sure the steel tow-cable is laid over the rollers of the fairlead, lower the sonar several meters into the water until the slack of the tow-cable has been taken up. This will have the sonar directly beneath the fairlead. To remove the rope, use the winch to slower raise the sonar so the top loop of the steel lanyard can be seen. Detach the snap shackle and lower the sonar back to several meters. The sonar is now ready for operation.

  WARNING: Do not let out too much cable as the towfish may hit the bottom and be lost or damaged. Always be aware of the water depth in the area of operation, and keep the towfish well clear by checking on the altitude value in Isis or SonarPro.

  Make sure an accurate record of cable-out is kept (see section 2.3.5)

6.4 Bow-mount Configuration

6.4.1 Setup towfish for bow-mount

As with the towed configuration, before a bow-mount is set up, the tidal level should be investigated to make sure it is high enough. If the tidal level is too low, it may not be possible for a crane to lower the bow mount frame in place and several hours will need to be waited until the tide reaches the minimum level. As outlined in section 6.3.1, there is a web page at the National Tidal Facility (http://www.ntf.flinders.edu.au/TEXT/TIDES/tides.html) that shows the water level predictions for the major ports of Australia and the South Pacific.

Having established that the water level is high enough to permit the bow-mount to be lowered onto a boat, observe the following procedure:

- secure the aluminium support beam onto the top of the sonar using several screws.
- Then loop the green lifting strop back onto itself under the top metal beam of the steel bow mount and connect the crane's hook into the loop that has been made (see Figure 80). Using a suitably qualified person at the controls of the crane, raise the steel bow-mount frame and manoeuvre it over the middle of the sonar. Carefully lower the bow-mount frame onto the aluminium pole making sure that the orientation of the frame and the towfish are in line (otherwise the sonar maybe orientated back to front when it is mounted to the boat). Connect the upper and lower parts of the bow-mount frame together using four screws with four nylon-coated nuts. Use the crane to keep the frame upright. This will permit the other set up procedures to occur more easily.
- Now get the short blue tow-cable, which has a shackle at one end, and using strong cable ties, connect the shackle to a point on the sonar or bowmount frame so that the male and female ends of the Subconn plug can be connected and that this connection will not be placed under stress whilst the sonar is underway. After coating the male ends of the Subconn plug with silicon grease connect the Subconn plug. Now put the TPU end of the tow-cable up through the centre of the frame as if the sonar was already in the water and using cable ties mount the tow-cable flush against the centre poll of the frame.
- At this stage it is a good idea to test the electrical continuity of the Subconn connection. This part can be postponed until the sonar is immersed in the water although if the Subconn connection does not work then either the bow-mount needs to be removed from the boat or a diver is required to reconnect the Subconn plug underwater.
  - To test the electrical continuity of the Subconn connection, connect the tow cable to the back of the TPU located on the boat.
  - Follow the rub test procedure outlined above for the towed configuration.

  - If the rub test fails then unscrew the Subconn plug at the sonar and re-attach tightly. If the rub test still fails then check the connection of the tow-cable at the back of the TPU.
- When the electrical continuity of the Subconn connection at the sonar has been tested and deemed successful, unscrew the tow-cable from the back of the TPU and roll it up, using cable ties to keep the roll from unwinding. To prepare for moving the bow-mount onto the bow of the boat, temporarily put the rolled up tow-cable on one arm of the bow-mount (see Figure 80). This stops the tow-cable getting in the way when the frame is being put on the boat. Use another cable tie to stop the rolled up tow-cable from falling off.

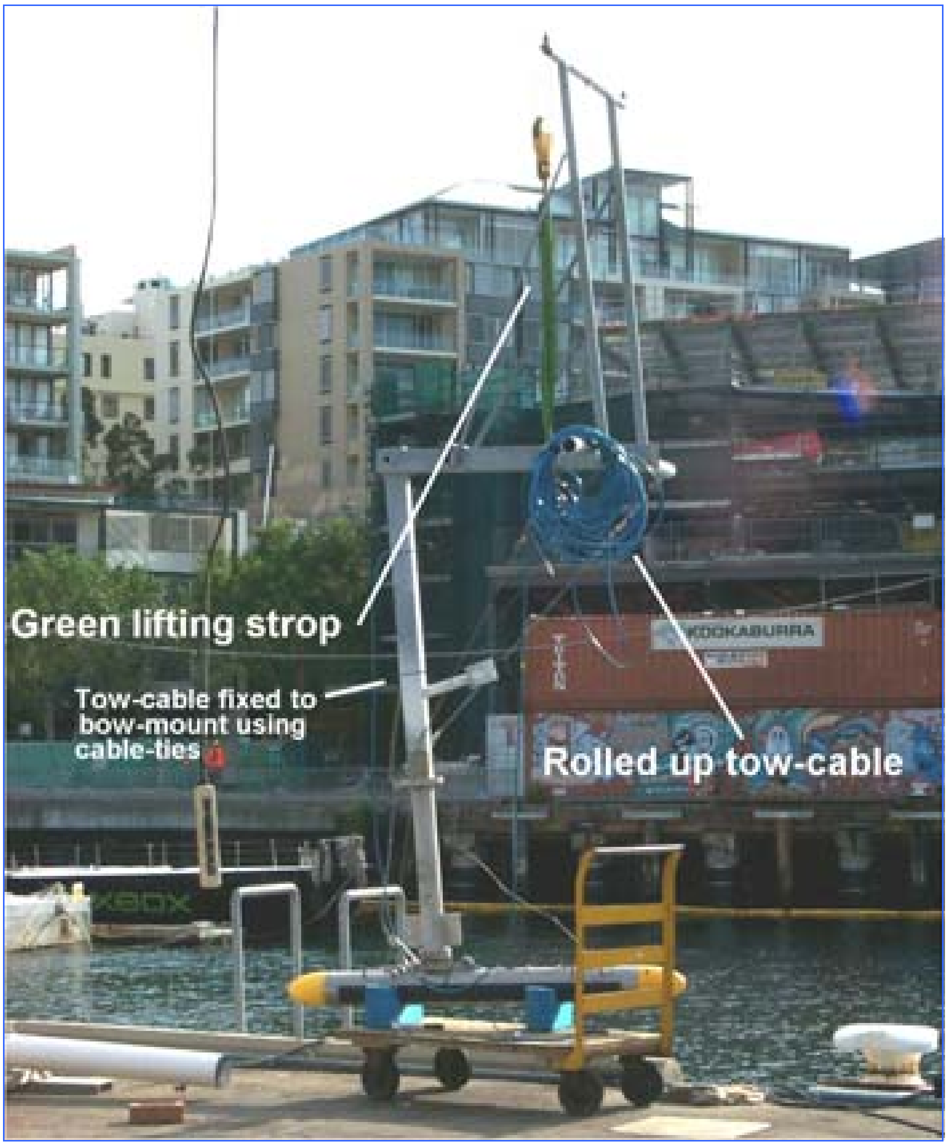


Figure 80 The final configuration of the bow-mount before it is lifted onto the workboat.

6.4.2 Put Bow-mount on Boat

- If not already done, put the solid steel bar that will hold the bow-mount frame to the boat under the bow rope guide (see Figure 81).
- With an experienced and licensed crane operator at the controls of the crane, gingerly raise the bow-mount. Have an operator on the wharf and a second on the bow of the boat controlling the movements of the frame. Make sure these personnel are wearing safety helmets and steel capped boots.
- Lower the frame to a height whereby it can be slid back under the cleat (or the anchor point used for the ropes when the boat is wharf side). Pull back on the bow-mount frame and slide it into position so it is rests on the bow of the workboat. When the frame is resting in place, disconnect the crane's skyhook and remove the green lifting strop. At this stage the crane is no longer required.
- Using the two big bolts, bolt the frame to the steel bar (see Figure 81). This may be difficult, as sometimes the bolts do not find the thread. If so, the steel bar will need to be slightly rotated about the vertical or be removed and rotated 180 degrees in the horizontal axis. *(Continued on next page)*

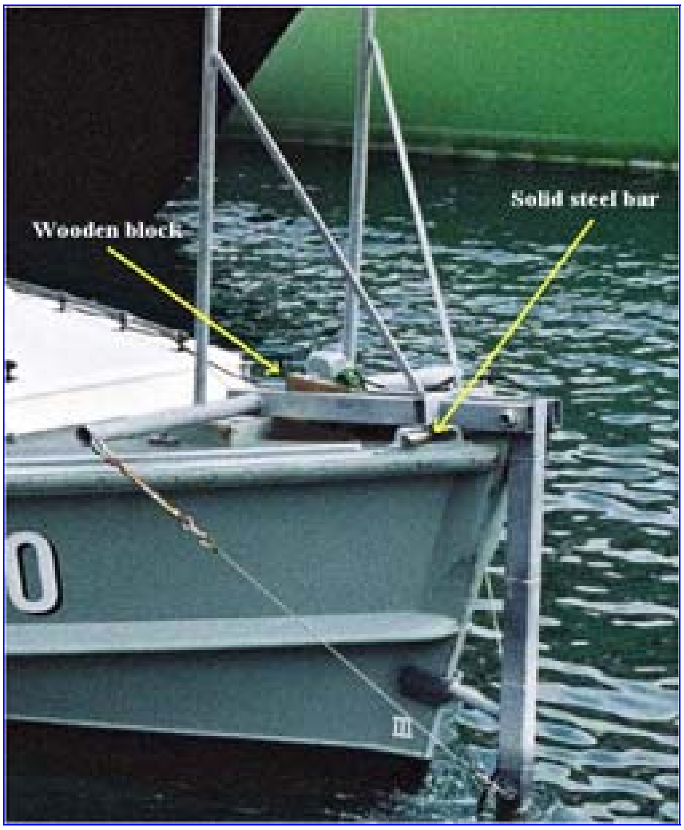


Figure 81 The bow-mount in its final configuration. Several pieces of equipment are identified. Refer to text for details. Adapted from an image taken by the Navy Imagery Unit-East.

- When the frame is securely attached to the boat, place two wooden blocks between the frame and the rope tie downs (see Figure 81). To stop the frame from moving forwards and backwards when the survey is underway have the blocks facing in opposite directions.
- All that is needed now is to cut the cable ties that were being used to stop the tow-cable from unwinding and run the cable back to the TPU along the deck of the boat.
- Use cable ties to try and locate the tow-cable out of the way of any walkways.
- The process of locating the bow-mount onto the boat is now complete and the sonar is ready for use.

7 Data Collection

7.1 Meta Data

As with most forms of data collection the key to any successful survey is documenting the meta data and systematically archiving any data that has been collected. At DSTO, Sydney the information that needs to be documented can be related to one of four topics. These are: (1) the requirements of the Occupational Health and Safety committee, (2) documenting any tests performed on the sonar, (3) documenting the progress of a survey, or (4) information that would normally be documented irrespective of whether the sonar was being tested or used for a survey.

7.1.1 OH and S Committee Requirements

When any type of sidescan sonar work is conducted it is a requirement of the OH and S committee at DSTO that the following information should be documented in the trials book:

- Date of collection
- Time of departure and return
- All personnel on the boat
- Reason for, or aim of data collection
- Whether the survey area was in Port Jackson or offshore, and also the area(s) visited.
- Any safety incidents including, most importantly, what occurred and to whom (these will need to be reported).

It is also a requirement that the aim of the days work be entered into the Survey Sheet and that the trials manager and boat driver sign this form at the end of each day. The Survey Sheet is included in the trials plan.

7.1.2 Testing the Sonar

When any instrument is being tested it is a very good idea to note the following:

- The alterations made to any instruments on the boat, particularly if another operator would not know that these have been made. It would be helpful if a small label were placed on the instrument so any other personnel can quickly see that the instruments set up has been altered.
- Any unusual set up procedures (for example was GPS NMEA strings routed to the acquisition computer instead of the TPU, or was a cable-out serial string routed to the acquisition computer?).
- Were any unusual settings used on the sonar? For example was a different pulse width used? If so when were the changes implemented and what data files do they correspond to?

7.1.3 Survey Information

If a proper survey is being conducted then in addition to the information above, the following should also be noted for the day in question. There is a data collection sheet in use in which this information can be entered. Any data sheets collected should be kept so they can be referred back to.

- What survey lines were either partially or fully completed?
- What were the names of the data files generated?
- What time interval and survey line does each file correspond to?

7.1.4 Miscellaneous

Irrespective of why the sonar is being used it is always helpful if the following information is documented:

- Was any equipment broken?
- Were there any unusual findings?
- Did the TPU or acquisition computer behave abnormally (for example did the TPU crash several times or did moving the mouse in the Isis ruggedised computer make the operating system crash).

Although it may appear that a lot of documenting takes place when the sidescan sonar is operated, any operator will get accustomed to the documenting that is needed and not all the information listed above will need to be documented on each occasion a sonar is used.

7.2 Collecting Data

The procedure to collect data using SonarPro or Isis will not be outlined here because it was outlined in Chapter#5. What will be outlined is such issues as correct techniques, media choices and data collection attributes.

Before the survey area is reached it can be a good idea to view the waterfall display, in either Isis or SonarPro, and make sure it looks correct. It is not needed to save any of this data until the surveying has begun.

Some important points to remember when data is being collected is the following:

- Is the bathymetry getting dangerously low for the sonar to work in? Bathymetry shallower than 5m should be of alarm when the sonar is being towed whilst for a bow-mount bathymetry is not that much of an issue as the boat needs a deeper draft than the sonar.
- Are any alarms being displayed in the acquisition programs Isis or SonarPro?
- Every time a new survey line is begun a new data file should be opened.

- Is a survey line being followed correctly or are there significant deviations? If a survey line is not being followed is it necessary to stop the data collection and return to the last location where good data was collected?
- At the end of a day's data collection systematically archive the files collected.
- File any data sheets created.

7.2.1 Media Selection

As it is likely that any post-processing will be undertaken on a separate computer, then this dictates that there is a need to transfer sidescan sonar data from the acquisition computer to the post-processing computer. As sidescan sonar data can take up a lot of space, with approximately 200 megabytes being collected in 8 minutes for the Klein 5500 or 1 GB in 40 mins, then the medium on which sonar data has been collected and transferred to the post-processing computer has been magneto-optical (M-O) disks or removable hard disks.

The magnetic optical disks at DSTO have capacities of around 2 GBytes, with each side becoming full after approximately 40 minutes. When using M-O disks, make sure that they are formatted using the command AFDisk, as described in Appendix D, otherwise the windows NT processing computers will not be able to read them reliably. For transfer from M-O to another computer, an external SCSI M-O drive exists at DSTO, Sydney and can be installed in any computer that has a SCSI card.

The removable hard disks used at DSTO, Sydney were the 40 GByte Seagate barracuda disks. Approximately 10 were purchased and they can be very helpful, requiring removal only after approximately 8 hours. If the disks are being transferred between computers of different operating systems then the disks may not be detected due to different file systems being used. For example Windows 2000 can use NTFS, or Fat32, whilst Windows 95 and Windows 98 uses Fat32 or Fat. If a disk does not appear in the My Computer, go to the Control Panel|Administrative Tools|Computer Management and click on disk management under storage. This will show all hard disks and partitions present in a computer (see Figure 82). If needed, the file system used in the removable hard disk can be altered here so the hard disk can be used.

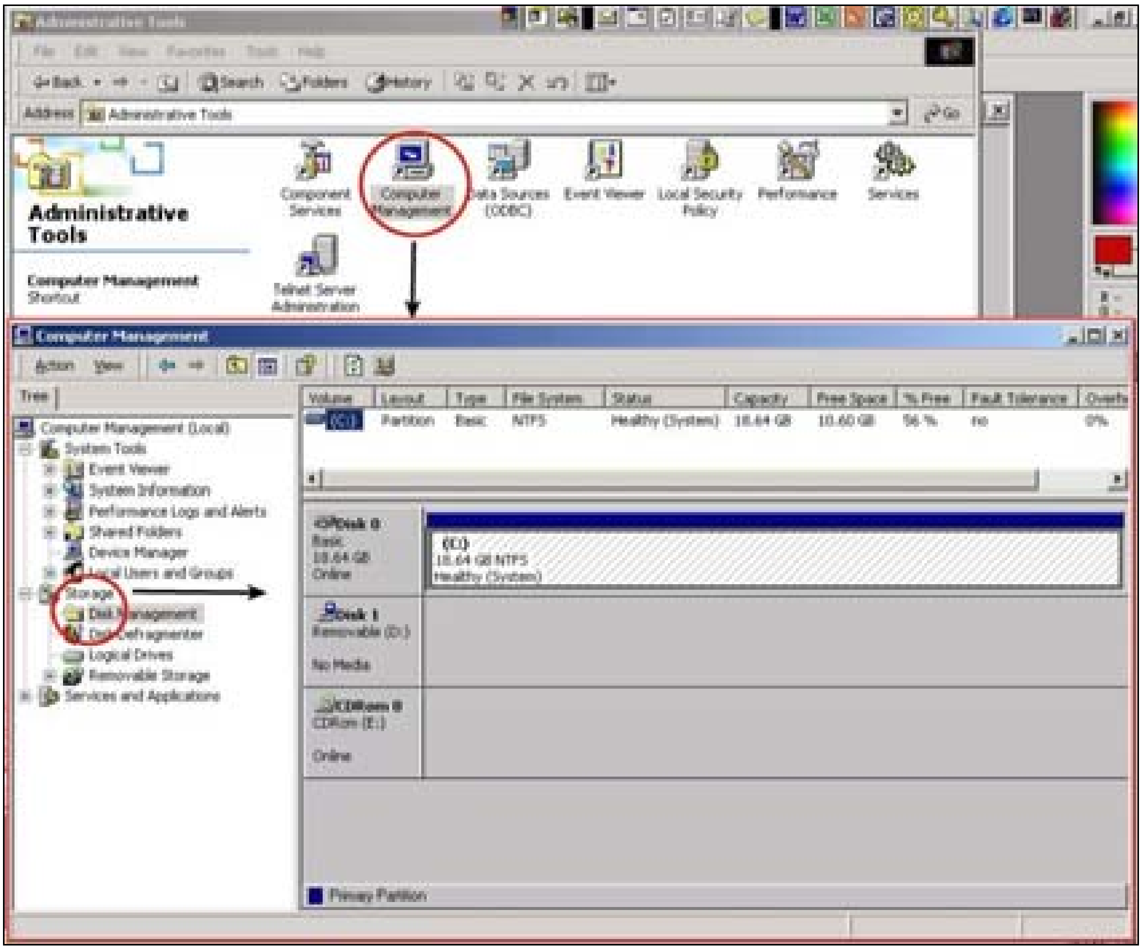


Figure 82 The Computer Management dialogue window in Windows 2000.

8 Post-Processing

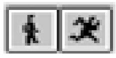
8.1 Introduction

SonarPro and Isis have primitive post-processing capabilities. In particular they can only play back data files, with SonarPro also consisting of a target database. As these two packages cannot smooth or edit navigational data or create mosaics then they have not been the first tool used at DSTO and the RAN, for post-processing sidescan sonar files. This was, and will be for some time, achieved by Sonarview (Young and Anstee (1999) outline how to utilise Sonarview).

Despite SonarPro and Isis' limited post-processing capabilities it was still thought beneficial if a chapter was dedicated to explaining how to use these tools because there are occasions when it is helpful to use them. Such occasions could be to play back recently collected data files to check for data file corruption or to re-evaluate any recently observed targets. This is easily achieved in SonarPro and Isis.

8.2 File Playback

8.2.1 ISIS

To play back DAT, XTF, SEG-Y or TRA[5] data files in Isis, click on "File | playback" or click on the "Playback" button . Either option will result in Isis requesting which data file to play back. The scrolling speed of the waterfall display(s) is controlled using the walking/running person icons  on the toolbar, or click on "view | playback speed".

8.2.2 SonarPro

Both sdf and 5kd files can be played back using SonarPro. To do so, click on the "Source" button in the Main window and select which Hard Disk the file is located on. When this is performed the appearance of the tool bar in the waterfall window will change from that which is available during data acquisition to that shown in Figure 83. Sidescan sonar data files collected in the XTF, SEG-Y or DAT format cannot be played back in SonarPro.

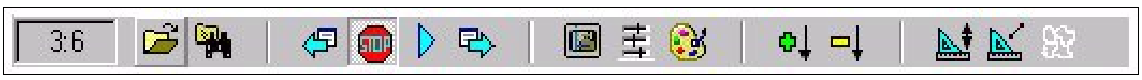
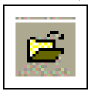
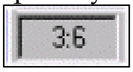
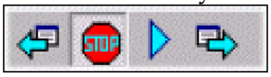


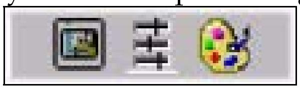
Figure 83 The tool bar available in the waterfall display of SonarPro when data files are being played back.

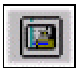
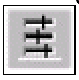
[5] Isis cannot save data files in the TRA format; it can only play them back.

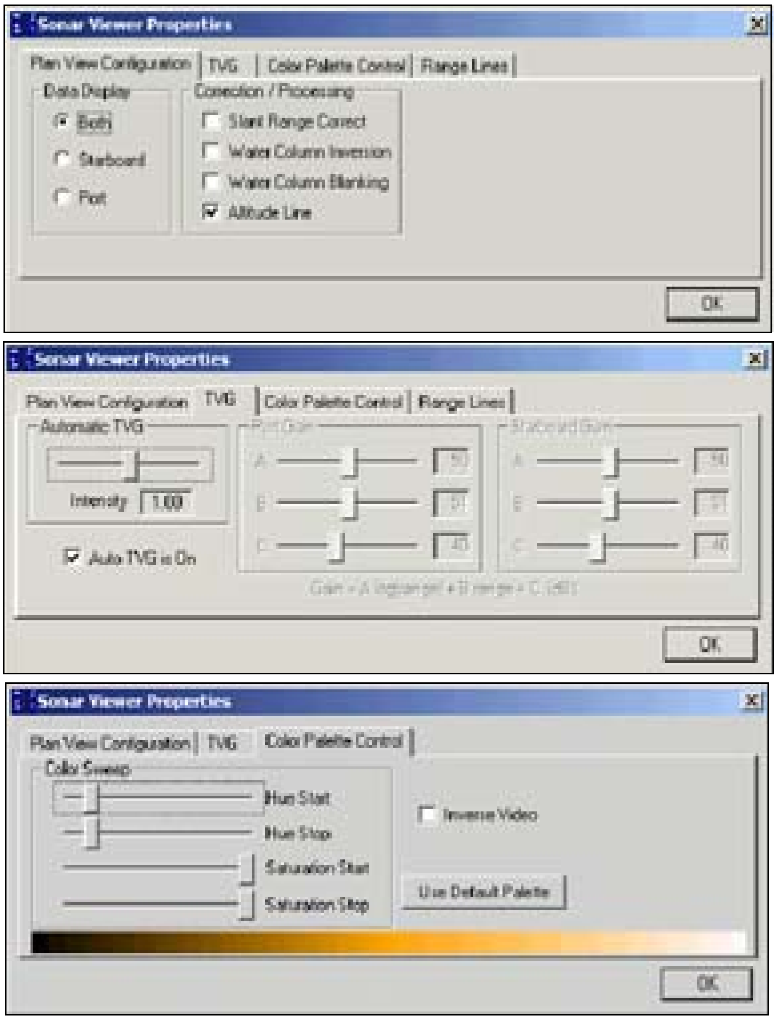
To play back sdf or 5kd files, first locate the data file. This can be achieved using the Open Sonar data icon  or the advanced search icon , which enables the operator to temporally search for files. Once the data file has been chosen, the file count window 

will adjust to reflect the chronological location of the chosen file relative to the total number of files available in the directory. Then it is a simple matter of using the Data Source Control buttons 

to play and stop data files as well as move forward or backward one data file. If the operator does not intervene, SonarPro will play all data files in the chosen directory starting with the chosen file and finishing with the last file collected.

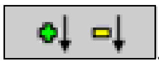
The other icons in the Playback Tool bar control the characteristics of the waterfall display as well as permitting the attributes of any targets to be displayed. The three icons  on the Playback Tool bar, have corresponding tabs in the Sonar Viewer Properties window (Figure #84) and their functions are outlined below.

-  The Plan View Configuration icon controls whether or not the waterfall display (1) is corrected for Slant Range, (2) displays the altitude line, (3) displays the port or starboard or both, sidescan data, (4) blanks out the water column or (5) is inverts the colour of the water column. Figure 84(a) shows the Plan View Configuration tab in the Sonar Viewer Properties window.
-  The Time Variable Gain (TVG) icon permits the operator to alter how the gain of the intensity is applied. The operator has the options of leaving the gain on Auto or adjusting the three components of the TVG, namely spherical spreading, absorption and scattering, for the port and starboard channels, using the slider rulers. Any adjustments made to the TVG will appear immediately in the waterfall display. Figure 84(b) shows the TVG tab in the Sonar Viewer Properties window.
-  The Color Palette icon enables the operator to adjust the Hue Start, Hue Stop, Saturation Start and Saturation Stop components of the color palette using slider rulers. The operator also has the option of chosing inverse video. Figure 84c shows the Color Palette tab in the Sonar Viewer Properties window. Like adjustments made to the TVG, any adjustments made to the color palette will be immediately displayed in the waterfall display.

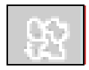


(a)
(b)
(c)

Figure 84 The three tabs of the Sonar Viewer Properties window. (a) Plan View Configuration, (b) TVG and (c) Color Palette.

The speed of the waterfall display can be altered using the icons . The waterfall display will scroll with the default speed of approximately twice the speed of data capture (248 pings per second), with a maximum of nine times the speed of data capture and a minimum of a half.

During data playback objects may be observed for which the height and length may need to be determined. This can be deduced respectively, using the two icons  with the values calculated being displayed in the status bar, which is located beneath the Information Window. Before these two functions can be used, the

waterfall display needs to be stopped scrolling. This can be achieved using the stop icon .
To aid keeping track of observed targets it was outlined in section#5.3.6 that the operator can mark the location of any targets by double-clicking in the waterfall display, with a red filled circle subsequently being placed in the navigation window where the target is located. This technique is good for small targets but for larger targets or geological features such as rocky areas, this technique is unsuitable. To enable the operator to highlight large areas in the waterfall display the icon  can be used. This icon enables the operator to draw freehand lines in the waterfall display, with any lines drawn subsequently shown in the Navigation Window. Unlike the length and height icons above, however, the scrolling of the waterfall display does not need to be stopped before this function can be invoked, although it is difficult to observe the lines in the waterfall display while it is scrolling.

8.3 Cursor Position Estimation

If the operator wishes to know the latitude and longitude of any location in the waterfall display then, assuming the layback information has been correctly entered (see section 5.3.4) and the method for estimating the towfish yaw has been chosen appropriately (see section 5.3.5), it is a simple matter of clicking on the waterfall display with the cursor where the operator wishes to know the position, and the latitude and longitude will be calculated and displayed in the status bar.

Note: cursor position information will be displayed in the status bar even if the layback function is dimmed and not active (which occurs when the data format is sdf). In this situation the position information should be disregarded.

In determining the position of any point in the waterfall display the assumption is made that the bathymetry does not change across the track. This is the flat bottom assumption and the operator should be aware of it. The operator should use caution if he or she is determining the locations of targets in regions where the bathymetry changes in the across-track direction. Figure 85 is a schematic displaying this scenario.

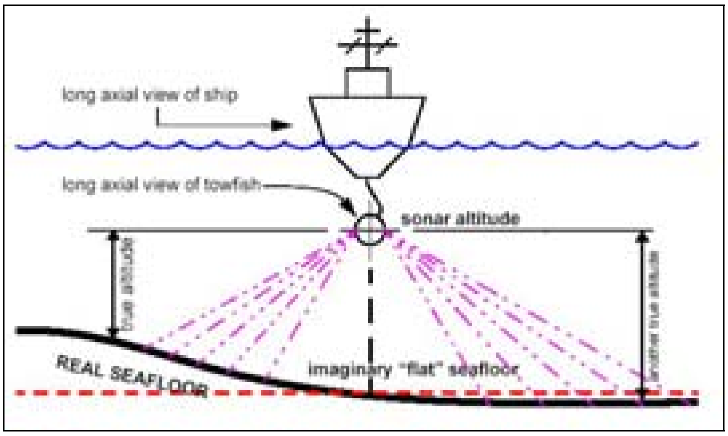


Figure 85 A schematic diagram showing how the flat bottom assumption can result in incorrect location of objects in areas of uneven bottom topography.

9 Trouble shooting

9.1 Introduction

Over the past several years at DSTO many problems have been observed with the Klein 5500 system and often these problems have only been remedied by consultation with either TEI or Klein Associates Inc. As this consultation often took several working days then it was deemed very advantageous if the steps that were taken were outlined.

The problems that were observed can be placed into several categories. These were:

- TPU not booting
- TPU lock loss/error lights on
- TPU crashing
- Incorrect usage of acquisition software
- Error messages generated by acquisition software
- Idiosyncracies of waterfall displays

In this chapter all of the problems that have been observed with the Klein 5500 sidescan sonar system will be outlined, including any indicators or error messages, the reasons for the problem and the action that needs to be taken. Some remedies have been taken from Klein Series 5000 System Troubleshooting GUIDE and this text is very helpful in isolating problems with the Klein 5500.

9.2 TPU not booting correctly

One of the most common problems to occur with the Klein 5500 sidescan sonar at DSTO was for the TPU not to boot up. The reasons for this could be incorrect setup of the FTP server on the acquisition computer, or the TPU operating system file vxworks being placed in an incorrect location on the acquisition computer. The TPU should boot successfully after approximately 1 minute of it being switched on and evidence that this has occurred is any of the following:

- The vme light on the DSP board of the TPU flashes at the sonars default ping rate.
- The terminal emulation software connected to the com1 port of the TPU shows the message shown in Figure 45.
- If the FTP server program is ServU, then in the main window, there will be four lines indicating that the TPU is downloading the file vxworks. If ServU does not show that the TPU is downloading the file vxworks then it will not boot.
- If an Ethernet hub is being used between the acquisition PC and the TPU, then the indicator lights on the ports being used on the hub should light up soon after the TPU is switched on, indicating that the file vxworks is being downloaded.

If it is clear that the TPU is not booting, then the following actions should be taken, in the order presented. In each of these actions use the white reset (rst) button located on the bottom board of the TPU instead of the green on/off switch to reboot the TPU.

- Use the "Ping" command in DOS on the acquisition computer and ping the IP address 127.0.0.1. The IP address 127.0.0.1 is the address of the network card. So the command ping 127.0.0.1 will test the inner loop between the computer and the network card. If no packets of data can be sent to the network card then the network card has not been installed correctly. Figure 86 shows an example of the ping command testing this inner loop. Note in this figure how four data packets were sent to the network card and four were sent back, indicating that the "inner loop" has been set up correctly.

Solution-if the ping command reveals that the network card is not installed correctly then remove old driver for network card (if it exists) and reinstall it. Then try the ping command again to test the inner loop. If successful, then reboot TPU and see whether it boots correctly. If it does not, but the inner loop exists, then proceed to the next step.

NOTE: It is not possible to use the ping command to ping the TPU from the acquisition computer because the ping command itself is part of the operating system, and this has not loaded yet on the TPU.

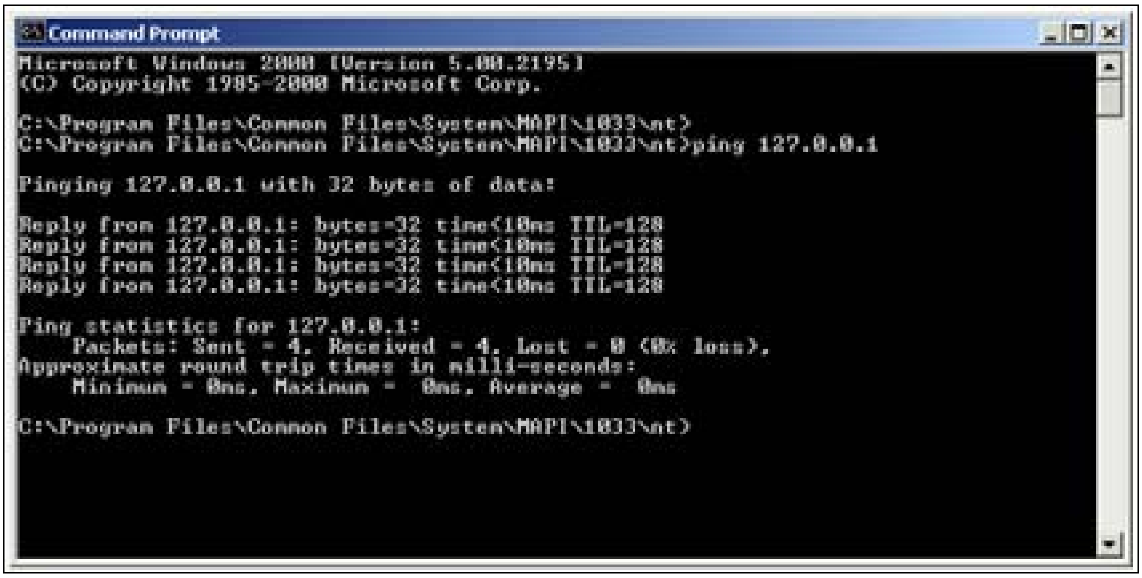


Figure 86 The results of successfully pinging the network card on a PC. Note how four data packets were sent and four were received, indicating a successful test.

- Is the file vxworks located in the directory C:\klein on the acquisition computer? If not, put it in there. Reset the TPU and see if it boots. If it does not then proceed to the next step.
- Check the settings in the FTP server (full details outlined in Chapter#3). The settings which are often entered incorrectly are

    - IP address of TPU (normally 160.64.181.222).
    - IP address of acquisition computer (normally 160.64.181.221).
    - the username and password the TPU will use to log in as.
    - the home directory the TPU will try and download its operating system file (vxworks) from.

- If the settings outlined in Chapter#3 have been entered correctly and the TPU still does not boot then if an Ethernet hub is being used, remove it and replace it with a single cross-over cable between the TPU and acquisition computer. This is because in the past, some Cat5 straight network cables have been broken and this has been discovered by replacing the two being used and a hub with one cross-over cable. If the usage of single cross-over cable enables the TPU to boot, then either

    - the hub is broken (this is very unlikely),
    - the hub does not have power,
    - one or both of the straight network cables is broken (this has happened),
    - the wrong ports on the back of the hub are being used (see section 2.3 for correct usage).

By now the TPU should be receiving its operating system file vxworks. If it is not, then does the TPU still output to com1 the beginning of its boot process (see Figure 45). If it does not then either:

- The TPU does not have power
- The TPU is malfunctioning and may need to be returned to Klein Associates in the USA.

9.3 TPU Error Light

Sometimes, the yellow error light on the demultiplexer board of the TPU will be lit when the TPU is switch on. This does NOT indicate that the TPU has not booted. It indicates that there is an error in the link between the TPU and the sonar. As data cannot be received until this link is restored then efforts will need to be made to locate the problem. The reasons why the error light on the demultiplexer board will light up, in order of likelihood, are the following:

- There is not a closed connection between the tow-cable termination and the TPU (located at the back of the TPU). Remove the tow-cable from the TPU and reattach it more tightly (but hand tight only). Reboot TPU and see whether the error light is still on.

Warning: do not connect or disconnect the tow-cable to or from the TPU while the TPU is on. Serious damage may occur to the sonar system electronics and/or any operators of the sonar may be injured.

- There is not a closed connection at the subconn plug at the sonar. If possible unscrew it, and reattach. Reboot TPU and see whether the error light is still on.
- If the sonar is being towed, so that the winch is being used, then there is a slight possibility that the tow-cable connection in the slip-ring has come apart. This has happened once in the past. Why it occurred is not understood and the possibility of it re-occurring is thought to be very unlikely. It will take several minutes to remove the inner housing of the slip-ring and check the connection.

If the above solutions do not work, then there is a slight possibility that the problem is originating to one of the following, although these are very rare. If any of these are suspected contact Klein Associates Inc. for guidance.

- Broken tow-cable
- Wrong tow-cable
- A too long tow-cable
- Failure of sonar (primarily the multiplexer board).

9.4 TPU Crashes

Sometimes, when data is being collected, for no apparent reason the TPU will crash. The TPU is designed to be a very stable platform on which data is acquired and so it is rare for this to happen, but it has been observed. There will be several clear indications that the TPU has crashed. These are:

- The vme light on the TPU will stop flashing and will stay on continuously.
- The waterfall display in Isis or SonarPro will stop scrolling.
- If Isis is being used then two dialogue boxes may be spawned saying "Failed on SetSys5000 Standby" or "DoPing Event ERROR". Although these error messages are spawned when Isis is running, they are in fact generated by the Klein System 5000 controller software ss.exe, which, as stated in section 5.2.6.2, augments the server KLN5000.exe to route data to Isis from the TPU. The error messages are generated because, as the TPU has crashed then no data is being sent to ss.exe, with the error "Failed on SetSys5000 Standby" preceding the error "DoPing Event Error". Both error messages are symptomatic of the same problem.

The solution is to first get SonarPro or Isis functioning correctly. SonarPro has no quirks which could confuse a new user and is likely just to need shutting down and re-running. Isis however does have a few quirks and the steps which should be taken to get it working again are outlined below:

- Highlight the Klein System 5000 controller dialogue box with the left mouse button and hit the escape key to remove it. Do not use the buttons in the top right hand corner of this window, as they will not work.
- Close the Isis server dialogue window for the Klein 5000 series of sidescan sonars.
- Now close Isis using File|Exit.
- Start up Isis making sure the Klein System 5000 controller dialogue box and the dialogue box for the Isis server have been spawned. Isis should now be functioning correctly.

Now the TPU must be rebooted. Press the RST (reset) button on the bottom board of the TPU and wait for it to boot up. After the TPU has booted successfully (as illustrated in Chapter#6) set up Isis or SonarPro to display data from the sonar (see Chapter#5 for these details).

9.5 Incorrect usage of SonarPro

As outlined in section 5.3.4, to have access to the layback icon  in SonarPro the data format needs to be set to 5kd and not sdf. If sdf is used then the layback icon will be dimmed  and it will not be possible to enter the layback characteristics of a sonar.

This will mean the location of any objects in the waterfall display are likely to be incorrect and unusable.

The data format which SonarPro (as well as Isis) expects to come from the TPU, is set using the variable Set Oldheader in the startup.ini file. This file, the reader may recall, is downloaded using the file transfer protocol (ftp) from the Master computer by the TPU during boot-up. When the variable Set Oldheader is set to zero (0) SonarPro expects the sdf format and when this variable is set to 1 the 5kd format is used.

9.6 Error Messages generated in Isis

9.6.1 Demo Mode

When Isis is executed it interrogates the printer port on the acquisition computer looking for the sentinel or dongle. If, for one of a few reasons, it does not see it then Isis will spawn a message outlining that it is in demonstration mode and that data acquisition is not possible; only data files can be played back. There are several reasons why this message may be spawned. These are:

- The dongle is not in place.
- The connection is faulty or
- Windows NT or Windows 2000 is being used and the appropriate driver has not been installed (see Appendix A for details on how to install the necessary driver).

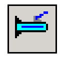
For the first scenario, reboot the computer after attaching the dongle. If Isis is still in demonstration mode then the printer port is likely to be faulty and the dongle may need to be removed and reattached several times. If the Isis ruggedised computer is being used then there is the additional option of internally mounting the sentinel. For the last scenario, follow the steps outlined in Appendix A on how to install the correct driver.

9.6.2 CSC Error

Sometimes when Isis is used to collect data (whether it is just being displayed or displayed and written to disk), an error message is displayed of the form "CSC Error Connecting to sonar source. Is source running? Check configuration (conf.exe) for correct configuration and server address. Note, only a single master is allowed." Although the causes of this error are described, each statement will be described below and the necessary remedial action also outlined.

- Has the TPU booted successfully and is the connection between the TPU and sonar closed? See section 9.2 and 9.3 above for the evidence and any action that is needed.
- All the other causes of this error are related to the System 5000 Configuration dialogue box (see Figure 75). Bring up this dialogue box by double-clicking on

the Klein software conf.exe. In this window, check the following and implement the recommendations:

- o The System 5000 Network Address is the IP address of the TPU and unless this has been changed it should be 160.64.181.222. If it is not this then change it. Click on the Save and Exit button and try collecting data again from the TPU.
- o If the same error is still being spawned and if there are more than one acquisition computer then make sure there is only one Master. This is the computer that will have control over such attributes as slant range, pulse length, pulse shape, resolution and sound speed used. For those computers using Isis, check the Master or Slave set up using the conf.exe program, and if SonarPro is being used then click on the towfish icon  and in the TPU Connection dialogue box (see Figure 66a) choose whether or not the PC connecting to the TPU will be the master or will connect to the TPU as a slave. If any of the acquisition computers were set up incorrectly (for example if there was more than one Master, or if all were Slaves) then make the necessary alterations and try again to acquire sonar data. If the same error message is generated then seek guidance from Klein Associates Inc.

9.7 Serial Port Lock-up on Laptops

If the Windows 2000 operating system has been installed on a laptop that a serial cable is connected to, when it is booting, and data is being transmitted down the cable, then the operating system will believe a serial mouse has been connected to the laptop. Because of this, the operating system will install the necessary drivers and will most importantly lock the serial port, not enabling any data to be received over it. This creates the problem that it will appear in Isis or SonarPro that the instrument connected to the laptop, most likely the KVH Gyro, is not working, when in fact it is, but it is really that laptop that is at fault.

If a laptop running Windows 2000 is booted up and it is suspected that the serial port has locked up as a result of data being transmitted down it, then several actions can be taken.

These are:

- First make sure data is streaming down the serial cable using a serial cable tester. Several RS232 Mini Testers (see Figure 87) from Jaycar (http://www.jaycar.com.au) were purchased in August 2002 at DSTO, Sydney and should be able to show whether data is streaming down on the serial cable.

Figure 87 The RS232 Mini Tester from Jaycar.

- If data is coming down the cable then set up a HyperTerminal session (see Chapter#4 for details) to establish that no data is being transmitted through the serial port in question. If this is correct then the port is locked.
- Remove the serial cable from the laptop's serial port and reboot the laptop.
- Only after the laptop has booted, insert the serial cable with the data streaming down it.
- To check that the serial port is working, set up another HyperTerminal session and make sure data can be seen coming into the laptop. If data does appear then the port was locked and is now ready for collecting data.

These details will enable the serial port to be used after several minutes of testing, but if a more permanent solution is desirable then, other than remembering when this problem occurs, this can be achieved by wiring the serial cable so that it does not "look" like a serial mouse. This modification must be done at the computer (or Data Terminal Equipment [DCE]) end of the serial cable by making the following alterations:

If a DB-25 (25 pin) Female plug is being used then solder a link between these pins.
pins 4 - 5
pins 6 - 8 - 20

If a DB-9 (9 pin) Female plug is being used then solder a link between these pins.
pins 7 - 8
pins 1 - 4 - 6

After jumpering the serial cable then either the laptop can be rebooted or the serial port can be unlocked by removing the extra "Pointing Device" using the device manager in the Control Panel (Triton Elics International CD, Winter 02).

9.8 IP Address Conflict

On the rare occasions that there is more than one acquisition computer, it is quite likely then when any of the slaves are connected to the network via the Ethernet hub, an error is generated that there is an IP conflict. The reason for this is that the IP address of the slave is the same as that of the TPU or any of the other computers and this is likely to occur as the slave in question is likely to have been a master at some stage and as such it would have been given the same IP address as the master that is currently in use.

To set up the slave computer so it does not have an IP address that is conflicting with those of the other computers, follow the directions below for the respective operating system:

9.8.1 Windows 95

Go to the Control Panel | Network and in the network window select the "Configuration" tab. Select the TCP/IP (Transmission Control Protocol/Internet Protocol) link from the network components list and then click the "Properties" button below this list. Select the "IP address" tab and "Let me specify an IP address" should be checked. Enter in an IP address that has not been used for all the other computers and the TPU and use a subnet mask of **255.255.255.0**. Click on OK and the IP address and subnet mask of the computer should be set.

9.8.2 Windows 2000

Go to the Control Panel|Network and Dial-up Connection and right click on Local Area Connection. Click on properties and the Local Area Connection Properties window will be spawned (see Figure 31). In the Local Area Connection Properties window select TCP/IP (Transmission Control Protocol/Internet Protocol) and click on Properties. Then the "Internet Protocol (TCP/IP) Properties" window is displayed. Click on "Use the following IP address" and enter in an IP address that has not already been used with a subnet mask of 255.255.255.0. Leave the Default gateway window empty. Figure 32 shows the Internet Protocol (TCP/IP) Property window with these necessary settings. Click on OK and the IP address and subnet mask of the computer will be set.

9.9 Waterfall Display Errors/Quirks

9.9.1 Symmetrical Waterfall Display in Isis

When the Klein 5500 was returned to DSTO in 2001, after undergoing a major overhaul, the waterfall display in Isis was symmetrical about the sonar track axis. This problem was simply caused by the variable "set OLDHEADER" in the startup.ini file being set to 0 (zero) and causing the TPU to generate the wrong data format sdf instead of this variable being set to 1 and causing the TPU to generate the 5kd format.

9.9.2 Jerky Waterfall Scroll Speed

On some occasions using Isis and SonarPro, the waterfall display has been scrolling somewhat sporadically and unevenly. The reason for this characteristic is outlined below for these two software packages:

Isis

- If the ship is moored, then the likely cause is that the speed of the waterfall display is being compensated for ship speed, and as the ship is rolling around sporadically then the ship speed from changes in GPS position are alternating between zero and 0.1 knots. There is no need to be concerned, as this problem would be rectified once the ship leaves the wharf, but if an operator would like to remove this problem then right-click on the waterfall display and deselect the speed correction radio button.

SonarPro

- In the early days of using SonarPro the waterfall display scrolled slowly and unevenly. Consultation with Klein Associates revealed that SonarPro was designed to be used with a 100 Mbits/second Ethernet Hub. The problem was generated because a cross-over network cable was being used between the TPU and the acquisition computer, with no hub, and data was being sent to SonarPro in a slightly uneven rate. The remedy was to use a hub. This problem is reported by the screen error:
  Version 5.0 - SonarPro® Sonar Processing System
  Date: 09/10/2001 Time: 16:47:39
  TPU reports requested data page is no longer available. Resetting requested data page.

9.9.3 Echosounder Interference

In 2001, Dr Phil Chapple, Task Manager for the Shallow Water Environment, visited Klein Associates Inc. in New Hampshire requesting feedback on some peculiar waterfall characteristics of the Klein 5500. At the time Klein requested that some data be collected that ensonified different bottom types and to send the data to them. They would then use the data to evaluate the performance of the Klein 5500 and provide advice on how it could be improved.

During the data collection across-track striping was observed in some of the waterfall plots (see Figure 88). Such striping is not a new feature in the sidescan sonar community and it was suggested by Klein Associates that it was caused by the echosounder on the boat. If high quality data needs to be collected then one solution would be to turn off the echosounder and make sure that is the problem. If it is and the echosounder is needed then the distance between the sonar and the echosounder could be increased.

Figure 88 Waterfall display of the Klein 5500 showing streaking.

10 Conclusion

This document begins by explaining how sidescan sonars operate and goes on to explain how to correctly set up the Klein 5500 sidescan sonar. In particular, this report begins with some basic underwater acoustic information that an operator of a sidescan sonar may find helpful. It then outlines how sidescan sonars operate and what type of information about the seafloor and water column they can provide. It outlines what the physical limitations are in their usage and how the backscatter results can be used to infer sediment types. This report then outlines how to correctly set up a computer so it can acquire backscatter data from the Klein 5500 sidescan sonar, how to set up the sonar either in a towed configuration or bow-mounted configuration, and how to use the acquisition software Isis and SonarPro. Lastly, but by no means least, common mistakes that can be made when setting up the acquisition computer are explained together with problems that can occur with the TPU. Error messages that have been observed with the acquisition software packages Isis and SonarPro are also highlighted and advice given on how to circumvent them.

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Appendix A: Installing software

In this report numerous software packages have been cited and summarised in relation to collecting sidescan sonar data from the Klein 5500. There was the graphics video display software Hawkeye, the FTP servers, Serv-U and Windows 2000, and the acquisition packages Isis and SonarPro.

This appendix will either describe the installation procedure for these packages or if no installation is required, where the application can be located. Winzip is a software package instrumental in installing the above software packages. As it is easy to install however then its installation procedure will not be outlined.

Warning: prior to making any alterations to a computer, such as installing or upgrading software packages, it is advisable to make a complete backup of the directories that will be altered.

Section 1 Hawkeye

As outlined in section 3.6.2, the Imagine 128 Graphics video card present in the Isis ruggedised PC can be used in conjunction with the Hawkeye support software package. This graphics card software enhancement works with the operating systems Windows 95/98/NT but not with Windows 2000.

Before installing the Number Nine drivers, close all open application programs and disable any anti-virus software that is running until the Hawkeye for Windows 95 installation is complete. To install Hawkeye follow the instructions below.

1. Go to the Number Nine web page http://www.nine.com (see Figure 89 for an example of the layout).
2. Click on Drivers.
3. Click on Image 128 directory.
4. To determine the role played by the setup files in this directory, read the file index.txt.
5. To install Hawkeye in Windows 95/98, Windows NT 3.51 or Windows NT 4.0 download the files 128w9213.exe, 128n3115.exe or nt410103.exe, respectively. NOTE: Do not store these files in a directory called C:\number9 as it will create a conflict with the configuration file of the same name. These files are self-extracting compressed files, containing the setup file, initialisation files, dynamic link libraries and any other support files.
6. When the setup file has been extracted, double click on its icon  and the Hawkeye software will be installed.

7. If installing Hawkeye on Windows 95/98, then when prompted restart the computer so the installation can be completed. Evidence that the installation was successful is that the number 9 icon  should appear in the bottom right-hand toolbar.

8. Any queries regarding the Hawkeye software can be directed to the Forum site at Number Nine web site (see Figure 89).

Figure 89 The Number Nine web page, with the Drivers and Forum icons highlighted by yellow ellipses.

Section 2 ServU

Serv_U (http://www.serv-u.com/) was written by Rob Beckers, the founder of Cat-Soft (http://www.cat-soft.com), and was originally named FTP Serv-U. In May, 2001, the internet software company, Rhinosoft (http://www.rhinosoft), entered into a partnership with Cat_Soft assuming all sales and technical support for past and current customers. A site licence of 20 users was purchased by MOD, DSTO for Serv-U by Stephen Pascoe several years ago although responsibilities and further administration of the licence was transferred to John Shaw. As DSTO was one of Rob Becker's early customers, it receives lifetime updates free of charge.

Serv-U has been written in both 16 bit and 32 bit versions, for the operating systems, Windows 95 / 98 / 98SE / Me, Windows NT Server/Workstation 4.0, Windows 2000 (Advanced) Server, Windows 2000 Professional, Windows XP Home / Professional.

Serv-U comes in three levels, Personal, Standard and Professional. DSTO has a licence to the last and most functional level, Serv-U Professional.

To install Serv-U, follow the procedure below:

- first make sure administrator rights have been activated if the installation is to made on the operating systems Win NT/2000.
- Download the latest installation file (susetup.exe) of Serv-U from (http://www.serv-u.com/) using any one of the four download sites available. The file susetup.exe is a self-extracted Winzip compressed file.
- Once the download is complete, double-click on this executable () and the installation will begin. As an installation of Serv-U will write over an old version then the first dialogue box that is spawned will state: “IMPORTANT: If you have an older version of Serv-U installed and did not do so already: Exit this installation now and make a backup of your Serv-U directory”.
- Click on the Next button and after accepting the licence agreement select the directory in which the new version of Serv-U will be placed.
- Once the installation directory has been chosen, click on the Next button. Then a box will appear outlining the options that can be installed. Check the options needed and click on the Next button.
- Then enter the name of the Program Manager group which the Serv-U icons will be added to. If a new program manager group is wanted with the Serv-U name then leave the default name of Serv-U FTP Server. Click on the Next button and Serv-U is ready to be installed.

Warning once the following Next button is clicked the installation will begin and should be allowed to progress to completion.

- Click on the Next button and install Serv-U. During the installation process a progress bar will appear and once the installation is completed a final window is spawned asking if the installer wishes to find out about any of the other products Rhinosoft produces. Click on the Close button in this window.
- Then a window will be spawned stating that if the current installation is a new installation of Serv-U then a setup Wizard will begin when the Administrator program is started for the first time. Rhinosoft highly recommends that this Wizard is used for the initial set up as changes can always be made later. If the installation is an upgrade from an earlier version then the setup wizard will not be spawned. Click on the Next button and follow the setup procedures outlined in section 3.3 for the FTP server.
- The last step is to enter the registration key. This is one line of ASCII characters and needs to be acquired from Rhinosoft. An example of a registration key for Serv-U is outlined below. If one of the twenty user licences of Serv-U needs to be installed by someone from DSTO, Mr Les Hamilton can be contacted for the correct key. As it is easy to lose the key then it is recommended to save it to a

file, for example named key.txt, and placed in the Serv-U directory. If the registration key is not entered the Professional version of Serv-U just installed will automatically revert to the Personal edition after the 30-day evaluation period.

REGISTRATION ID
Name:XXXXXXXXXXXXX
E-Mail Address:XXXXXXXXXXX
Registration ID:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXX

To enter the registration key, first highlight the registration ID string and use the right mouse button to copy it to the clipboard. In the setup wizard, click on the key icon (), or click on the Licence drop down menu, and click on Enter Key. If the current installation is an upgrade and the setup wizard has not been spawned, then spawn Serv-U's main window by clicking on the Serv-U icon () in the bottom right-hand corner of the screen and follow one of the approaches just listed. Then paste the key into the registration window and click on the OK button. Figure 90 shows these details.

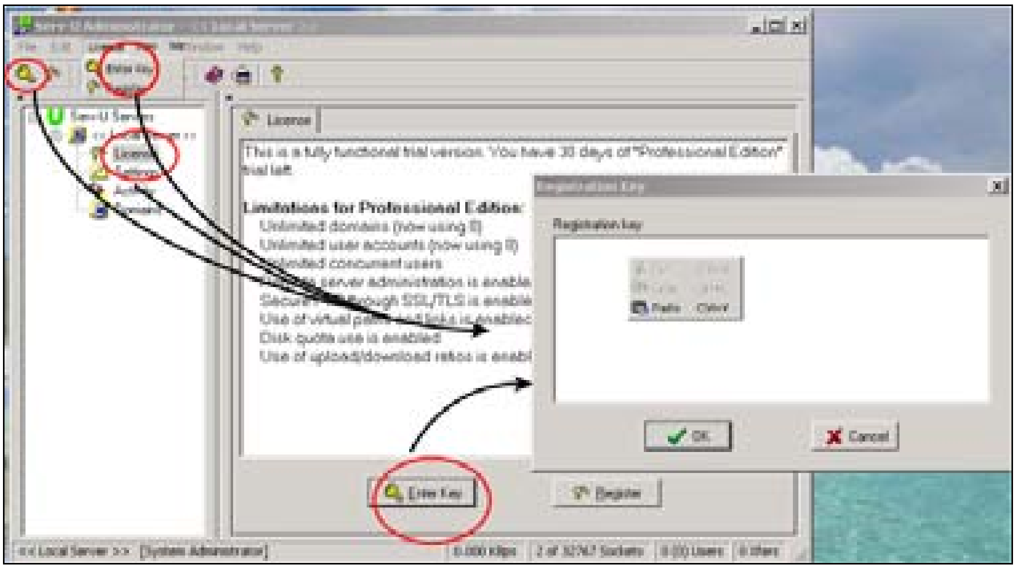

Figure 90 The different ways in which the registration key can be entered into the Serv-U setup Wizard.

- When the registration key has been accepted a Professional Serv-U should be installed correctly and ready for use.

Support for Serv-U should be directed to the Serv-U support team using the email address support@serv-u.com. Any sales queries directed to sales@serv-u.com.

Section 3 Windows 2000 FTP Server

To install the Windows 2000 FTP Server there is a need to log on either as the administrator or as a user that has been granted Administrator privileges. Then put in the Windows 2000 CD and after it has auto-booted, click on "Install Add-On Components". Then check "Internet Information Services (IIS)" and click on the Details button. The Details button provides control over which subcomponents of the Internet Information Services (IIS) are installed. The subcomponents that are needed if the FTP server is to be installed correctly are the Common Files, File Transfer Protocol (FTP) Server, and Internet Information Services (II) Snapin. When a subcomponent is deactivated, the windows component that subcomponent is needed for is displayed. This makes it difficult to accidentally deactivate a critical subcomponent.

Once the three components are checked, the FTP server will be installed when OK is clicked in the subcomponents window, and also in the components window. Figure 91 outlines the windows that are spawned in installing the FTP server is installed and the subcomponents that need to be checked. To enquire as to whether the FTP server has been successfully installed, there should be a "Default FTP Site" under Internet Information Service, in the Computer Management window of the control panel (see Figure 92). Windows 2000 does not need to be rebooted immediately after the installation for administration to be performed on the server.

On some occasions when the Windows 2000 FTP server has been installed an error message has been spawned outlining that some files could not be found. This occurs because some files that are needed could not to be loaded from the CD as the CD has been given a wrong drive letter. When this error appears, click on the Browse button and choose the correct drive letter for the CD containing the Windows 2000 CD.

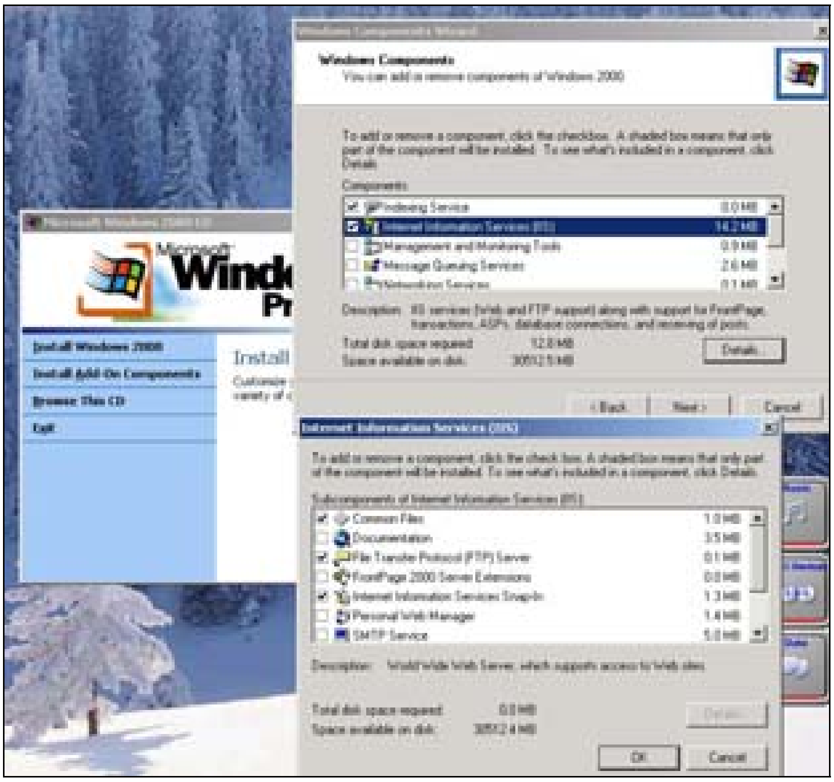

Figure 91 The windows that are spawned and the options that need to be chosen to install the Windows 2000 FTP server.

Figure 92 A picture showing the hierarchical location of a "Default FTP Site" in the Internet Information Service folder of the Computer Management window of the control panel.

Section 4 Isis

The Environmental Assessment Group of DSTO has a maintenance contract with the compilers of Isis, namely Triton Elics International (TEI), which gets renewed yearly. This contract is designed to provide support for the Isis ruggedised computer (such as helping with hardware and operating system upgrades). In the past this support has been via emails as well as some on-site support. The maintenance contract also involves supplying the latest versions of Isis, Delph Map (with real time mosaicking), and SeaClass Bottom Characterization and providing support for these products. As only Isis was summarised in this report then only the installation procedure for this product will be described below.

Two options are available to install Isis on the acquisition computer. Either the executable Isis.exe can be obtained from another computer and copied onto the one in question, or the latest version of Isis can be installed using the TEI seafloor imaging CD. If the latter option is selected then the procedure that needs to be followed is:

- If using Windows NT or Windows 2000 operating system then make sure the installer has administrator rights.
- Insert the TEI installation disk.
- Exit all other applications before beginning the installation program.
- Either go to the directory C:\TEI software\Isis 5.50\ and double click on setup.exe or, click on Start|Run and in the dialogue box that is spawned type in X:\setup, where X is the drive letter for the CD-rom, and click on OK.
- The Install shield should be spawned and the installation of Isis will begin after the OK button is clicked on. During the installation process the installation software will ask which hard disk (or partition) Isis should be installed on. TEI recommends that two partitions be used, one for any TEI software and another partition to save data to.
- The first time Isis is installed on a machine that is running Windows NT 4.0, the computer will need to be rebooted during the installation. When the installation finishes the computer must be rebooted if Windows NT 4.0 or Windows 95/98 is being used. This reboot is so the alterations Isis has made to the PATH environment variable are applied.
- When the installation is complete there will be an Isis icon on the desktop and there will be a TEI folder in the programs tab on the Start menu.

It should now be possible to spawn Isis by either using the icon on the desktop or by clicking Start|Programs|TEI|Isis. When Isis is spawned if an error message is displayed stating Isis is in demo mode and that Isis can only play back data or demonstration files, then this is caused by Isis not detecting the sentinel (see section 9.6.1 for full details). One reason how this could occur is because unlike Windows 95 and Windows 98, under Windows NT and Windows 2000 the Isis dongle requires specific drivers before Isis will recognise it. The driver is

RainbowSSD5.39.2.exe, which can be located at (X:\Drivers and Third Party Applications\Sentinel Driver\, where X is the drive name of the CD) on the Isis® Installation CD. Install the driver and Isis should work correctly.

Section 5 SonarPro

SonarPro is quite easy to install. Unlike Isis, SonarPro does not require any sentinels and up to the time when this report was written, it was being obtained free of charge by the Environmental Assessment Group at DSTO from Klein Associates. SonarPro does have the disadvantage, albeit small, that it was designed to be executed on the 32 bit operating systems Windows NT and Windows 2000. SonarPro was not designed to be executed on the 16 bit operating systems Windows 95/98 and Klein Associates make no guarantees of the stability of SonarPro on these operating systems and will not provide support if this action is taken.

To download the latest version of SonarPro, go to (http://www.kleinsonar.com/tech/download.html) and scroll down to the SonarPro section. Click on the "Get" button next to the compressed version required and download the file. Before uncompressing this file, rename the klein folder to, for example, klein_old, make a new folder named klein and then use the Winzip utility to extract all the files in the compressed file into the folder klein. This way, there is still a working version of SonarPro if the new version cannot be extracted correctly. When the compressed file is uncompressed there should several dynamic link libraries and the SonarPro executable (sonarpro.exe) in the klein folder. If it is desirable to have SonarPro on more than one machine then the executable SonarPro.exe can be copied to any number of machines. SonarPro should now be usable by double-clicking on this executable file.

Early installation versions of SonarPro, namely 5.0 and 5.3, were accompanied by a setup program for the application SnagIt (see Figure 93). SnagIt is a powerful utility that can capture either the whole or part of the screen or an active window and send either the image or the text to a printer, a file, an email, a rendering package, a catalogue, the clipboard or an FTP server (for web page creation). SnagIt can be called from within SonarPro, however, later installations of SonarPro do not have Snagit encompassed with them. If it is only screen captures that are needed then Snagit may not be warranted, as this can be achieved using the print screen key on the keyboard in conjunction with any graphics package. If it is felt that SnagIt is worthy of use then if it can not be found in the SonarPro compressed installation file then it can be downloaded from (http://www.techsmith.com/products/snagit/default.asp) or requested from Klein Associates.

Figure 93 The main window of the screen capture utility SnagIt.

Appendix B: TPU Bootup Files

The TPU has been set up so that when it is switched on or rebooted it requests two files from the host computer. These two files are called vxworks and startup.ini. The first of these files is the operating system for the TPU. It is a binary file and is essential if the TPU is to boot successfully. Normally an operator does not need to know the contents or structure of this file. The second file, startup.ini, is an ASCII file and is used to alter the default settings of the TPU's operating system.

This appendix will outline the role played by each variable in the startup.ini file, the values available, the default values and the values used at DSTO for the Klein 5500 sidescan sonar. The information below has been extracted from the *Technical Memorandum***Titled:** Klein System 5000 Software Version 3.0 Release Notes.

The contents of the file startup.ini are as follows, followed by an explanation of the role played by each variable.

```
set SONARTYPE 5000
set BATHY 0
set OLDHEADERTYPE 0
set OLDMUX 0
set RESMODE 0
set BAUDRATE 4800

set STANDBYMODE 0
set DESPECKLESWITCH 0
set SPEEDFILTERSWITCH 1
set TVGPAGE 7

set RANGE 2
set TXWAVEFORM 0
set RESPDIV 15
set RESPFREQ 7

set DVLDELAYDELTA 31
set HEARTBEAT 0
set PINGSPERFILE 5000
set SPEEDSOUND 150000

set DIAGLEVEL 0
```

- SONARTYPE {d=2000, 3000, 5000} This sets the type of Klein sidescan sonar that is going to be used. At DSTO this is often set to 5000, although the 2000 has been used in the past and the successor to the 5000 is likely to be the new 3000.

- RANGE {d = 0,1,2,3}. This sets the slant range with the values of d=0,1,2,3 corresponding to 50m, 75m, 100m and 150m, respectively. The default value for the TPU is 100m although at DSTO the value used is 75m.

- TXWAVEFORM {d = 0,1,2}. This sets the pulse length (or sometimes called pulse width) of the chirp the sonar is generating. The values corresponding to d =0, 1, 2 are 50μsec, 100μsec and 200μsec, respectively. The default value is 50μsec and this is the value used at DSTO.

- RESPDIV {d = 0 - 15}. This variable sets the responder output rate to a fraction of that of the sonar. The value is calculated using the formula 2^d, where d is an integer between 0 and 15. The default value is 15, which turns off the responder. At DSTO a responder is not used to locate the position of the sonar and so the value used is 15.

- RESPFREQ {d = 0 - 15}. This sets the responder frequency using the formula 24 kHz + d * 500 Hz, where d is an integer between 0 and 15. The default value is 7 (or 27.5 kHz). As no responder is used at DSTO then this variable can take any value. The value used at DSTO is 7 (or 27.5kHz).

- DESPECKLESWITCH {d = 0,1,2,3} This sets the despeckle mode, where the values of d = 0, 1, 2, 3 corresponding to off, low, medium and high. Default is off and this is the value used at DSTO.

- SPEEDFILTERSWITCH {d = 0,1} This turns the velocity filter on the waterfall display on or off, with the values of d = 0, 1 corresponding to off and on, respectively. The default value is on and this is the value used at DSTO.

- TVGPAGE {d = 0 - 15} This sets the TVG. Decreasing d decreases the gain by 3dB and increasing d increases gain by 3dB. A setting of 15 selects a "flat" TVG curve where the gain is constant. The default is 7 and this is the value used at DSTO.

- HEARTBEAT {d = 0 - 256} This sets the heartbeat message divisor. Heartbeat messages are output once every 'd' pings where d is a value from 0 to 256. Note that a value of 0 shuts off messages and this is the default value and the value used at DSTO.

- SPEEDSOUND {d = 140000 – 150000} This sets the speed of sound in the water in units of cm/s. The default is 150000 cm/s and this is the value used at DSTO. The accepted range is from 140000 to 160000 cm/s.

- RESMODE {d = 0,1} Set resolution mode where d = 0 is normal and d = 1 is high resolution. Note ranges of 100m and 150m are not available in high-resolution mode. Default is normal.

- BAUDRATE {d = 300, 600, 1200, 2400, 4800, 9600, 19200, 38400} This sets the baud rate in units of bits/sec for the com 2 port on the TPU. The default is 4800 (the NMEA standard) and this is the value used at DSTO.

- BATHY {d = 0,1} This instructs the TPU to process bathymetry data. The Klein 5500 at DSTO, however, did not have the bathymetry option fitted, and so the value that has been used at DSTO for d is 0.

- OLDHEADERTYPE {d = 0,1} This instructs the TPU how to construct the header information in the data and plays a very important role. The two values of d, namely 0 and 1, correspond to the data formats sdf (sonar data format) and 5kd (5000 data), respectively, if SonarPro is being used or if Isis is being used then d must take the value of 1 and this corresponds to XTF. If d is set to 0 and Isis is being used then the waterfall display may take on a symmetrical appearance, with one of the channels being discarded.

- PINGSPERFILE {d=5000} This instructs the acquisition software to create data files containing 5000 pings.

It should be evident from the above bullet points that many of the default settings for the variables are those that are used at DSTO. This is the reason why it has been remarked on several occasions throughout this document that the downloading of the startup.ini file by the TPU from the host computer is not necessary for the TPU to be used with the Klein 5500.

Appendix C: Klein 5500 Pressure Transducer Calibration

As outlined in section 5.2.6, the dialogue box for the Klein 5000 Isis server, KLN5000.exe, (see Figure 57) has a component labelled "compute depth from voltage". It is in this window that the calibration of the pressure transducer voltage for the Klein 5500 sidescan sonar needs to be entered.

To calibrate the pressure transducer and establish what coefficients need to be entered into this window first remove any old calibration coefficients and set up Isis so it is receiving data from the sonar. Then lower the sonar into the water at 0.5 metre intervals and using Isis either read off the depth displayed in the Telemetry panel of the Parameter display window or use the values recorded in any data files that are generated. Graph the depth from the pressure sensor against actual depth, with the former being the dependent variable or ordinate and the latter being the independent variable or abscissa. As Isis only permits a linear calibration then the scatter between these two values should appear linear. If this is the case, then calculate the least squares linear fit. This could be done easily using a spreadsheet program such as Excel. This linear fit should provide the slope of the line (m) and the ordinate intercept (c) and it is this line that is the new relationship between pressure transducer voltage (V) and the true depth (D), and is given by the following formula:

$$\boxed{V = mD + c} \quad (1)$$

As the aim of this exercise is calibrate the pressure transducer so that the true depth (D) of the sidescan sonar can be calculated using the voltage outputs (V), then equation#1 needs to be rearranged so that D is the subject of the equation and not V. When this is performed equation#1 reads:

$$\boxed{V \times \left(1/m\right) - \left(c/m\right) = D} \quad (2)$$

This is the form that the equation takes in the dialogue window.

The pressure transducer in the Klein 5500 sonar has not been calibrated for several years and on the last occasion the relationship between voltage and depth was determined to be:

$$\boxed{V \times 13.730 - 10.37 = D} \quad (3)$$

Appendix D: Formatting Magneto-Optical Disks

As outlined in section 7.2.1, because the data acquisition rates of sidescan sonar are very high (approximately 200 megabytes in ten minutes) there is a need to be able to transfer large amounts of data from acquisition computers to post-processing computers. At DSTO this has been accomplished using removable hard disks and magneto-optical (M-O) disks.

Before a M-O disk can be used it needs to be low and a high level formatted. M-O disks are supplied with a low level format but not a high level format. The low level format is either 512 bytes/sector or 1024, with the former being normally used with Unix (or equivalent) operating systems and the latter with Microsoft operating systems. Isis can save data to M-O disks of either low level format, however, it expects to "see" the low level format of 512 bytes/sector and this is the low level format recommended by TEI. Isis can only be read M-O disks with a low level format of 1024 bytes/sector at 10% of their normal rates. The low level format of a M-O disk, if it has not been previously altered, can be determined by reading it off the disk's shutter. The capacity of a M-O disk, namely 600 megabytes, 1.2 Gigabytes or 2 Gigabytes, gives no indication of the low level format of the disk. The disks used at DSTO have a capacity of 2 Gigabytes.

The low level format of 1024 bytes per sector can be reduced to 512 bytes/sector by using the utility scsifmt.exe, located in the directory C:\scsi. Like the command used to alter or set an M-O disks high-level format, the command scsifmt.exe needs to be run from within DOS and not from a MS-DOS shell whilst Windows is running. If it is run from within an MS-DOS window an error message will be spawned. The command scsifmt.exe can also be used to test (or verify) that the surface of an M-O disk is free from any bad sectors and if any are found to flag them so they will not be used during data collection. As conducting a low or high level format deletes any data on a disc then important data on the disc needs to be backed up before any formatting is performed. The procedure to back-up an M-O disk is outlined below, followed by the procedure to set the low-level format:

Section 1 Backing-up M-O disks:

- If using Windows 95, use the Start|Shutdown function to "return to DOS". Do not leave Windows 95 running and use a DOS shell window. If using Windows NT restart the PC with a bootable DOS floppy.
- When DOS boots up insert the M-O disk and use the DOS command COPY or XCOPY to copy the important files to the hard disk (C:\ or D:\).

Section 2 Low-level Format

1. Exit windows and return to DOS by clicking Start|Shutdown|Return to DOS.
2. Make sure power is being supplied to the M-O drive and insert the M-O disk.

3. Go to the directory C:\scsi and run the command scsifmt.exe. Do not run this command before the M-O disk has been inserted into the M-O drive.
4. When the first screen is displayed hit the enter key.
5. Use the arrow keys to select the M-O disk drive that needs its low-level format of 1024 bytes/sector reduced to 512 and then press the enter key.
6. Then a screen appears asking if the disk needs to be verified or formatted. Select Format and then press Enter. Confirm that a format is required.

Warning, formatting any computer media will result in any data on the media being deleted. Check any media that is being readied for formatting for important data. If data is present that needs to be backed up, then follow the procedure above.

7. The formatting of a M-O disk may take a while. Once completed, other disks can be formatted by following steps 5 to 6.
8. When the low-level formatting tasks have been completed, the scsifmt utility can be exited by hitting the escape (esc) key.

Whether a M-O disk has a low level format of 512 bytes/sector or 1024, each side of a M-O disk needs one DOS partition before Isis can use it. This is termed the high level format and can be set using the commands AFDISK or FDISK. AFDISK is an Adaptec SCSI disk partitioning and high-level formatting utility and can only be used on SCSI disks and drives that are not controlled by the host adapter BIOS (which is the BIOS on the SCSI PCI card). Those SCSI hard disks and drives that are controlled by the host adapter BIOS need to use the DOS command FDISK. The command used generally at DSTO is AFDISK. The commands AFDISK and FDISK need to be run from within DOS and not from a MS-DOS shell whilst Windows is running. If they are run from within an MS-DOS window an error message will be spawned. The procedure to set the high level format is outlined below. It has been taken from Appendix D of Volume 2 Isis Users manual.

Warning, formatting any computer media will result in any data on the media being deleted. Check any media that is being readied for formatting for important data. If data is present that needs to be backed up, then follow the procedure below:

Section 3 High Level Format

With the important files copied to the hard disk, the M-O disk is ready for high level formatting. The procedure to follow for each operating system is listed below.

Windows 95

1. Insert a startup floppy disk labelled for Windows 95 into a: drive and restart the computer. This will restart the computer in DOS.
2. Wait until the prompt a:> appears.
3. Insert the MO disk into the MO drive on the appropriate side.
4. Type "afdisk" or "fdisk" and hit Enter to start the programs. If DOS cannot locate these programs then they may be located at C:\APSI or C:\SCSI.
5. Use arrow keys to highlight the target as "... Sony SMO-F541+3" or use the SCSI number of 5 and hit enter.

Do not select the SCSI target number of zero (0), as this is the hard disk.

If a SCSI device is selected that is controlled by the host adapter BIOS and afdisk is being used then an error message will be displayed outlining that the utility FDISK should be used instead.

6. If a SCSI device is chosen that is not controlled by the BIOS on the host adaptor (what the utility AFDISK is designed for) then a message will be generated asking “Use Extended BIOS translation for this >1Gb Drive?” Use arrows to select “Yes” and hit enter. When this action is performed one of two scenarios will occur, depending upon whether the disk contains data. These are outlined below:

   Case 1: If the disk has previously been formatted then a warning will be spawned outlining that data will be lost if the reformat is continued. To continue, hit “Esc”. Then another message will be spawned about format types. Hit “Esc” to continue. Then select “Standard Hard Disk Format” by using the arrow keys, and then hit “Enter”. Proceed to step 7.

   Case 2: If the disk is unformatted then a message is displayed stating *“This disk is unformatted. --Press <Esc> to continue—“.*

7. A table is spawned with the headings “Type, Start, End, Megs” across the top (see Table 9). If the disk has never been formatted then this table will be empty. In this case proceed to step 9. If the table is not empty, then the disk has already been formatted, and may contain data.

If the disk contents are unknown do not continue to step 8 as this will delete all data on the disk.

Table 9 The table spawned by AFDISK regarding the high level format of a M-O disk.

Type	Start	End	Megs
DOS	0	138	1090

If the table appears as shown in Table 9 then disk has already been suitably formatted for use with Isis and does not need reformatting. Proceed to step 10 and exit the program. If the table is as shown in Table 9 except that the variable “Megs” reads 1023 then the disk is readable under Windows 95 and NT, but is not formatted to its full capacity. Proceed to step 8 to reformat the disk to its full capacity. If the table contains some other entries then also proceed to step 8.

8. If the table is not empty and all the important data has been backed up (see Backing up M-O above) then first delete all the partitions on the disk. Use the arrow keys to select a partition, and hit “delete”. Then use the arrow keys to highlight the “Yes” button in the message “Delete Partition?” and hit enter.
9. The table should now be empty. Hit “Insert” to create a new partition. This brings up a description of the new partition. Hit “enter”. You will then be asked “Create Partition?” Use the arrow keys to select “Yes” and hit enter. You may get a message “Please wait”, and then a new entry will be created in the table. It should read as described in Table 3.

10. If the other side of the M-O disk needs high level formatting then eject the disk, turn it over and put re-insert it into the M-O drive. Follow the procedures outlined in steps 5 to 9. If other M-O disks need formatting then eject that just formatted and insert those needing formatting. Also, follow steps 5 to 9.
11. If no other disks need high level formatting then exit AFDISK by hitting “Esc” twice. Then use the arrow keys to select “Yes”, you want to exit AFDISK, and hit “Enter”.
12. Now enter “Exit” at the DOS prompt or hit “Ctrl + Alt + Del” to reboot the machine and return to Windows.

Note: If at any stage a message is spawned stating that no context-specific help is available at this time, then this should be ignored and continue by hitting “Esc”. If continuing is not possible then exit AFDISK and try restarting it, making sure the MO being formatted is already in the drive.

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19. ABSTRACT

This document outlines in detail all facets associated with the set up and usage of the Klein 5500 sidescan sonar. In particular this document outlines: (1) the different types of hardware that are required, how they need to be set up and networked, (2) how to set up and use the acquisiton software packages Isis and SonarPro, and (3) how to detect, analyse and trouble-shoot incorrect set up and malfunctions in the hardware and software.