SICS User Manual for Small Angle Scattering. Quokka Edition

DRAFT ANSTO version 0.1

Mark Koennecke

Heinz Heer

Ferdi Francheschini

Nick Hauser

SICS User Manual for Small Angle Scattering. Quokka Edition: DRAFT ANSTO version 0.1

Mark Koennecke
Heinz Heer
Ferdi Francheschini
Nick Hauser

Table of Contents

List of Figures

List of Examples

Part I. INTRODUCTION

Table of Contents

Chapter 1. SICS - The Instrument Control Server

Ferdi Franceschini

Safety

SICS is **NOT** a safety system! It will allow you to do tasks that may damage persons and the instruments.

DO use the **STAR** principle. **STOP. THINK. ACT. REVIEW**

Familiarise yourself the location of the Emergency Stop buttons located near the cabin exit, or in several places within the instrument enclosure.

Familiarise yourself with the instrument and its safe operation.

DO NOT do anything with SICS that may risk damage to persons or the instrument.

DO NOT rely on these commands to stop motors or close shutters. If in any doubt, use the Emergency Stop button.

The commands in this chapter may fail for a variety of reasons.

- SICS has crashed
- Your network connection to the SICS is blocked, due to network congestion or failure
- The motor controller is no longer accepting connections or has a rogue process running

What is SICS

Neutron scattering experiments require control of motors for instrument configuration, control of histogram memory for counting neutrons, and control of sample environment. SICS is a program that accepts human readable commands, and converts these to commands that devices understand. For simplicity, much of the control for an experiment is done in a sequence (synchronously), requiring that an operation completes successfully before the next is commenced. SICS can also be used asynchronously, but more care has to be exercised by the operator to ensure the desire result.

Instrument control is based on a client server architecture, each instrument has a dedicated server, called SICS, which receives commands from client applications and then executes them by issuing control sequences to the hardware. SICS was originally developed at `PSI` to control the SINQ spallation source instruments. Drivers and site specific extensions have been developed at ANSTO to control and provide status information for motors, sample environment and histogrammed neutron event data from the detectors.

Driving a device synchronously is done using the **drive** command. The device could be a motor or sample environment e.g. temperature controller.

Driving a devices asychronously is done using the **run** command.

Stopping the device is done using the **stopexe** command.

Counting of histogrammed neutron events is done using the **histmem** command.

Running scans that are a linear sequence of driving, counting and file saving tasks is done using the **runscan** command.

Creating a new file is done using the **newfile** command, and saving data to the file is done using the **save** command.

Detail for using each of these commands is provided in the next chapter. SICS provides many other functions, but we won't cloud the issue at this stage.

Should I read further?

In general, the Bragg Institute instrument scientists manage SICS for the instrument users. SICS should be running when you come to the instrument, and you should only need to run the Gumtree program. You should read further if you think that SICS is not running and you want to start it, you want to command a device directly with SICS (the first half of this manual), or you would like to change the instrument configuration (the second half).

Where is SICS?

SICS runs on an ICS computer (instrument control server). All ICS computers run the Linux operating system, and have a name that looks like ics1-echidna.nbi.ansto.gov.au. If you have an account on the NBI network, you can use that username and password to login. You must login using **ssh** from a unix computer, or using an ssh client on a Microsoft Windows computer like putty or F-Secure

Starting and stopping SICS using runsics

To control the instrument, the SICS software must be running on the instrument control computer. First, check to see if SICS is already running by calling the **runsics** `status` command as shown below. Note: the "echidna@ics1-echidna:~>" is just the command line prompt.

```
echidna@ics1-echidna:~> runsics status
SICServer running
SICS script validator running
```

This example shows SICS is already running. In this case, you should proceed to login to SICS.

If the reply is

```
echidna@ics1-echidna:~> runsics status
SICServer NOT running
SICS script validator NOT running
```

then use the **runsics** `start` command

```
echidna@ics1-echidna:~> runsics start

Starting SICS
29087
SUCCESS


Starting SICS Script Validator
```

```
29091
SUCCESS
```

Login to SICS

Most users won't want to login to SICS. However, if you do need to get to the SICS command line, then use the **sicsclient** command at the Linux prompt.

```
echidna@ics1-echidna:~> sicsclient
OK
```

Now you'll have to login to SICS with your `role` and `password`. The role is `spy`, `user` or `manager`, and the instrument scientist will provide you with the password.

```
myusername mypassword
Login OK
```

When a correct username and password is entered, SICS announces that the login was successful. SICS commands can now be entered.

Starting SICS from the command line

To start SICS you have to log on to the instrument control computer and then

```
cd /usr/local/sics/server
```

and launch the server in the background with a command similar to the one shown below

```
cd /usr/local/sics/server

nohup ./SICServer xxx_configuration.tcl &
```

where *xxx* is the instrument name.

Note

The *'&'* is important, it runs the server in the background, nohup logs output from SICS to a file called nohup.out and ensures that SICS continues running when you logout.The .tcl file specified on the command line is the configuration file for your instrument, replace the *xxx* with your instrument's ID. The configuration file may source other .tcl files.

SICS Directory Structure

SICS is installed on the /usr/local/sics/ directory of the instrument control computer. It has the following subdirectories

`/server`	This contains the SICServer and the *.tcl configuration files
`/data`	Data files are stored here
`/log`	Server log files are stored here along with the status.tcl file. The status.tcl file preserves variable settings and some parameter values from the last session with the SICServer
`/tmp`	The server keeps temporary files here

SICS Configuration

SICS is configured via *.tcl files which initialise the command objects which clients use to control the hardware. Also, the server's functionality can be extended by defining new commands in the configuration files, we can do this because SICS embeds a `Tcl` interpreter (hence the .tcl extension).

Chapter 2. Control, interrupt and system commands

Mark Koennecke

Introduction

In the previous chapter, you learnt how to start and stop SICS, and how to login. Now you'll learn how to control the instrument.

The first part of this chapter deals with some of the most used commands in SICS. This includes system commands and control commands. This provides you with a soft start.

The second part of the chapter deals with logging activity and configuring your connection to SICS.

The next chapter will go more deeply into the how SICS executes those commands, through a sequence of states. You may want to skip the next chapter if you don't require a deeper understanding of SICS.

This chapter and the next are from the master user manual for SICS. It gives an overview over all commands implemented, independent of a specific instrument. This is to be used as the source for more instrument specific user manuals and gives an overview of the commands available within SICS. Please note, that many instruments have special commands realized as scripts in the SICS built in scripting language. Only the most common of such commands are listed here.

System Commands and Concepts

Authorisation

A client server system is potentially open to unauthorised hackers who might mess up the instrument and your valuable measurements. A known problem in instrument control is that less knowledgeable user accidentally change instrument parameters which ought to be left fixed. In order to solve these two problems SICS supports authorisation on a very fine level. As a user you have to specify a username and password in order to able to access SICS. Some clients already do this for you automatically. SICS support four levels of access to an instrument:

Roles

Spy	may look at everything, request any value, but may not actually change anything. No damage potential here.
User	is privileged to perform a certain amount of operations necessary to run the instrument.
Manager	has the permission to mess with almost everything. A very dangerous person.
Internal	is not accessible to the outside world and is used to circumvent protection for internal uses. However some parameters are considered to be so critical that they cannot be changed during the runtime of the SICS-server, not even by Managers.

All this is stated here in order to explain the common error message: You are not authorised to do that and that or something along these lines.

General Structure

SICS is a client server system. The application the user sees is usually some form of client. A client has two tasks: the first is to collect user input and send it to the SICS server which then executes the

command. The clients second task is to listen to the server messages and display them in a readable format. This approach has two advantages: clients can reside on machines across the whole network thus enabling remote control from everywhere in the world. The second advantage is that new clients (such as graphical user interface clients) can be written in any feasible language without changes to the server.

SICS Command Syntax

SICS is an object oriented system. This is reflected in the command syntax. SICS objects can be devices such as motors, single counters, histogram memories or other hardware variables such as wavelength or Title and measurement procedures. Communication with these objects happens by sending messages to the target object. This is very simply done by typing something like: object message par1 par2 .. parn. For example, if we have a motor called A1:

```
A1 list
```

will print a parameter listing for the motor A1. In this example no parameters were needed. There exist a number of one-word commands as well. For compatibility reasons some commands have a form which resembles a function call such as:

```
drive a1 26.54
```

This will drive motor a1 to 26.54. All commands are ASCII-strings and usually in english. SICS is in general CASE INSENSITIVE. However, this does not hold for parameters you have to specify. On a unix system for instance file names are case sensitive and that had to be preserved. Commands defined in the scripting language are lower case by convention.

Most SICS objects also hold the parameters required for their proper operation. The general syntax for handling such parameters is:

```
objectname parametername
```

prints the current value of the parameter

```
objectname parametername newvalue
```

sets the parameter value to newvalue if you are properly authorized.

SICS Variables

Most of the parameters SICS uses are hidden in the objects to which they belong. But some are separate objects of their own right and are accessible at top level. For instance things like Title or wavelength. They share a common syntax for changing and requesting their values. This is very simple: The command objectname will return the value, the command objectname newvalue will change the variable. But only if the authorisation codes match.

Commonly Used SICS Commands

The most used commands in SICS are:

sicslist interface drivable prints a list of all drivable objects. This is more than motors and includes virtual motors, sample environment devices and wavelength

run *device value* **run** a *device* to a *value*

runs any object listed using **dir inter driv** in non-blocking/ asynchronous mode

drive *device value* **drive** a *device* to a *value*

drives any object listed using **dir inter driv** in blocking/ synchronous mode

stopexe *device* interrupts a **drive** or **run** command. In the case of motors, the motor will decelerate. It won't stop immediately, as this can cause damage to the instrument

Warning

This will not interrupt a scan e.g. **runscan**.

SICS will continue to accept commands from a client

stopexe all interrupts all devices. In the case of motors, the motor will decelerate. It won't stop immediately, as this can cause damage to the instrument

Warning

This will not interrupt a scan e.g. **runscan**.

SICS will continue to accept commands from a client

runscan *scanvar start stop numpoints mode preset [force datatype savetype]*

Arguments must be in the order described. See more detail in the "Simple Scans" chapter.

scanvar a drivable device, ie a motor or temperature controller etc

start the start position for the scan variable

stop the stop position for the scan variable

numpoints the number of scan points (the start and stop positions will be included in the scan)

mode Allowed *mode* one of:

time

unlimited

period

count

frame

MONITOR_n (where n=1,2,3 ...)

If you set the mode to MONITOR_1 then the histogram server will stop when MONITOR_1 reaches the preset number of counts which has been set with the following *preset* parameter

preset the acquisition duration at each scan point, this is in second if the mode is time, or counts if the mode is count or MONITOR_n

INT1712 3 interrupts a **runscan** command. In the case of motors, the motor will decelerate. It won't stop immediately, as this can cause damage to the instrument

SICS System Commands

sics_exitus A single word commands which shuts the server down. Only managers may use this command.

wait time waits time seconds before the next command is executed. This does not stop other clients from issuing commands.

resetserver resets the server after an interrupt.

sicslist Prints a list of all SICS objects.

sicslist server Prints a list of all server options.

sicslist *sicsobject* Prints all the metadata associated with the SICS object *sicsobject*.

sicslist *sicsobject key* Prints the value of the *key* associated with the SICS object *sicsobject*.

sicslist setatt *sicsobject key value* Sets a user defined attribute with the name *key* and the value *value* for the SICS object *sicsobject*.

sicslist *metadatakey* List all unique entries for the specified metadata key.

System supplied metadata keys are:

`type` The object class

`interface` The object interfaces implemented by SICS

e.g. **sicslist type** will print all the objects classes available in the SICS server

This list may be augmented with user generated keys as defined through using the **sicslist setatt obj key value** command

sicslist *metadatakey value* List all the SICS objects which match the value for the *metadatakey* given as parameters.

e.g. **sicslist interface drivable** will print all objects implementing the drivable interface in the SICS server.

sicslist objstatus *obj* Will query the current state of the SICS object *obj*. This makes sense for things like motors, counter etc. which can be run asynchronously. The result can be:

`idle, fault, busy` etc.

sicslist match *mask*

Will print the names of all SICS objects where the name matches the wildcard given as *mask*

status

A single word command which makes SICS print its current status.

Possible return values can be:

`Eager to execute commands`

`Scanning`

`Counting`

`Running`

`Halted`

Note that if a command is executing which takes some time to complete the server will return an `ERROR: Busy` message when further commands are issued.

status interest

initiates automatic printing of any status change in the server. This command is primarily of interest for status display client implementors.

backup

saves the current values of SICS variables and selected motor and device parameters to the disk file specified as parameter. If no file parameter is given the data is written to the system default status backup file. The format of the file is a list of SICS commands to set all these parameters again. The file is written on the instrument computer relative to the path of the SICS server. This is usually /home/INSTRUMENT/bin.

backup motsave

toggles a #ag which controls saving of motor positions. If this #ag is set, commands for driving motors to the current positions are included in the backup file. This is useful for instruments with slipping motors.

restore

reads a file produced by the backup command described above and restores SICS to the state it was in when the status was saved with backup. If no file argument is given the system default file gets read.

restore listerr

prints the list of lines which caused errors during the last restore.

killfile

decrements the data number used for SICS file writing and thus consequently overwrites the last datafile. This is useful when useless data files have been created during tests. As this is critical command in normal user operations, this command requires managers privilege.

sicsidle

prints the number of seconds since the last invocation of a counting or driving operation. Used in scripts.

Deprecated commands

dir

DEPRECATED: use sicslist a command which lists objects available in the SICS system. Without any options prints a list of all objects. The list can be restricted with:

dir var	**DEPRECATED: use sicslist**prints all SICS primitive variables
dir mot	**DEPRECATED: use sicslist**prints a list of all motors
dir inter driv	**DEPRECATED: use sicslist**prints a list of all drivable objects. This is more than motors and includes virtual motors such as environment devices and wavelength as well.
dir inter count	**DEPRECATED: use sicslist**Shows everything which can be counted upon.
dir inter env	**DEPRECATED: use sicslist**Shows all currently configured environment devices.
dir match *wildcard*	**DEPRECATED: use sicslist**lists all objects which match the wildcard string given in wildcard - **doesn't work**

Logging your activity

SICS offers not less then three different ways of logging your commands and the SICS server's responses

- You may create a similar per client log file on the computer running the SICS server through the **logbook** command.
- Then there is a way to log all activity registered from users with either user or manager privilege into a file. This means all commands which affect the experiment regardless from which client they have been issued. This is accomplished with the **commandlog** command.
- the **GetLog** command receives messages from all active clients. This allows you to view all events on your connection, and is intended for debugging.

LogBook command

Some users like to have all the input typed to SICS and responses collected in a file for further review. This is implemented via the **LogBook** command. **LogBook** is actually a wrapper around the config file command. **LogBook** understands the following syntax:

LogBook	alone prints the name of the current logfile and the status of event logging.
LogBook file *filename*	sets the filename to which output will be printed. Please note that this new filename will only be in effect after restarting logging.
LogBook on	This command turns logging on. All commands and all answers will be written to the file defined with the command described above. Please note, that this command will overwrite an existing file with the same name.
LogBook off	This command closes the logfile and ends logging.

The Commandlog

The Commandlog is a file where all communication with clients having user or manager privilege is logged. This log allows to retrace each step of an experiment. This log is normally configured in the startup file or can be configured by the instrument manager. There exists a special command, **Commandlog**, which allows to control this log file.

Commandlog new *filename* — starts a new commandlog writing to *filename*. Any prior files will be closed. The log file can be found in the directory specified by the ServerOption LogFileDir. Usually this is the log directory.

Commandlog — displays the status of the commandlog.

Commandlog close — closes the commandlog file.

Commandlog auto — Switches automatic log file creation on. This is normally switched on. Log files are written to the log directory of the instrument account. There are time stamps any hour in that file and there is a new file any 24 hours.

Commandlog tail *n* — prints the last *n* entries made into the command log. n is optional and defaults to 20. Up to 1000 lines are held in an internal buffer for this command.

Commandlog intervall *minutes* — Queries and configures the intervall in *minutes* at which time stamps are written to the commandlog.

It is now possible to have a script executed whenever a new log file is started. In order to make this work a ServerOption with the name logstartfile must exist in the instrument configuration file. The value of this option must be the full path name of the file to execute.

Note: with the command **config listen 1** you can have the output to the command log printed into your client, too. With **config listen 0** you can switch this off again. This is useful for listening into a running instrument.

GetLog Command

The SICS server logs all its activities to a logfile, regardless of what the user requested. This logfile is mainly intended to help in server debugging. However, clients may register an interest in certain server events and can have them displayed. This facility is accessed via the **GetLog** command. It needs to be stressed that this log receives messages from all active clients. **GetLog** understands the following messages:

GetLog All — achieves that all output to the server logfile is also written to the client which issued this command.

GetLog Kill — stops all logging output to the client.

GetLog OutCode — request that only certain events will be logged to the client issuing this command. Enables only the level specified. Multiple calls are possible.

Possible values for **OutCode** are:

`Internal` internal errors such as memory errors etc.

`Command` all commands issued from any client to the server.

`HWError` all errors generated by instrument hardware. The SICS server tries hard to fix HW errors in order to achieve stable operations and may not generate an error message if it was able to fix the problem. This option may be very helpful when tracking dodgy devices.

`InError` All input errors found on any clients input.

`Error` All error messages generated by all clients.

`Status` some commands send status messages to the client invoking the command in order to monitor the state of a scan.

`Value` Some commands return requested values to a user. These messages have an output code of Value.

Connection Configuration Commands

SICS has a command for changing the user rights of the current client server connection, control the amount of output a client receives and to specify additional logfiles where output will be placed. All this is accessed through the following commands:

Config command

The **config** command configures various aspects of the current client server connection. Basically three things can be manipulated: The connections output class, the user rights associated with it, and output files.

config OutCode *`val`*

sets the output code for the connection. By default all output is sent to the client. But a graphical user interface client might want to restrict message to only those delivering requested values and error messages and suppressing anything else. In order to achieve this, this command is provided.

Possible values: Values for *`val`* are

`Internal`

`Command`

`HWError`

`InError`

`Status`

`Error`

`Value`

This list is hierarchical. For example specifying `InError` for *`val`* lets the client receive all messages tagged `InError`, `Status`, `Error` and `Value`, but not `HWError`, `Command` and `Internal` messages.

config Rights *`Username Password`*

Each connection between a client and the SICS server has user rights assocociated with it. These user rights can be configured at runtime with the command **config Rights** *`Username Password`*. If a matching entry can be found in the servers password database new rights will be set.

config File *`name`*

Scientists are not content with having output on the screen. In order to check results a log of all output may be required. The command **config File** *`name`* makes all output to the client to be written to the file specified by *`name`* as well. The file must be a file accessible to the server, i.e. reside on the same machine

as the server. Up to 10 logfiles can be specified. Note, that a directly connected line printer is only a special filename in unix.

config close *num* — closes the log file denoted by num again.

config list — lists the currently active values for outcode and user rights.

config myname — returns the name of the connection.

config myrights — prints the rights associated with your connection.

config listen *val* — switches listening to the commandlog on or off for this conenction. If this on, all output to the commandlog, i.e. all interesting things happening in SICS, is printed to your connection as well.

val = `0` is off

val = `1` is on

Chapter 3. Interrupting SICS

Ferdi Franceschini

Safety

SICS is **NOT** a safety system! It will allow you to do tasks that may damage persons and the instruments.

DO use the **STAR** principle. **STOP. THINK. ACT. REVIEW**

Familiarise yourself the location of the Emergency Stop buttons located near the cabin exit, or in several places within the instrument enclosure.

Familiarise yourself with the instrument and its safe operation.

DO NOT do anything with SICS that may risk damage to persons or the instrument.

DO NOT rely on these commands to stop motors or close shutters. If in any doubt, use the Emergency Stop button.

The commands in this chapter may fail for a variety of reasons.

- SICS has crashed
- Your network connection to the SICS is blocked, due to network congestion or failure
- The motor controller is no longer accepting connections or has a rogue process running

stopexe command

The **stopexe** command will stop drivable objects. It will NOT stop scans or batch files. For that you'll have to use an interrupt as found in the next section.

stopexe *`device`*
: interrupts a **drive** or **run** command. In the case of motors, the motor will decelerate. It won't stop immediately, as this can cause damage to the instrument

  ### Warning

  This will not interrupt a scan e.g. **runscan**.

  SICS will continue to accept commands from a client

stopexe all
: interrupts all devices. In the case of motors, the motor will decelerate. It won't stop immediately, as this can cause damage to the instrument

  ### Warning

  This will not interrupt a scan e.g. **runscan**.

  SICS will continue to accept commands from a client

Interrupting SICS

On occasion, you as the user, or a SICS object may come to the conclusion that an error is so bad that the measurement needs to be stopped. Clearly a means is needed to communicate this to upper level

code. This means is setting an interrupt on the connection. The current active interrupt is located at the connection object (note for SICS programmers, this can be retrieved with SCGetInterrupt and set with SCSetInterrupt. Interrupt codes are defined in interrupt.h). These codes are ordered into a hierarchy

INT1712 0 Continue. Everything is just fine. eContinue

INT1712 1 Abort Operation.

Stop the current scan point or whatever is done, but do not stop altogether. eAbortOperation

INT1712 2 Abort Scan.

Abort the current scan, but continue processing of further commands in buffers or command #les. eAbortScan

INT1712 3 Abort Batch.

Aborts everything, operations, scans and batch processing and leaves the system ready to enter new commands. eAbortBatch

INT1712 4 Halt System.

As eAbortBatch, but lock the system. eHaltSystem

INT1712 5 Free System

Unlocks a system halted with eHaltSystem. eFreeSystem

INT1712 6

Warning

For internal usage only

Makes the SICS server run down and exit. .

Higher level SICS objects may come to the conclusion that the error reported by lower level code is actually not that critical and clear any pending interrupts by setting the interrupt code to eContinue and thus consume the interrupt.

Chapter 4. File commands

Ferdi Franceschini

Introduction

Filenames

SICS provides methods to create and save files. You can create a single file, and save either a single dataset, or multiple datasets to the one file. You can also create and manage collections of files, and save single or multiple datasets to files in the collection

SICS automatically creates the filename. The filenames have the form

xxxnnnnnnn.nx.hdf — where xxx is a 3 letter abbreviation of the instrument

QKK - quokka

ECH - echidna

WOM - wombat

KOW - kowari

PLA - platypus

nnnnnnn is a 7 numeral sequence number, starting at 0000000 when the facility commenced operation, and is automatically incremented by SICS.

The file /usr/local/sics/DataNumber is used to keep track of the number. DO NOT edit this file.

.nx denotes that the file is a NeXus file.

.hdf denotes the file is an hdf5 (binary) file.

e.g. QKK0001234.nx.hdf

File Format. NeXus

Files are saved using the ANSTO interpretation of the NeXus standard.

SICS support both the xml and hdf5 form. For performance of reading and writing, by default we write hdf5 binary.

SICS can also be configured to write xml. This is set in `nxscripts_common_1.tcl`. Set the file,format element of the state array to "xml"

File Content

This section will give only a very brief overview of NeXus. Further reading can be found at the NeXus webite, www.nexusformat.org

NeXus is a hierachical data format; data is saved in groups and these groups live under entries. It a similar structure to directories on a file system. We have made a policy decision at the Bragg Institute to have only one entry per file. This entry may contain a variable parameter or scan, where e.g. temperature is varied. If you use the **runscan** command, histogram data is taken at discrete

temperatures. Temperature will be a vector in the file, and the histogram data may be a data cube of 2 dimensional x,y or 3 dimensional x,y,t histogram arrays.

There are 4 groups in NeXus. User, Sample, Instrument and Data. SICS will write the data it acquires to one of these groups. The content that is saved, and where in the file it is saved to is controlled by configuration files.

`/usr/local/sics/server/config/nexus` contains `*.dic` dictionary files. These files tell SICS how to map a SICS object to a location in a NeXus file, and what type the data will be, and its attributes e.g units. Below is an example from nexus.dic

```
samphi = /entry1,NXentry/sample,NXsample/SDS sample_phi
-type NX_FLOAT32 -rank 1 -dim {-1}
-attr {units,degrees}   -attr {long_name,sample_phi}
```

Changes to configurations are done by the facility. Dictionaries can be checked with check_instdict.tcl and check_sicsobj_attributes.tcl.

By default, if the SICS object exists and there is an entry in the dictionary, then it will be saved to the data file. There is a second hierarchy of SICS objects which is used by Gumtree for control. This is called hipadaba. We won't go into detail about hipadaba in this manual, but it is important for this discussion to know how hipadaba controls saving of SICS objects. Hipadaba has the same structure as NeXus. The hipadaba tree when initially created by SICS is a complete NeXus tree, which is then pruned to contain only those nodes that exist for that instrument. This allows any node to be added to `nexus.dic` for an instrument without having to change hipadaba. There are dictionary files for hipadaba found at `/usr/local/sics/server/config/hipadaba/`. In general, there is no instrument specific information in these files. Every node in hipadaba has data and nxsave attributes. By default, nxsave is set to true, and if the node contains data, data is set to true. If either of these is set to false, then the data will not be saved.

File Locations

File are written to `/usr/local/sics/data` of the ics1-*`australian_fauna`* computer. This path is configured in `server_config.tcl` by setting the `SicsDataPath` variable. Posix symbolic links are used to link the directory to the appropriate directory on filer.nbi.ansto.gov.au, under the `/experiments` mount point. You can mount this directory on the MS Windows machine dav1-*`australian_fauna`*.

File Commands. Single Files

newfile command

newfile *`file_type`* [scratch]

creates a new file of type *`file_type`* ready to write to. The command does write any information to disk.

To save data, use the **save** command.

You can only hold a reference to one file. If you need to reference a number of files, then use newfile_collection.

Only use the optional [scratch] if you want to write data to a scratch file. The file will be overwritten with the next invocation of this option

`file_type` may have the following values:

`BEAM_MONITOR` Saves data from the configured beam monitors, histogram memory data is not saved.

`HISTOGRAM_T` Saves histogram total time data and beam monitor data.

`HISTOGRAM_X` Saves histogram x data and beam monitor data.

`HISTOGRAM_XT` Saves histogram x,t data and beam monitor data.

`HISTOGRAM_Y` Saves histogram y data and beam monitor data.

`HISTOGRAM_YT` Saves histogram y,t data and beam monitor data.

`HISTOGRAM_XY` Saves histogram x,y data and beam monitor data.

`HISTOGRAM_XYT` Saves histogram total x,y,t data and beam monitor data.

save command

save *`index`* saves data to disk.

`index` is the index of data to be saved, starting with 0. To save your first slice of data you would save 0. This provides you with a complete NeXus file. You may be doing After you acquire you next slice of data, you would save 1, then save 2 etc.

Other single file commands

killfile decrements the data number used for SICS file writing and thus consequently overwrites the last datafile. This is useful when useless data files have been created during tests. As this is critical command in normal user operations, this command requires managers privilege.

File Collection Commands

newfile_collection command

newfile_collection `-labels` *`{sample1 sample2}`* `-filetype` *`file_type`* `-savetype` *`save_type`*

Whereas newfile creates one file, newfile_collection will create as many files as there are labels. The command does write any information to disk.

To save data, use the **save_collection** command

Example: You have a multi-sample changer or robot. You want to do a measurement on each sample at multiple temperatures. Your experimental sequence has the sample changer as the fastest varying parameter (inner loop), and temperature change as the slowest varying parameter (outer loop). You want to record all temperature data for a sample in one file.

`-savetype` *`save_type`* may have the following values:

`data` writes to a normal data file

`scratch` writes to a scratch file. The file will be overwritten with the next invocation of this option. Used mainly for testing.

`-filetype` *`file_type`* may have the following values:

`BEAM_MONITOR` Saves data from the configured beam monitors, histogram memory data is not saved.

`HISTOGRAM_T` Saves histogram total time data and beam monitor data.

`HISTOGRAM_X` Saves histogram x data and beam monitor data.

`HISTOGRAM_XT` Saves histogram x,t data and beam monitor data.

`HISTOGRAM_Y` Saves histogram y data and beam monitor data.

`HISTOGRAM_YT` Saves histogram y,t data and beam monitor data.

`HISTOGRAM_XY` Saves histogram x,y data and beam monitor data.

`HISTOGRAM_XYT` Saves histogram total x,y,t data and beam monitor data.

save_collection command

save_collection `-index` *`val`* `-` **labels** *`sample1`*

saves data to disk within a collection (multiple files)

-index*`val`* is the index of data to be saved, starting with 0. To save your first slice of data you would save 0. This provides you with a complete NeXus file. You may be doing After you acquire you next slice of data, you would save 1, then save 2 etc.

-labels *`sample1`* will save to the file referenced by the label *`sample1`*. You would put all data relating to a sample into this one file.

Part II. QUOKKA SPECIFIC COMMANDS

Table of Contents

Chapter 5. Ordela Detector Voltage Control

Ferdi Franceschini

Commands

The High Voltage controller for the Ordela detector has been implemented as a standard SICS environment controller object with a driveable interface. It has been configured differently to other SICS objects in several ways. Firstly, you use **up** and **down** commands to drive the voltage to its **upper** and **lower** limits. This is a blocking task i.e. no other task can started until this is complete. Secondly, the instrument has been configured with the SICS anticollider to prevent you from moving the detector when the voltage is above a certain threshold, which will lead to damage of the detector. This is important for Quokka as the detector is moved frequently.

dhv1 up Raise the voltage

dhv1 down Lower the voltage

> **Note**
>
> NOTE This command blocks until the power supply reaches the "upper" or "lower" running voltages, see below.

INT1712 1 If this commands hang SICS you can interrupt it with by entering this at the SICS command line, or by pressing the interrupt button at the bottom of GumTree

dhv1 reset Reset the controller

dhv1 list Displays the values of the various parameters

dhv1 send *command* Sends a *command* to the unit and displays the response

dhv1 off Drives the output voltage to zero

Parameters

dhv1 upper *voltage* Sets the running voltage for the **up** command. This would normally be the operating voltage for the equipment to which the power supply is connected.

dhv1 lower *voltage* Sets the standby voltage for the **down** command. This would normally be the standby voltage for the equipment to which the power supply is connected.

dhv1 max *voltage* Sets the hardware maximum for the power supply. For the Ordela power supplies, it is important that this is the correct full-scale value of the power supply itself. This is used to convert between the voltage step and voltages and to calculate the step period from the voltage slew rate.

dhv1 rate *voltage* The volts per second at which the power supply slews between voltages. For the Ordela power supplies, this is used to calculate the time between voltage steps based on the `max` parameter

dhv1 debug *val* Allowed *val*

	`0` No debug information in log
	`1` Debug information in log
dhv1 lock	This locks the device from being set by users. Users can use **up down** and **off** commands to set voltages
dhv1 unlock	Managers may unlock the device

Chapter 6. Beamstops

Ferdi Franceschini

Commands

Raising and lowering of beamstops is implemented via action objects, you control them via the **action** and **waitaction** commands.

action *bs1 position*

Will send beamstop *bs1* either up or down

Allowed *position*

up

down

bs1 status

this will report one of the following:

bs1 = up,

bs1 = down

bs1 = inbetween

> **Note**
>
> Currently there is no automatic notification when a move is complete

waitaction *bs1*

If you want to sequence some commands in a batch file, you can use the **waitaction** command

e.g. If you put these lines in a batch file the histogram memory won't start counting until the beamstop is up

```
waitaction bs1 up
histmem start
```

Troubleshooting

Beamstop position can be checked visually (by eyes) from the vessel port with touch. To do this, you should drive the detector to position 9300mm, and view from the middle vessel port.

Chapter 7. Astrium Velocity Selector

Nick Hauser

Commands

The Astrium velocity selector is a SICS script context object. There are 2 parts, the script context object, which has the name **/instrument/velocity_selector** and the 2 driveable interfaces to the object, which have the names **nvs_speed** and **nvs_lambda**. Hence you can **drive** and **run nvs_speed** and **nvs_lambda**. To get and set other parameters use **hget** or **hset /instrument/velocity_selector/**

run nvs_lambda *wavelength*	Units: Angstroms Runs the velocity selector to *wavelength*
drive nvs_lambda *wavelength*	Units: Angstroms Is the same as **run** but it blocks the client that requested the **drive** from issuing commands until the task has finished.
hset /instrument/ velocity_selector/setstate `brake`	Set the state. The state can be read using **hget /instrument/ velocity_selector/state** If the state is set to **brake** , then **hget /instrument/ velocity_selector/state** will return `BRAKING` even when the rotor has stopped. You can use **run nvs_speed** to run the rotor again Allowed values: `brake`
hget /instrument/ velocity_selector/state	Get the state. The normal operating state under SICS control is `CONTROL`
hlist /instrument/ velocity_selector	Lists all the **velocity_selector** nodes
hset /instrument/ velocity_selector/*node val*	Set *val* on a *node*
hget /instrument/ velocity_selector/*node*	Get the value of a *node*
hset /instrument/ velocity_selector/setspeed *val*	Privilege = User Units = rpm Set the rotor set speed. Once this is set, the velocity selector will attempt to run to this speed. If called with no argument, will return an error

The velocity selector is under the `/instrument/velocity_selector` node in hipadaba, which is where it will be found when using the Gumtree TableTree. This complies with the NeXus standard.

Parameters

For more detailed description of these parameter, please see the `ASTRIUM velocity selector manual` on ANSTOnet.

hget /instrument/ velocity_selector/wvalv

Privilege = User

Get the state of the water valve. The water valve will open in once the velocity selector has reached 3000 rpm. The valve will close again and the selector will brake to 0 rpm if the water flow is not within tolerance.

`open` Water valve open

`clos` Water valve closed

hget /instrument/ velocity_selector/rtemp

Privilege = User

Units = Celsius

Get the rotor temperature.

hget /instrument/ velocity_selector/state

Privilege = User

Get the state.

`IDLING` Is not being controlled. Should be at zero rpm.

`RESET` A reset has been issued by the velocity selector client program

`CONTROL` Control has been requested by SICS or the velocity selector client program

`BRAKING` The velocity selector has the brake applied due to an **hset setstate brake** request, the Brake button applied on the velocity selector client program, or due to a fault condition

`POWERLOSS MEASUREMENT` Powerloss measurement button applied on the velocity selector client program

`EMERGENCY STOP` Emergency stop button applied on the velocity selector client program

hget /instrument/ velocity_selector/aspeed

Units = rpm

Get the actual speed

hget /instrument/ velocity_selector/sspeed *`val`*

Privilege = User

Units = rpm

No idea ???

hget /instrument/ velocity_selector/winlt

Units = Celsius

Get the cooling water inlet temperature

hget /instrument/ velocity_selector/wflow

Units = litres/min

Get the cooling water flow rate

hget /instrument/ velocity_selector/ploss	Units = Watts Get the last measured power loss
hget /instrument/ velocity_selector/splos	Units = rpm Get the speed of the last measured power loss
hget /instrument/ velocity_selector/rspeed	Units = rpm Get the requested speed, set using **run nvs_speed**
hget /instrument/ velocity_selector/woutt	Units = Celsius Get the cooling water outlet temperature
hget /instrument/ velocity_selector/vacum	Units = 10^{-3}bar Get the vacuum
hget /instrument/ velocity_selector/bcuun	Get the BCU units
hget /instrument/ velocity_selector/ttang	Units = degrees Get the turntable angle. 999.99 if not initialised
hget /instrument/ velocity_selector/vibrt	Units = mm/s Get the vibration

hget /instrument/ velocity_selector/vvalv	Get the vacuum valve state
	Returned values:
	`open`
	`closed`

hget /instrument/ velocity_selector/aveto	Get the veto state Returned values: `nok` not OK `ok` OK

Chapter 8. Julabo Temperature Control

Nick Hauser

Commands

The Julabo temperature controller is a SICS script context object. There are 2 parts, the script context object, which has the name **/sample/tc1** and the driveable interface to the object, which has the name **tc1_driveable** ie. "tee-cee-one". Note this name can change in the configuration. Hence you can **drive** and **run tc1_driveable**. To get and set other parameters use **hget** or **hset /sample/tc1**

run tc1_driveable *temp1* — Runs the temperature controller **tc1** to *temp1*

drive tc1_driveable *temp1* — Is the same as **run** but it blocks the client that requested the **drive** from issuing commands until the task has finished.

hlist /sample/tc1 — Lists all the **tc1** nodes. Nodes can be get and set using **hget** and **hset**

The temperature controller is usually put under the `/sample` node in hipadaba, which is where it will be found when using the Gumtree SICS. This complies with the NeXus standard.

Parameters

Use **hget** and **hset** on these parameters. Parameter without *val* are read only and therefore cannot be set.

/sample/tc1/setpoint *val*

Privilege = User

Units = Celsius

Get/Set the temperature setpoint. If the setpoint is set, the controller will change the temperature to this value, subject to constraints including **operate remote_ctrl hitemp lotemp upperlimit lowerlimit**

/sample/tc1/overtemp_warnlimit *val*

Privilege = User

Units = Celsius

Get/Set the controller's temperature upper limit. When the temperature is > *val*, SICS will veto counters until the temperature fall below *val* .

/sample/tc1/subtemp_warnlimit *val*

Privilege = User

Units = Celsius

Get/Set the controller's temperature lower limit. When the temperature is < *val*, SICS will veto the histogram memory and counters until the temperature rises above *val* .

/sample/tc1/sensor/value

Units = Celsius

Get the controller's temperature sensor value

/sample/ tc1/heating_power_percent *val*

Units = percent

Get the controller's current heating power

/sample/tc1/operate *val*

Privilege = User

Get/Set the operate state.

Allowed *val*:

`0` Controller doesn't control temperature. Will still report parameters

`1` Controller provides control.

/sample/tc1/status

Get the controller's operate state

Allowed *val*:

`Busy` Equivalent to *tc1* **operate** `1`

`Idle` Equivalent to *tc1* **operate** `0`

/sample/tc1/remote_ctrl *val*

Privilege = User

Get/Set remote control enable/disable

Allowed *val*:

`True` *tc1* remote control enabled

`False` *tc1* remote control disabled

/sample/tc1/lh45_lasterror

Get the last error recorded on the controller. Note that this error condition is not cleared if the error no longer exists. This value is only overwritten by another error state.

Example of an error state:

```
-04 LOW TEMPERATURE WARNING
```

/sample/tc1/tolerance *val*

Privilege = User

Units = Celsius

Get/Set **tolerance**.

overtemp_warnlimit and **subtemp_warnlimit** will be set when you use the **run** or **drive** *tc1 temp1*. Control is dependent on the **overtemp_warnlimit** and **subtemp_warnlimit** values, not on tolerance. Setting **overtemp_warnlimit** or **subtemp_warnlimit** will override **tolerance**

/sample/tc1/apply_tolerance *val*

Privilege = User

Get/Set apply_tolerance **Don't know what this does**

Allowed *val*:

`0`

`1`

/sample/tc1/lowerlimit *val*

Privilege = Manager

Get/Set the lower limit for **setpoint**. If you try to set **setpoint** below this value, will return.

ERROR: setpoint violates limits

/sample/tc1/upperlimit *val*

Privilege = Manager

Get/Set the lower limit for **setpoint**. If you try to set **setpoint** above this value, will return.

ERROR: setpoint violates limits

/sample/tc1/emon/monmode

Get emon's monitor mode **Don't know what this does**

Returned values:

`monitor`

`???`

/sample/tc1/emon/isintol

Get if the value is within tolerance (but which tolerance?) hitemp lotemp or tolerance

Returned values:

`0` out of tolerance

`1` in tolerance

/sample/tc1/emon/errhandler

Get if the value is within tolerance (but which tolerance?) hitemp lotemp or tolerance

Returned values:

`pause` ???

`???` ???

Part III. COMMANDS IN DETAIL

Table of Contents

Chapter 9. SICS Overview

Introduction

SICS, the SINQ Instrument Control System, meets the following specifications:

- Control the instrument reliably.
- Good remote access to the instrument via the internet.
- Portability across operating system platforms.
- Enhanced portability across instrument hardware. This means that it should be easy to add other types of motors, counters or other hardware to the system.
- Support authorization on the command and parameter modification level. This means that certain instrument settings can be protected against random changes by less knowledgeable users.
- Good maintainability and extendability.
- Be capable to accommodate graphical user interfaces.
- One code base for all instruments.
- Powerful macro language.

A suitable new system was implemented using an object oriented design which matches the above criteria.

SICS Overall Design

In order to achieve the design goals stated above it was decided to divide the system into a client server system. This means that there are at least two programs necessary to run an instrument: a client program and a server program. The server program, the SICS server, does all the work and implements the actual instrument control. The SICS server usually runs on the ics (instrument control server) computer. The client program may run on any computer on the world and implements the user interface to the instrument. Any numbers of clients can communicate with one SICS server. The SICS server and the clients communicate via a simple ASCII command protocol through TCP/IP sockets. With this design good remote control through the network is easily achieved. As clients can be implemented in any language or system capable of handling TCP/IP the user interface and the functional aspect are well separated. This allows for easy exchange of user interfaces by writing new clients.

SICS Clients

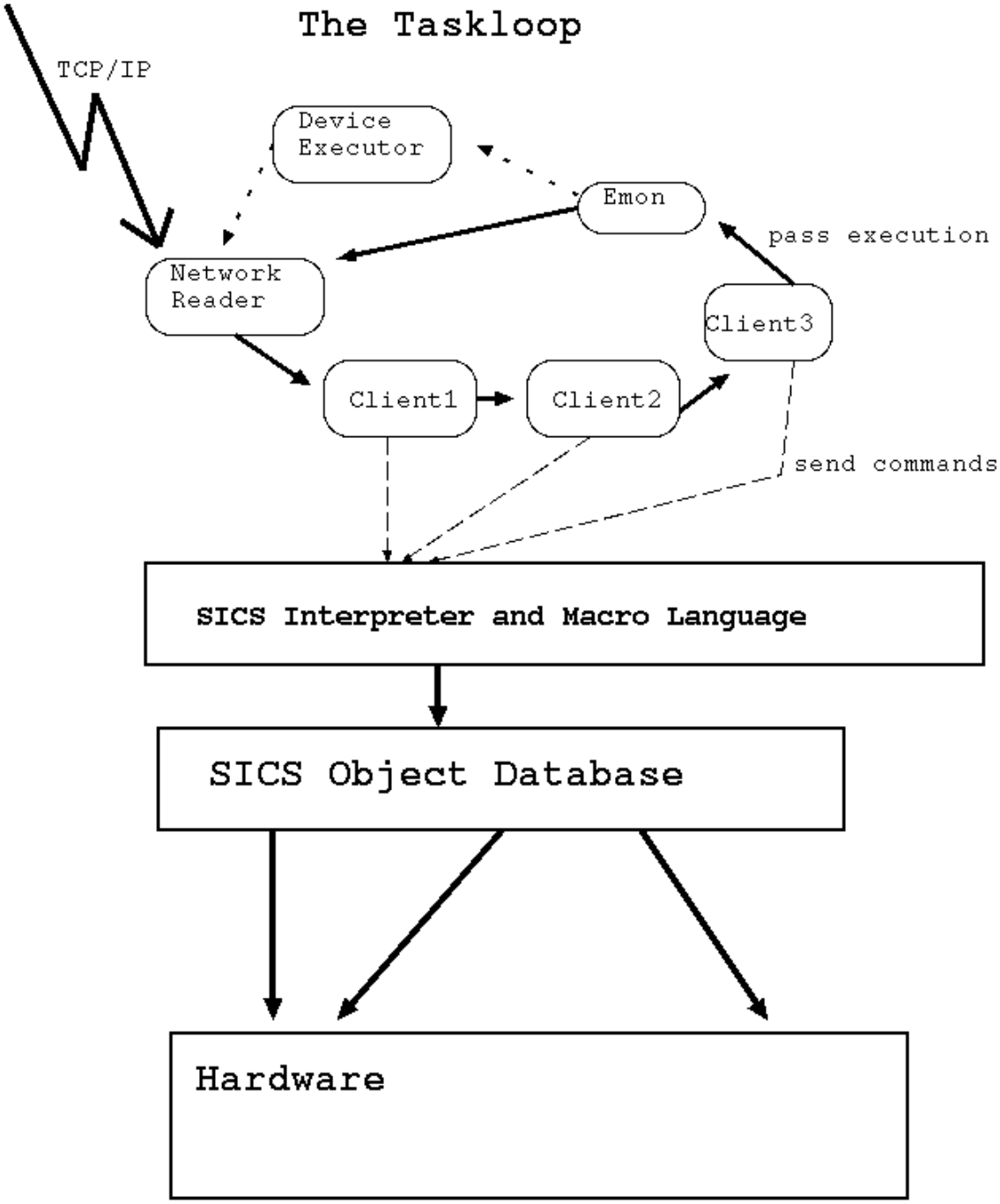
SICS Clients implement the SICS user interface. The Gumtree client is implemented in Java for platform independence. This is a real concern where MS Windows, Macintosh and Unix users have to be satisfied. As many instrument scientists still prefer the command line for interacting with instruments, the most used client is a visual command line client. Status displays are another kind of specialized client programs.

The SICS Server

The SICS server is the core component of the SICS system. The SICS server is responsible for doing all the work in instrument control. Additionally the server has to answer the requests of possibly multiple clients. The SICS server can be subdivided into three subsystems:

The kernel	The SICS server kernel takes care of client multitasking and the preservation of the proper I/O and error context for each client command executing.
SICS Object Database	SICS objects are software modules which represent all aspects of an instrument: hardware devices, commands, measurement strategies and data storage. This database of objects is initialized at server startup time from an initialization script.
The Interpreter	The interpreter allows to issue commands to the objects in the objects database.

Figure 9.1. Schematic Representation of the SICS server structure



The SICS Server Kernel

In more detail the SICS server kernel has the following tasks:

- Accept and verify client connection requests.
- Read and execute client commands.
- Maintain the I/O and error context for each client connection.
- Serialize data access.
- Serialize hardware access.
- Monitor HW operations.
- Monitor environment devices.

Any program serving multiple clients has the problem how to organize multiple clients accessing the same server and how to prevent one client from reading data, while another client is writing. The approach used for the SICS server is a combination of polling and cooperative multitasking. This scheme is simple and can be implemented in an operating system independent manner. One way to look at the SICS server is as a series of tasks in a circular queue executing one after another. The servers main loop does nothing but executing the tasks in this circular buffer in an endless loop. There are several system tasks and one such task for each living client connection. Thus only one task executes at any given time and data access is efficiently serialized.

One of the main system tasks, and the one which will be always there, is the network reader. The network reader has a list of open network connections and checks each of them for pending requests. What happens when data is pending on an open network port depends on the type of port: If it is the servers main connection port, the network reader will try to accept and verify a new client connection and create the associated data structures. If the port belongs to an open client connection the network reader will read the command pending and put it onto a command stack existing for each client connection. When it is time for a client task to execute, it will fetch a command from its very own command stack and execute it. This is how the SICS server deals with client requests.

The scheme described above relies on the fact that most SICS command need only very little time to execute. A command needing time extensive calculations may effectively block the server. Implementations of such commands have to take care that control passes back to the task switching loop at regular intervals in order to prevent the server from blocking.

Another problem in a server handling multiple client requests is how to maintain the proper execution context for each client. This includes the clients I/O-context (socket), the authorisation of the client and possible error conditions pending for a client connection. SICS does this via a connection object, a special data structure holding all the above information plus a set of functions operating on this data structure. This connection object is passed along with many calls throughout the whole system.

Multiple clients issuing commands to the SICS server may mean that multiple clients might try to move motors or access other hardware in conflicting ways. As there is only one set of instrument hardware this needs to be prevented. This is achieved by a convention. No SICS object drives hardware directly but registers it's request with a special object, the device executor. This device executor starts the requested operation and reserves the hardware for the length of the operation. During the execution of such an hardware request all other clients requests to drive the hardware will return an error. The device executor is also responsible for monitoring the progress of an hardware operation. It does so by adding a special task into the system which checks the status of the operation each time this tasks executes. When the hardware operation is finished this device executor task will end. A special system facility allows a client task to wait for the device executor task to end while the rest of the task queue is still executing. In this way time intensive hardware operations can be performed by drive, count or scan commands without blocking the whole system for other clients.

The SICS server can be configured to support another security feature, the token system. In this scheme a client can grab control of the instrument. With the control token grabbed, only the client which has the token may control the instrument. Any other client may look at things in the SICS server but does not have permission to change anything. Passing the control token requires that the client which has the token releases the token so that another client may grab it. There exists a password protected back door for SICS managers which allows to force the release of a control token.

Most experiments do not happen at ambient room conditions but require some special environment for the sample. Mostly this is temperature but it can also be magnetic of electric fields etc. Most of such devices can regulate themselves but the data acquisition program needs to monitor such devices. Within SICS, this is done via a special system object, the environment monitor. A environment device, for example a temperature controller, registers it's presence with this object. Then a special system task will control this device when it is executing, check for possible out of range errors and initiates the proper error handling if such a problem is encountered.

The SICS Interpreter

When a task belonging to a client connection executes a command it will pass the command along with the connection object to the SICS interpreter. The SICS interpreter will then analyze the command and forward it to the appropriate SICS object in the object database for further action. The SICS interpreter is very much modeled after the Tcl interpreter as devised by John Ousterhout

For each SICS object visible from the interpreter there is a wrapper function. Using the first word of the command as a key, the interpreter will locate the objects wrapper function. If such a function is found it is passed the command parameters, the interpreter object and the connection object for further processing. An interface exists to add and remove commands to this interpreter very easily. Thus the actual command list can be configured easily to match the instrument in question, sometimes even at run time. Given the closeness of the design of the SICS interpreter to the Tcl interpreter, the reader may not be surprised to learn that the SICS server incorporates Tcl as its internal macro language. The internal macro language may use Tcl commands as well as SICS commands.

SICS Objects

As already said, SICS objects implement the true functionality of SICS instrument control. All hardware, all commands and procedures, all data handling strategies are implemented as SICS objects. Hardware objects, for instance motors deserve some special attention. Such objects are divided into two objects in the SICS system: A logical hardware object and a driver object. The logical object is responsible for implementing all the nuts and bolts of the hardware device, whereas the driver defines a set of primitive operations on the device. The benefit of this scheme is twofold: switching to new hardware, for instance a new type of motor, just requires to incorporate a new driver into the system. Internally, independent from the actual hardware, all hardware object of the same type, for example motors look the same and can be treated the same by higher level objects. No need to rewrite a scan command because a motor changed.

In order to live happily within the SICS system SICS object have to adhere to a system of protocols. There are protocols for:

- Input/Output to the client.
- Error handling.
- Interaction with the interpreter.
- For identification of the object to the system at run time.
- For interacting with hardware, see device executor above.

- For checking the authorisation of the client who wants to execute the command.

SICS objects have the ability to notify clients and other objects of internal state changes. For example when a motor is driven, the motor object can be configured to tell SICS clients or other SICS objects about his new position.

SICS uses NeXus, the upcoming standard for data exchange for neutron and xray scattering as its raw data format.

SICS Working Examples

In order to get a better feeling for the internal working of SICS the course of a few different requests through the SICS system is traced in this section. The examples traced will be:

- A request for a new client connection.
- A simple command.
- A command to drive a motor in blocking mode.
- A command to drive a motor which got interrupted by the user.
- A command to drive a motor in non blocking mode.

For the whole discussion it is assumed that the main loop is running, executing cyclically each single task registered in the server. Task switching is done by a special system component, the task switcher.

The Request for a new Client Connection

- The network reader recognizes pending data on its main server port.
- The network reader accepts the connection and tries to read an username/password pair.
- If such an username/password pair comes within a suitable time interval it is checked for validity. On failure the connection is closed again.
- If a valid connection has been found: A new connection object is created, a new task for this client connection is introduced into the system and the network reader registers a new client port to check for pending commands.
- Control is passed back to the task switcher.

A Simple Command

- The network reader finds data pending at one of the client ports.
- The network reader reads the command, splits it into single lines and put those on top of the client connections command stack. The network reader passes control to the task switcher.
- In due time the client connection task executes, inspects its command stack, pops the command pending and forwards it together with a pointer to itself to the SICS interpreter.
- The SICS interpreter inspects the first word of the command. Using this key the interpreter finds the objects wrapper function and passes control to that function.

- The object wrapper function will check further arguments, checks the clients authorisation if appropriate for the action requested. Depending on the checks, the wrapper function will create an error message or do its work.
- This done, control passes back through the interpreter and the connection task to the task switcher.
- The next task executes.

A "drive" Command in Blocking Mode

- The network reader finds data pending at one of the client ports.
- The network reader reads the command, splits it into single lines and put those on the top of the client connections command stack. The network reader passes control to the task switcher.
- In due time the client connection task executes, inspects its command stack, pops the command pending and forwards it together with a pointer to itself to the SICS interpreter.
- The SICS interpreter inspects the first word of the command. Using this key the interpreter finds the drive command wrapper function and passes control to that function.
- The drive command wrapper function will check further arguments, checks the clients authorisation if appropriate for the action requested. Depending on the checks, the wrapper function will create an error message or do its work.
- Assuming everything is OK, the motor is located in the system.
- The drive command wrapper function asks the device executor to run the motor.
- The device executor verifies that nobody else is driving, then starts the motor and grabs hardware control. The device executor also starts a task monitoring the activity of the motor.
- The drive command wrapper function now enters a wait state. This means the task switcher will execute other tasks, except the connection task requesting the wait state. The client connection and task executing the drive command will not be able to process further commands.
- The device executor task will keep on monitoring the progress of the motor driving whenever the task switcher allows it to execute.
- In due time the device executor task will find that the motor finished driving. The task will then finish executing. The clients grab of the hardware driving permission will be released.
- At this stage the drive command wrapper function will awake and continue execution. This means inspecting errors and reporting to the client how things worked out.
- This done, control passes back through the interpreter and the connection task to the task switcher. The client connection is free to execute other commands.
- The next task executes.

A "drive" Command Interrupted

- The network reader finds data pending at one of the client ports.
- The network reader reads the command, splits it into single lines and put those on the top of the client connections command stack. The network reader passes control to the task switcher.

- In due time the client connection task executes, inspects its command stack, pops the command pending and forwards it together with a pointer to itself to the SICS interpreter.
- The SICS interpreter inspects the first word of the command. Using this key the interpreter finds the drive command wrapper function and passes control to that function.
- The drive command wrapper function will check further arguments, checks the clients authorisation if appropriate for the action requested. Depending on the checks, the wrapper function will create an error message or do its work.
- Assuming everything is OK, the motor is located in the system.
- The drive command wrapper function asks the device executor to run the motor.
- The device executor verifies that nobody else is driving, then starts the motor and grabs hardware control. The device executor also starts a task monitoring the activity of the motor.
- The drive command wrapper function now enters a wait state. This means the task switcher will execute other tasks, except the connection task requesting the wait state.
- The device executor task will keep on monitoring the progress of the driving of the motor when it is its turn to execute.
- The network reader finds a user interrupt pending. The interrupt will be forwarded to all tasks in the system.
- In due time the device executor task will try to check on the progress of the motor. It will recognize the interrupt. If appropriate the motor will get a halt command. The task will then die. The clients grab of the hardware driving permission will be released.
- At this stage the drive command wrapper function will awake and continue execution. This means it finds the interrupt, tells the user what he already knows: an interrupt was issued.
- This done, control passes back through drive command wrapper, the interpreter and the connection task to the task switcher.
- The next task executes.

A "run" Command in Non Blocking Mode

- The network reader finds data pending at one of the client ports.
- The network reader reads the command, splits it into single lines and put those on the top of the client connections command stack. The network reader passes control to the task switcher.
- In due time the client connection task executes, inspects its command stack, pops the command pending and forwards it together with a pointer to itself to the SICS interpreter.
- The SICS interpreter inspects the first word of the command. Using this key the interpreter finds the drive command wrapper function and passes control to that function.
- The "run" command wrapper function will check further arguments, checks the clients authorisation if appropriate for the action requested. Depending on the checks, the wrapper function will create an error message or do its work.
- Assuming everything is OK, the motor is located in the system.
- The "run" command wrapper function asks the device executor to run the motor.

- The device executor verifies that nobody else is driving, then starts the motor and grabs hardware control. The device executor also starts a task monitoring the activity of the motor.
- The run command wrapper function passes control through the interpreter and the clients task function back to the task switcher. The client connection can handle new commands.
- The device executor task will keep on monitoring the progress of the motor driving whenever the task switcher allows it to execute.
- In due time the device executor task will find that the motor finished driving. The task will then die silently. The clients grab of the hardware driving permission will be released. Any errors however, will be reported.

All this seems to be pretty complex and time consuming. But it is the complexity needed to do so many things, especially the non blocking mode of operation requested by users. Tests have shown that the task switcher manages +900 cycles per second through the task list on a DigitalUnix machine and 500 cycles per second on a pentium 2GHz machine running linux. Both data were obtained with software simulation of hardware devices. With real SINQ hardware these numbers drop to as low as 4 cycles per second if the hardware is slow in responding. This shows clearly that the communication with the hardware is the systems bottleneck and not the task switching scheme.

Chapter 10. Motor Controls & Drive

Ferdi Franceschini

Drive commands

Many objects in SICS are drivable . This means they can run to a new value. Obvious examples are motors. Less obvious examples include composite adjustments such as setting a wavelength or an energy. Such devices are alos called virtual motors. This class of objects can be operated by the drive, run, Success family of commands. These commands cater for blocking and non-blocking modes of operation.

Commands

run *mot1 pos1 mot2 pos2 ...*	runs *mot1* to *pos1*, *mot2* to *pos2*, *...*
success	waits and blocks the command connection until all pending operations have finished (or an interrupt occured).
drive *mot1 pos1 mot2 pos2 ...*	is the same as **run** but it blocks the client that requested the **drive** from issuing commands until the motion has finished. Can be called with one to n pairs of object new value pairs. This command will set the variables in motion and wait until the driving has finished. A **drive** can be seen as a sequence of a **run** command as stated above immediatly followed by a **Success** command
mot OR *mot* **position**	prints the current position of the motor. All zero point and sign corrections are applied
mot **hardposition**	prints the current position of the motor. No corrections are applied. Should read the same as the controller box
mot **list**	Lists all the motor's parameters.
mot **reset**	resets the motor parameters to default values. This is software zero to 0.0 and software limits are reset to hardware limits
mot **interest**	initiates automatic printing of any position change of the motor. This command is mainly interesting for implementors of status display clients.
mot **uninterest**	disables interest
mot **homerun** `1 or 0`	**homerun** with no arguments reports the current status, a value of "1" means that the motors have been homed. **homerun** *1* will run the homing routine. Used on motors with relative encoders e.g. slit motors.
list *mot* `type`	Returns the motor's type.

Warning

Appears to be broken.

Configurable virtual motors do not have a list subcommand.

Parameters

mot **absenc**

Privilege = User

Get the absolute encoder reading. (Only implemented by motors that have absolute encoders.)

mot **accel** *val*

Privilege = User

Get/Set the acceleration along/about the axis controlled by this motor in physical units per square second, ie mm/s^2, deg/s^2

mot **accesscode** *val* *(persists)*

Default = 2 i.e. user

Privilege = Manager

Controls which type of user is allowed to control the motor

Allowed *val*

0 Internal. Motor is reserved for internal use by SICS

1 Manager. Only users who logon as managers are allowed to move the motor. Usually just instrument scientists

2 User

3 Spy. Anyone is allowed to move the motor

mot **blockage_check_interval** *val*

Privilege = Manager

Units = seconds

Get/Set the interval at which the motor driver checks the axis for significant changes in position

mot **decel** *val*

Privilege = User

Get/Set the deceleration along/about the axis controlled by this motor in physical units per second, ie mm/s^2, deg/s^2.

mot **failafter** *val*

Privilege = Manager

This is the number of consecutive failures of positioning operations this motor allows before it thinks that something is really broken and aborts the experiment

mot **fixed** *val* *(persists)*

Default = 1.0

Privilege = User

Set to -1.0 to prevent the motor from being moved, set to 1.0 to allow movement.

NOTE: The instrument manager can set the accesscode to prevent users from moving a motor.

mot **home** *val*

Warning

subject to change. This may be changed to a configuration only parameter

	Privilege = Manager
	Get/Set the home position for the axis which the motor controls, (ie phi, chi, two-theta, x, y). So it is the physical home position in the units given by the *units* parameter below, (ie mm, degrees, ...)
mot **ignorefault** *val (persists)*	Position faults will be ignored if this is greater than zero
mot **interruptmode** *val (persists)*	Default = 0 (continue)
	Privilege = Manager
	Controls what effect a motor failure has on operations
	Allowed *val* one of:
	`0` Continue. A motor failure will not affect other operations
	`1` AbortOperation. Stop current hardware operation but no scans or batchfiles
	`2` AbortScan. Stop current scan or operation but continue processing of batch files with next command
	`3` AbortBatch. Stop all processing, even batch files
mot **maxretry** *val*	Default = `3`
	Privilege = Manager
	The number of times that SICS will retry a move if a motor has not reached the target position to within the required precision
mot **movecount** *val (persists)*	Default=`10`
	Privilege = Manager
	Controls frequency with which position changes are reported if a user subscribes interest to a motor. A larger value reduces the frequency
mot **precision** *val (persists)*	Privilege = Manager
	Controls precision of movements. If a motor has not completed a move to the required precision then the move command will be resent. The number of retries is controlled by the maxretry parameter.
mot **sign** *val (persists)*	Default = `1`
	Privilege = Manager
	Controls direction of motion, set to -1 to reverse.
mot **softlowerlim** *val (persists)*	Privilege = User
	Get/set lower software limit. This is automatically adjusted when you set the softzero or use the **setpos** command.
mot **softupperlim** *val (persists)*	Privilege = User

Get/set upper software limit. This is automatically adjusted when you set the softzero or use the **setpos** command.

mot **softzero** *val (persists)*

Default = 0

Privilege = User

Sets the zero position to *val*. You probably want to use **setpos** described below, it's easier to understand.

mot **speed** *val*

Privilege = User

Get/Set the speed of motion along/about the axis controlled by this motor in physical units per second, ie mm/s, deg/s.

mot **units** *val*

Privilege = User

Get/Set the physical units

Preferred *val*:

`mm`

`degrees`

list output

mot **list** shows the values of the parameters listed below, in the order listed below.

`Position` Reports the current positon

`TargetPosition` Shows target position

`hardlowerlim` Hardware lower limit for motor set in SICS configuration file

`hardupperlim` Hardware upper limit for motor set in SICS configuration file

`softlowerlim` Lower software limit. This is automatically adjusted when you set the softzero or use the **setpos** command.

`softupperlim` Upper software limit. This is automatically adjusted when you set the softzero or use the **setpos** command.

`softzero` The zero position.

`fixed` `-1.0` prevents movement

`1.0` allows movement.

NOTE: The instrument manager can set the accesscode to prevent users from moving a motor.

`interruptmode` Controls what effect a motor failure has on operations

Values:

`0` Continue. A motor failure will not affect other operations

`1` AbortOperation. Stop current hardware operation but no scans or batchfiles

	2 AbortScan. Stop current scan or operation but continue processing of batch files with next command
	3 AbortBatch. Stop all processing, even batch files
precision	Controls precision of movements. If a motor has not completed a move to the required precision then the move command will be resent. The number of retries is controlled by the **maxretry** parameter.
accesscode	Controls which type of user is allowed to control the motor
	Allowed values:
	0 Internal. Motor is reserved for internal use by SICS
	1 Manager. Only users who logon as managers are allowed to move the motor. Usually just instrument scientists
	2 User
	3 Spy. Anyone is allowed to move the motor
sign	Default = 1
	Privilege = Manager
	Controls direction of motion, set to -1 to reverse.
failafter	This is the number of consecutive failures of positioning operations this motor allows before it thinks that something is really broken and aborts the experiment
maxretry	The number of times that SICS will retry a move if a motor has not reached the target position to within the required precision
ignorefault	Position faults will be ignored if this is greater than zero
movecount	Default=10
	Controls frequency with which position changes are reported if a user subscribes interest to a motor. A larger value reduces the frequency
home	home position for the axis which the motor controls, (ie phi, chi, two-theta, x, y). So it is the physical home position in the units given by the *units* parameter below, (ie mm, degrees, ...)
speed	The speed of motion along/about the axis controlled by this motor in physical units per second, ie mm/s, deg/s.
maxSpeed	Speed in **units**/s
accel	Acceleration along/about the axis controlled by this motor.
	Configurable
maxAccel	Maximum allowed acceleration in **units**/s^2
decel	Deceleration along/about the axis controlled by this motor.
	Configurable

`maxDecel`	Maximum allowed deceleration in **units**/s^2
`motOffDelay`	Number of msec to wait before switching off a motor after a move Default = `0`
`Debug`	
`Settle`	
`Blockage_Check_Interval`	
`Blockage_Thresh`	
`Blockage_Ratio`	
`Blockage_Fail`	
`Backlash_offset`	
`Protocol`	
`absEncoder`	Allowed values: `0` no absolute encoder `1` absolute encoder enabled
`absEncHome`	The calibrated "home" position in encoder counts Required if **absEncoder** = 1
`cntsPerX`	Number of absolute encoder counts per **unit** of movement along/about the axis of motion
`Creep_Offset`	
`Creep_Precision`	
`posit_count`	
`posit_1`	
`posit_2`	
`posit_3`	
`stepsPerX`	Number of motor steps per **unit** of movement along/about the axis of motion

Chapter 11. Counters

Ferdi Franceschini

Beam monitors have not been documented completely in either the PSI source code or on the Bragg Institute Plone CMS. Therefore, this document is a standalone document, not edited from another source.

Beam monitors

When you are doing an experiment with the main detector, you don't address beam monitors directly. You would normally select and configure the beam monitor to control your experiment using the **histmem** command.

However, you may want to use a scan command with a beam monitor and without the main detector. This can be done with **bmonscan** which is a SICS scan object. For more detail on bmonscan, see the chapter "Simple Scans".

Instruments often have more than one beam monitor. SICS has a multicounter interface named **bm**, which is a list of all the beam monitors on the instrument, usually 2 or 3 beam monitors with names bm1, bm2 and bm3. You must select which beam monitor will control your experiment. When you run the experiment using bm, all the beam monitors on the instrument will count, and with most instrument configurations, the values will be saved to the data file - you should check this is the case if you need these values.

Selecting a beam monitor for bm

bmonscan setchannel *n*	Sets the active beam monitor. *n* = 0 is bm1, *n* =1 is bm2 etc. This is the preferred command when doing a **bmonscan**
bm setchannel *n*	Sets the active beam monitor. *n* = 0 is bm1, *n* =1 is bm2 etc. This is the alternate command when using **bmonscan**
histmem mode *MONITOR_n*	Sets the active beam monitor. *n* = 1 is bm1, *n* =2 is bm2 etc. Use this command when using **histmem**

runscan also has an argument to select the beam monitor.

Do not use these interchangably e.g. do not use **bm setchannel** *n* to set **histmem mode** *MONITOR_n*. It will not work.

Since there are four commands for selecting beam monitor, you have to be careful to use the right one. Be explicit with your selection of beam monitor when using these commands. Don't assume.

If you are using **histmem** to control the detector, set the beam monitor using **histmem mode**.

If you are using **bmonscan** set the beam monitor using **bm setchannel** or **bmonscan setchannel**

If you are using **runscan** set the beam monitor with the *mode* setting in the runscan arguments.

Setting modes for the beam monitors

The mode for a beam monitor, either `Timer` or `Monitor` can be set using **bm mode**, where bm can be bm, bm1, bm2 etc. The mode of the mulitcounter **bm** may be different from the mode of the selected beam monitor e.g. **bm1 mode**.

Even if you select bm1 using **bm setchannel 0** or **bmonscan setchannel 0**, changing the mode of bm1 e.g. **bm1 mode monitor** will not change **bm mode**.

bm mode is set by the most recent **bmonscan run**.

Active beam monitor commands (bm)

The active beam monitor **bm** has the following commands. These commands are get only

`bm_preset`	scalar value at which an acquisition will be stopped. Used in conjunction with *`mode`* get only tree interface **/monitor/preset**
`bm_mode`	mode to stop acquisitions, either `Timer` or `Counter` get only Return values: `Timer` will stop acquisition **preset** seconds after the acquisition is started `Monitor` will stop acquisition **preset** counts after the acquisition is started tree interface **/monitor/mode**
`tree interface only`	gets the scalar value for the instantaneous time of the beam monitor selected to control the experiment. get only Units: seconds tree interface **/monitor/time**
`tree interface only`	gets the scalar value for the instantaneous counts of the beam monitor selected to control the experiment. get only Units: counts tree interface **/monitor/data**

bm is available in the tree interface under the /monitor node, and attributes can be set and get using the **hget** and **hset** commands.

Specific beam monitor commands (bm1)

Each beam monitors are accessible as SICS objects, and in the tree interface under the /monitor node. They can be addressed by name, or using the hget commands when using the tree interface. There are generally either 1, 2 or 3 monitor per instrument, and the commands are of the form

bm1_...

where 1 can be 1, 2 or 3

For simplicity, all the command descriptions below will use **bm1**

bm1_counts	returns the instanteous value of the number of counts Units: counts tree interface */monitor/bm1_counts*
bm1_event_rate	returns the instanteous value of the count rate Units: counts per second tree interface */monitor/bm1_event_rate*
bm1_time	return the instantaneous time on this beam monitor. Each beam monitor can have a unique time value. Units: seconds tree interface */monitor/bm1_time*
bm1_status	Return values: `RUNNING` Beam monitor is enabled `DISABLED` Beam monitor is disabled tree interface */monitor/bm1_status*

Commands used on both active (bm) and specific (bm1) beam monitors

Use the commands on either **bm** or **bm1**

Please replace *bm1* with the beam monitor you want to control.

*A setting on **bm** will not change the setting on the selected beam monitor e.g. **bm1***

bm1 preset value	get or set a preset *value* for *bm1*. This is the value at which the acquisition will be stopped. Used in conjunction with *mode*
bm1 mode value	get or set the mode to stop acquisitions, either `timer` or `monitor` *value* must be one of these options `timer` will stop acquisition **preset** seconds after the acquisition is started `monitor` will stop acquisition **preset** counts after the acquisition is started
bm1 status	returns the monitor status. e.g. bm1.CountStatus = 10000 0 Beam: 0 E6 = preset, current control value, current counts. The current counts may be high by 10 times. To be tested and fixed.
bm1 count value	Sets the preset to *value* and runs the counter to the preset.

Use **hget** with the tree interface e.g. **hget /monitor/bm1_counts**.

hget /monitor/bm1_counts will return the same value as **bm1_counts**

These attributes are get only e.g. **hget /monitor/bm1_counts**

The next section refers to **histmem** which is most commonly used. The second section will refer to bm, and how it interacts with **histmem**

Configuring counters

Counters must be configured into the SICS server with the MakeCounter command, they cannot be added dynamically to a running server. The MakeCounter command has the following syntax

MakeCounter *name type [parameters]*

The list of parameters depends on the type of counter that is being created.

Chapter 12. Histogram Control

Ferdi Franceschini

histmem command

You can start and stop acquisitions and do limited configuration the histogram server with the histmem command.

Note that histmem does not save data. You have to explicitly use the save command.

The histogram memory server is a component that is separate from SICS. SICS currently exposes only a subset of the histogram server interface. In the future, Gumtree will provide an editor for the histogram server configuration files.

For a simple experiment in beam monitor mode, where you want to histogram data until one million counts are counted in the beam monitor, from the command line you would

```
...
histmem mode MONITOR_1
histmem preset 1000000
histmem start
"wait until the histogram is finished"
save
```

For subsequent acquisitions where you want to do fast starts of the histogram server because you don't need to change configuration

```
histmem pause
do something in SICS like change the sample or temperature
histmem start
"wait until the histogram is finished"
save
```

You must call the histmem command with one of the following subcommands

histmem start `block`	will start an acquisition in the current mode The option `block` prevents subsequent commands from being processed until the histmem is finished. Used in scripts, when using the **count** or **time** modes
histmem stop	will stop the histogram memory if it is running in **unlimited** mode that has been started without the `block` option. NOTE: If you are running in 'unlimited & block' mode, count or time modes, you must send an INT1712 1 to abort the acquistion or hit the Interrupt button in Gumtree.
histmem veto `enable/disable`	`disable` will stop the histogram memory from counting and not clear memory. It will have no effect on configuration. Use this command if you need to pause a measurement without clearing the memory. `enable` will resume counting without clearing the memory.

histmem pause

if MULTIPLE_DATASETS=ENABLE mode (default - but check)

use pause instead of stop for a 'fast' start. Use this if you don't have to change the histogram memory configuration. Clears histograms and counters, but doesn't reinitialisation the histogram server.

if MULTIPLE_DATASETS=DISABLE mode

use pause instead of veto. Does not clear histograms and counters, does not reinitialise the histogram server. Data is accumulated.

Note that the MULTIPLE_DATASETS mode is set in the SICS hmm configuration files and/or on the histogram memory server. SICS does not report this value. To view this value, you must look at the config tab on the histogram server web client.

histmem mode *mode*

Allowed *mode* one of:

MONITOR_n (where n=1,2,3 ...). If you set the mode to MONITOR_1 then the server will stop when MONITOR_1 reaches the **preset** counts

time will stop at the **preset** time after **start**

unlimited will stop when it receives a **histmem stop** or INT1712 1

count will stop when the total histogram counts reaches **preset** counts

frame will stop when the **preset** number of TOF (time of flight) frames. e.g. when there's no TOF, there is an internal frame frequency which by default is 50Hz. So if you have a **preset** of 1000 frames you will get a 20 second acquisition

period will stop when it reaches **preset** number of periods. A histogram period contains some number of frames averaged together - this is controlled by the BAT (base address table) and its attributes. The mapping can be fairly complex (e.g. time-averaged, time-history and stroboscopic acquisition) so there's not always a simple relationship between number-of-periods acquired and the DAQ time, but it can be worked out from the BAT setup

count_roi

Not supported. Will stop when the total histogram counts reaches **preset** counts in a region of interest defined in the histogram server configuration.

histmem preset *val*

the acquisition will terminate after the *val* period. This is seconds if the mode is time, and counts if the mode is count or MONITOR_n.

histmem freq *val*

val is the frame frequency (Hz) for time resolved data. If you set a frequency of zero then this will default to 50Hz.

histmem fsrce *frame_source*

Allow values of *frame_source* are:

	`EXTERNAL` (default) `INTERNAL` You can set this to `INTERNAL` if you don't have an external frame signal
histmem status	**Warning** This doesn't report anything Started, Stopped, or Paused
histmem loadconf	this uploads configuration tables (e.g. OAT for setting bins) to the histogram memory
OAT_TABLE	with no arguments will print out SICS's copy of the OAT_TABLE
OAT_TABLE `-set X {` *`bb0 bb1`* `} Y {`*`bb0 bb1`*`} T {`*`bb0 bb1`*`}`	will generate a table starting at bin boundary *`bb0`* with a spacing of (bb1-bb0) extrapolated to the maximum bin boundary. The numbers of channels are calculated automatically.
OAT_TABLE `-set X {` *`bb0 bb1`* `} Y {`*`bb0 bb1`*`} T {`*`bb0 bb1`*`} NTC` *`val1`* `NXC` *`val2`* `NYC` *`val3`*	this version sets the number of channels explicitly

SICS cannot read the current OAT_TABLE from the histogram server, the only way to make sure that SICS is in sync with the histogram memory is to use the SICS **OAT_TABLE** `-set` command to change your table and then to upload it to the histogram server with the **histmem loadconf** command

Histogram memory object

In most cases, the **histmem** command will be sufficient to configure and control an experiment.

This section describes a richer level of configuration and control, using the SICS histogram memory object. The histogram memory object in SICS is used to set the configuration of the histogram memory server (described in detail in a later chapter), and to get the current histogram memory server configuration and data. Note that it is possible to for the histogram memory's configuration to be set independently from SICS e.g. through the histogram memory's web interface. Therefore, care must taken to ensure synchronisation between the SICS histogram memory object and the histogram memory server.

SICS has seven histogram-memory objects as follows:

hmm

hmm_xy

hmm_xt

hmm_yt

hmm_x

hmm_y

hmm_t

which you can use to fetch xyt, xy, xt, yt, x, y and t data.

For simplicity, we will use *hm* to refer to any of the 7 histogram memory objects. Make sure you use the one appropriate to your measurement.

hm **get 1**	gets the current histogram memory data ie. 'live' data
hm **zipget 1**	gets the current histogram memory data in binary zip form
hm **configure rank**	gets the rank of the current histogram memory
hm **configure dim***n*	gets the current histogram memory data in binary zip form

Chapter 13. Simple Scans

Ferdi Franceschini

runscan command

You can run a histogram memory scan with the **runscan** command. With this command you can acquire data with the histogram memory server while scanning against a "drivable" device, eg motors, temperature controllers. By default this saves time resolved, ie HISTOGRAM_XYT data at each scan point.

Multi-dimensional scans, where you would like to scan say temperature and a motor, have to be done in a batch file, or by using a tcl **for** loop, which may contain a runscan. See Chapter5. Batch Manager

Note

The data acquired at each scan point is saved before going to the next point.

runscan *scanvar start stop numpoints mode preset [force datatype savetype]*

Arguments must be in the order described

scanvar	a drivable device, ie a motor or temperature controller etc
start	the start position for the scan variable
stop	the stop position for the scan variable
numpoints	the number of scan points (the start and stop positions will be included in the scan)
mode	Allowed *mode* one of: **time** **unlimited** **period** **count** **frame** **MONITOR_n** (where n=1,2,3 ...) If you set the mode to MONITOR_1 then the histogram server will stop when MONITOR_1 reaches the preset number of counts which has been set with the following *preset* parameter
preset	the acquisition duration at each scan point, this is in second if the mode is time, or counts if the mode is count or MONITOR_n

runscan options

These parameters must be supplied as a name-value pair, e.g. **datatype** HISTOGRAM_Y

They can be given in any order.

force *val*

Force a scan

Allowed *val* one of:

`true`

`false` (default)

If you really want to, you can force a scan when the instrument isn't ready. This can be useful for getting a background reference.

datatype *val*

Select the histogram memory **datatype** to save in your data file.

Allowed *val* one of:

`HISTOGRAM_T`

`HISTOGRAM_X`

`HISTOGRAM_XT`

`HISTOGRAM_Y`

`HISTOGRAM_YT`

`HISTOGRAM_XY`

`HISTOGRAM_XYT` (default)

savetype *val*

Allowed *val* one of:

`save` (default)

`nosave`

By default your data will be saved in a file with a three letter instrument prefix and a run number. If you use **savetype** `nosave` then the data will be written to a scratch file called scratch.nx.hdf

Example 13.1. runscan example

runscan `sphi 0 2 4 time 5`

This will run a four point scan with the sphi motor starting at 0 and stopping at 2. The data will be acquired over five seconds at each point, with the default datatype HISTOGRAM_XYT, and saved in a file with a three letter instrument prefix and run number.

Example 13.2. runscan example

runscan `mom 69.000 75 2` **MONITOR_2** 3000 **savetype** `nosave` **datatype** `HISTOGRAM_Y` **force** `true`

This example sets all **runscan** parameters

bmonscan command

You can run a beam monitor scan with the **bmonscan** command. With this command you can acquire data with a counter in the histogram memory server while scanning against a "drivable" device, eg

motors. The main detector is not required. Generally this would be used to align an instrument, e.g. alignment of a monochromator or sample crystal.

Additional information can be found in the chapters "Counters", "User Defined Scans" and "Batch Manager".

bmonscan will create a data file of type BEAM_MONITOR.

Multi-dimensional scans have to be done in a batch file, or by using a tcl **for** loop, which may contain a runscan. See the chapter "Batch Manager".

Unlike runscan, bmonscan is a standard SICS scan object. This means you can configure, interrogate and control bmonscan using the commands in the chapter "User Defined Scans". This section has only a summary of the most used commands, which allows you to do a one variable scan.

Note

The data acquired at each scan point is saved before going to the next point.

bmonscan run *NP mode preset*

Executes a scan.

NP is the number of scan points

mode is the counter mode, either `timer` or `monitor`

preset is the preset value for the counter

Scan data is written to an output file.

tree interface */commands/scan/bmonscan/NP*

tree interface */commands/scan/bmonscan/mode*

tree interface */commands/scan/bmonscan/preset*

bmonscan clear

Clears the list of scan variables. Must be called before each scan that has different parameters.

bmonscan add *variable start increment*

Adds the variable specified by the argument *variable* to the list of variables scanned in the next scan. The arguments *start* and *increment* define the starting point and the step width for the scan on this variable.

tree interface */commands/scan/bmonscan/scan_variable*

tree interface */commands/scan/bmonscan/scan_start*

tree interface */commands/scan/bmonscan/scan_increment*

bmonscan getvarpar *i*

Prints the name, start and step of the scan variable number *i*

tree interface */commands/scan/bmonscan/scan_variable*

bmonscan setchannel *n*

Sets the beam monitor to collect data from, where *n* is an integer ID for the beam monitor to use. setchannel uses zero-based counting, so 0 is bm1 etc.

tree interface */commands/scan/bmonscan/channel*

Example 13.3. bmonscan example

bmonscan clear clears the list of scan variables

bmonscan add *`stth 0 0.1`* adds the motor stth to the scan, with a starting value of 0 degrees and an increment value 0.1 degrees

bmonscan getvarpar *`0`* lets you check the variable you are scanning, its start and step value. In this case it returns bmonscan.stth = 0.000000 = 0.100000

bmonscan setchannel *`0`* selects the first beam monitor, aka bm1. You'll need to check physically where this beam monitor is on the instrument you're driving

bmonscan run *`10 monitor 10000`* runs the scan with 10 scan points, in counter mode with a preset of 10000 counts.

Chapter 14. Batching Tasks

Ferdi Franceschini

Usage

The SICS batch manager reads commands from a Tcl script and executes them, you can use Tcl loops and logical constructs in the batch file, see the `Tcl command` reference. The batch manager command is **exe**. Refer to the command reference section below for syntax and usage.

Following is an example of an advanced batch file which runs some twotheta scans and omega scans several times each. The batch execution has been made dynamically configurable by using two tcl arrays, "scan()" and "batch()", to hold parameters for the scan commands and the loops. This means that the user can change the number of points per scan or the number of iterations in the loops from the command line before executing the batchfile. The 'if' statements at the start of the file initialise the arrays if they don't already exist.

Example 14.1. Batch file example

```
# This is an example of a dynamically configurable batch file.
# Set default values for the batch and scan parameters.
if { [info exists scan(np)] == 0 } { set scan(np) 5 }
if { [info exists scan(mode)] == 0 } { set scan(mode) timer }
if { [info exists scan(preset)] == 0 } { set scan(preset) 1.0 }
if { [info exists batch(repeatnum)] == 0 } { set batch(repeatnum) 3 }
clientput "Starting batch of twotheta scans"
MyScan add twotheta 50 0.01
for {set i 0} {$i < $batch(repeatnum)} {incr i} {
    clientput "twotheta scan: $i"
    MyScan run $scan(np) $scan(mode) $scan(preset)
}

MyScan clear
clientput "Starting batch of omega scans"
MyScan add omega 50 0.01
for {set i 0} {$i < $batch(repeatnum)} {incr i} {
    clientput "omega scan: $i"
    MyScan run $scan(np) $scan(mode) $scan(preset)
}
```

Assuming that the file is called batch.tcl, the user could execute it as follows

```
set scan(np) 100
exe batch.tcl
```

Warning about the run command

The **run** command does not wait for a move to complete before it returns, this means that the batch manager will execute any following commands straight away. If you want move an axis and then perform some action after the move is completed you should use the **drive** command instead of **run**. The following batch file will print the message after the move is complete.

```
drive omega 5
clientput "omega is has reached five degrees"
```

Commands

The batch buffer manager handles the execution of batch files. It can execute batch files directly. Additionally, batch files can be added into a queue for later processing. The batch buffer manager supports the following commands described below. The command for controlling the batch manager is called **exe**

exe append *'tcl commands'*

Note

don't know the syntax. nha
Append some tcl commands.

exe *buffername*

directly load the buffer stored in the file *buffername* and execute it. The file is searched in the batch buffer search path.

exe batchpath *newpath*

Without an argument, this command lists the directories which are searched for batch files.

newpath sets a new search path. It is possible to specify multiple directories by separating them with colons.

exe clear

Clears the queue of batch buffers. For safety, use in conjuction with **exe clearupload**

exe clearupload

Clears partially uploaded batch buffers.

exe enqueue *buffername*

Appends *buffername* to the queue of batch buffers to execute.

exe forcesave *filename*

Will overwrite an existing batch file without warning.

exe info

prints the name of the currently executing batch buffer

exe info stack

prints the stack of nested batch files (i.e. batch files calling each other).

exe info range *name*

Without an argument prints the range of code currently being executed.

name prints the range of code executing in named buffer within the stack of nested buffers. The reply looks like:

```
number of start character = number of end
character = line number
```

exe info text *name*

Without an argument prints the code text currently being executed.

name prints the range of code text executing in the named buffer within the stack of nested buffers.

exe interest

Switches on automatic notification about starting batch files, executing a new bit of code or for finishing a batch file. This is most useful for SICS clients watching the progress of the experiment.

exe print *buffername*	Prints the content of the batch buffer *buffername* to the screen.
exe queue	Prints the content of the batch buffer queue.
exe run	Starts executing the batch buffers in the queue.
exe save *filename*	Save the commands to a batch file. Returns an error if you try to overwrite an existing batch file
exe syspath *newpath*	Without an argument, this command lists the system directories which are searched for batch files. *newpath* sets a new system search path. It is possible to specify multiple directories by separating them with colons.
exe upload	Prepare the batch manager to upload a new set of commands from the client

Chapter 15. User Defined Scans

Ferdi Franceschini

Creating a Scan Command

A scan command must first be initialised with **MakeScanCommand** command in the SICS configuration file before it can be used. **MakeScanCommand** initialises the SICS internal **scan** command.

MakeScanCommand *name countername headfile recoverfil*

Arguments must be in the order described

name	The scan will be accessible as *name* in the system.
countername	The name of a valid counter object to use for counting
headfile	The full pathname of a header description file. This file describes the contents of the header of the data file. The format of this file is described below
recoverfil	The full pathname of a file to store recover data. The internal scan command writes the state of the scan to a file after each scan point. This allows for restarting of aborted scans.

Using a Scan Command

The scan command (named here **MyScan**, but may have another name) understands the following commands:

MyScan run *NP mode preset*	Executes a scan. *NP* is the number of scan points *mode* is the counter mode, either `timer` or `monitor` *preset* is the preset value for the counter Scan data is written to an output file.
MyScan add *name start step*	Adds the variable specified by the argument *name* to the list of variables scanned in the next scan. The arguments *start* and *step* define the starting point and the step width for the scan on this variable.
MyScan appendvarpos *i pos*	Append *pos* to the array of positions for scan variable *i*. To be used from user defined scan functions.

MyScan callback *status*	Triggers callbacks configured on the scan object.
	Allow *status* one of:
	`scanstart`
	`scanpoint`
	`scanend`

	May be used by user functions implementing own scan loops.
MyScan clear	Clears the list of scan variables. Must be called before each scan that has different parameters.
MyScan configure *mode*	Configures the scan *mode* Allowed *mode* one of: `standard` (default). Writing ASCII files `script` Scan functions are overriden by the user. `soft` The scan stores and saves software zero point corrected motor positions. The standard is to save the hardware positions as read from the motor controller.
MyScan continue *NP mode preset*	Continues an interrupted scan. Used by the recovery feature.
MyScan function list	Lists the available configurable function names. The calling style of these functions is described in the next section about stdscan.
MyScan function *functionname*	Returns the currently configured function for *functionname*
MyScan function *functionname newfunctionname*	Sets a new function to be called for the function *functionname* in the scan.
MyScan getcounts	Retrieves the counts collected during the scan.
MyScan getfile	Returns the name of the current data file
MyScan getmonitor *i*	Prints the monitor values collected during the scan for monitor *i*
MyScan gettime	Prints the counting times for the scan points in the current scan.
MyScan getvardata *n*	Retrieves the values of a scan variable during the scan (the x axis). *n* is the ID of the scan variable to retrieve data for. ID is 0 for the first scan variable added, 1 for the second etc.
MyScan getvarpar *i*	Prints the name, start and step of the scan variable number *i*
MyScan interest	A SICS client can be automatically notified about scan progress. This is switched on with this command. Three types of messages are sent: a string `NewScan` on start of the scan a string `ScanEnd` after the scan has finished a string `scan.Counts = {109292 8377 ...}` with the scan values after each finished scan point.
MyScan uuinterest	As for **interest** but the array of counts is transferred in UU encoded format.

MyScan dyninterest As for **interest** but scan points are printed one by one as a list containing:

point number first_scan_var_pos counts.

MyScan uninterest Uninterest switches automatic notification about scan progress off.

MyScan integrate Calculates the integrated intensity of the peak and the variance of the intensity for the last scan.

Returns either an error when insufficient scan data is available, or a pair of numbers. Peak integration is performed along the method described by Grant and Gabe in J. Appl. Cryst. (1978), 11, 114-120.

MyScan log *var* Adds *var* to list of variables logged during the scan. Can be slave motors such as `stt, om, chi, phi` during four circle work. These variables are not driven, just logged. *var* is the SICS variable to log. Only drivable parameters may be logged in such a way.

MyScan noscanvar Prints the number of scan variables

MyScan np Prints the number of points in the current scan.

MyScan setchannel *n* Sometimes it is required to scan not the counter but a monitor. This command sets the channel to collect data from. *n* is an integer ID for the channel to use.

MyScan simscan *pos FWHM height*

Warning

BROKEN

This is a debugging command. It simulates scan data with a hundred points between an x axis ranging from 10 to 20. A gaussian peak is produced from the arguments given:

pos the position of the peak maximum

FWHM is the full width at half maxxximum for the peak

height is its height

MyScan silent *NP mode preset* Executes a scan.

Does not produce an output file

MyScan storecounts counts time mon1 mon2 ...

Warning

Don't understand the syntax nha.

This stores an entry of count values into the scan data structure. To be used from user defined scan functions. The scan pointer is incremented by one.

MyScan storecounter Store the counts and monitors in the counter object configured for the scan into the scan data structure. Increments the scan pointer by one.

MyScan recover Recovers an aborted scan.

The scan object writes a file with all data necessary to continue the scan after each scan point. If for some reason a scan has been aborted due to user intervention or a system failure, this scheme allows to continue the scan when everything is alright again. This works only if the scan has been started with **run**, not with **silent**

MyScan window *newval* — Peak Integration uses a window in order to determine if it is still in the peak or in background. This command allows to request the size of this window (without argument) or set it with *newval*

User Definable Scan Functions

The last commands in the last section allow overloading functions that implement various operations during the scan with user defined functions. This section is the reference for user defined functions. The following operations during a scan can be configured:

count MyScan *userobjectname point mode preset* — Called at each scan point to perform the counting operation

collect MyScan *userobjectname point* — Called for each scan point. This function stores the scan data into the scan data structure.

drive MyScan *userobjectname point* — **drive** to the next scan point

finish MyScan *userobjectname* — Called after the scan finishes and may be used to dump a data file or perform other clean up operations after a scan.

prepare MyScan *userobjectname* — Does operations before a scan starts.

userdata — This is the name of a user defined object which may be used to store user data for the scan.

writeheader MyScan *userobjectname* — Write the header of the data file

writepoint MyScan *userobjectname point* — Called for each scan point. Prints information about the scan point to the data file and to the user.

MyScan is the name of the scan object invoking the function. This can be used for querying the scan object. *userobjectname* is the name of a entity as specified as userdata in the configuration. point is the number of the current scan point.

Chapter 16. Batch Manager

Ferdi Franceschini

Commands

The batch buffer manager handles the execution of batch files. It can execute batch files directly. Additionally, batch files can be added into a queue for later processing. The batch buffer manager supports the following commands described below. The command for controlling the batch manager is called **exe**

exe *buffername*
directly load the buffer stored in the file *buffername* and execute it. The file is searched in the batch buffer search path.

exe batchpath *newpath*
Without an argument, this command lists the directories which are searched for batch files.

newpath sets a new search path. It is possible to specify multiple directories by separating them with colons.

exe syspath *newpath*
Without an argument, this command lists the system directories which are searched for batch files.

newpath sets a new system search path. It is possible to specify multiple directories by separating them with colons.

exe info
prints the name of the currently executing batch buffer

exe info stack
prints the stack of nested batch files (i.e. batch files calling each other).

exe info range *name*
Without an argument prints the range of code currently being executed.

name prints the range of code executing in named buffer within the stack of nested buffers. The reply looks like:

```
number of start character = number of end character = line number
```

exe info text *name*
Without an argument prints the code text currently being executed.

name prints the range of code text executing in the named buffer within the stack of nested buffers.

exe enqueue *buffername*
Appends *buffername* to the queue of batch buffers to execute.

exe clear
Clears the queue of batch buffers

exe queue
Prints the content of the batch buffer queue.

exe run
Starts executing the batch buffers in the queue.

exe print *buffername*
Prints the content of the batch buffer *buffername* to the screen.

exe interest
Switches on automatic notification about starting batch files, executing a new bit of code or for finishing a batch file. This

	is most useful for SICS clients watching the progress of the experiment.
exe upload	Prepare the batch manager to upload a new set of commands from the client
exe append *'tcl commands'*	**Note** don't know the syntax. nha Append some tcl commands.
exe save *filename*	Save the commands to a batch file. Returns an error if you try to overwrite an existing batch file
exe forcesave *filename*	Will overwrite an existing batch file without warning.

Chapter 17. TCL command language interface

Ferdi Franceschini

Common commands & exclusions

From the PSI SANS documentation by Dr. Joachim Kohlbrecher and Dr. Mark Könnecke with slight modifications.

The macro language implemented in the SICS server is `John Ousterhout` Tool Command Language `TCL` . Tcl has control constructs, variables of its own, loop constructs, associative arrays and procedures. Tcl is well `documented` by several books, online tutorials and manuals. All SICS commands are available in the macro language.

Some potentially harmful Tcl commands have been deleted from the standard Tcl interpreter. These are:

exec

source

puts

vwait

exit

gets

socket

Below only a small subset of the most important Tcl commands like assigning variables, evaluating expressions, control and loop constructs are described. For complete description of Tcl commands have a look on the `manual pages` or on one of the many books about Tcl/Tk.

set *varName value* **set** *arrName(index) value*

Set/get scalar variables or array elements. Arrays in Tcl are actually associative arrays, this means that their indices are not restricted to integers. The following examples demonstrate setting a scalar variable and a couple of array elements. Note the third array example which shows that the same array can have mixed indices (the number 1 and 'one') as well as mixed data types (the number 10 and 'ten') in the same array.

```
set a 3
set arr(1) 10
set arr(one) ten
```

expr *arg arg arg*

Concatenates arg's (adding separator spaces between them), evaluates the result as a Tcl expression, and returns the value. The operators permitted in Tcl expressions are a subset of the operators permitted in C expressions, and they have the same meaning and precedence as the corresponding C operators. Expressions almost always yield numeric results (integer or floating-point values). For example, the expression

```
expr 8.2 + 6
```

evaluates to 14.2. For some examples of simple expressions, suppose the variable a = 3 and b = 6. Then the commands shown below will produce the value after the ->

```
set a 3
set b 6
expr 3.1 + $a                    -> 6.1
expr 2 + "$a.$b"                 -> 5.6
expr [ splitreply [omega] ] / 2.0 ->
                      omega axis position / 2.0
```

Note the use of square brackets [] for command substitution.

Math functions

Tcl supports the following mathematical functions in expressions:

acos	cos	hypot	sinh
asin	cosh	log	sqrt
atan	exp	log10	tan
atan2	floor	pow	tanh
ceil	fmod	sin	

Note you must use the **expr** command to invoke these functions eg,

```
expr cos(0)
set pi [expr acos(-1)]
expr sin($pi)
```

Each of these functions invokes the math library function of the same name; see the manual entries for the library functions for details on what they do. Tcl also implements the following functions for conversion between integers and floating-point numbers and the generation of random numbers:

abs(*arg*), **double**(*arg*) , **int**(*arg*), **rand**(*arg*), **round**(*arg*), **srand**(*arg*).

if - execute scripts conditionally

```
if expr1 then
  body1
elseif expr2 then
  body2
elseif...
else
  bodyN
```

The **if** command evaluates *expr1* as an expression (in the same way that **expr** evaluates its argument). The value of the expression must be a boolean (a numeric value, where 0 is false and anything is true, or a string value such as "true" or "yes" for true and "false" or "no" for false); if it is true then *body1* is executed by passing it to the Tcl interpreter. Otherwise *expr2* is evaluated as an expression and if it is true then *body2* is executed, and so on. If none of the expressions evaluates to true then *bodyN* is executed. The **then** and **else** arguments are optional "noise words" to make the command easier to read. There may be any number of **elseif** clauses, including zero. *BodyN* may also be omitted as long as **else** is omitted too. The return value from the command is the result of the body script that was executed, or an empty string if none of the expressions was non-zero and there was no *bodyN*.

Example 17.1. "if"

```
set a 3
  if {$a == 3} {puts "a equals three"}
```

for - "for" loop

```
for start test
  next
  body
```

for is a looping command, similar in structure to the C **for** statement. The *start, next*, and *body* arguments must be Tcl command strings, and *test* is an expression string. If a **continue** command is invoked within *body* then any remaining commands in the current execution of *body* are skipped; processing continues by invoking the Tcl interpreter on *next*, then evaluating *test* , and so on. If a **break** command is invoked within *body* or *next* , then the **for** command will return immediately. The operation of **break** and **continue** are similar to the corresponding statements in C. **for** returns an empty string.

Example 17.2. "for"

```
for {set x 0} {$x<10} {incr x} {puts "x is $x"}
```

while - execute script repeatedly as long as a condition is met

```
while test
  body
```

The **while** command evaluates *test* as an expression (in the same way that **expr** evaluates its argument). The value of the expression must be a proper boolean value; if it is a true value then *body* is executed by passing it to the Tcl interpreter. Once *body* has been executed then *test* is evaluated again, and the process repeats until eventually *test* evaluates to a false boolean value. **continue** commands may be executed inside *body* to terminate the current iteration of the loop, and **break** commands may be executed inside **body** to cause immediate termination of the **while** command. The **while** command always returns an empty string.

Example 17.3. "while"

```
set x 0
  while {$x<10} {
  puts "x is $x"
  incr x
}
```

Part IV. CONFIGURATION AND TROUBLESHOOTING

Table of Contents

Chapter 18. Personal configuration

Nick Hauser

Personalised configuration. extraconfig.tcl

You can add your own variables and functions to sics. Start by opening /usr/local/sics/extraconfig.tcl in a text editor (this is on the ics computer).

The purpose of the extraconfig.tcl file is to allow instrument scientists and users to create personal configurations, that can be stored in the user's home directory and reused later if required. It also allows users to experiment with additional features, that once proven, can be migrated to an appropriate configuration file

Edit the file using the patterns provided below.

For the changes to take effect, you'll need to save the file and stop and restart sics.

Adding a procedure

To add a procedure to SICS. Say you want to add the procedure **movdet** to sics and set by a user,

```
proc movedet {pos} {

drive dhv1 600
drive det $pos
drive dhv1 2350
}
publish movedet user
```

This function will drive the high voltage controller to 600 volts, move the motor **det** to position *pos* and drive the high voltage controller to 2350 volts

publish is a SICS manager command which makes a Tcl command or procedure visible in the SICS interpreter. **publish** provides a special wrapper for a Tcl command, which first checks the user rights of the client connection which wants to execute the Tcl command. If the user rights are appropriate the command is invoked in the Tcl–interpreter.

Adding a variable

To add a variable, use the **mkVar** procedure. **mkVar** is a Tcl wrapper for the SICS function **VarMake**. These 2 functions share the same first 3 parameters.

To view these settings, use **hlistprop** *name*

::utility::mkVar *name type access_privilege long_name nxsave class control data*

name	name on the sics command line
type	text, int, float
access_privilege	spy, user, manager, internal, readonly
long_name	long name
nxsave	saves to NeXus file

	true, false (default).
class	node under which this variable is saved and controlled
	e.g. instrument, sample
control	will appear in the Gumtree table tree if this is set to true
	true, false (default)
data	will appear in the data node of NeXus file if this is set to true. nxsave must also be set to true.
	true, false (default)

Example

::utility::mkVar starttime Text user start true experiment true true

creates a variable called starttime, which is a text variable requiring user privilege to set. The long_name is start, it will be saved to the NeXus file under the 'experiment' node and appear in the Gumtree table tree.

Chapter 19. Motor Configuration

Ferdi Franceschini

Configuration example

Motors are configured by following this pattern

- Setup the host and port of the controller
- Make the motor queue
- Set the home value for the absolute encoder
- Set the motor configuration parameters

Example 19.1. Motor configuration example

from `ics1-echidna.nbi.ansto.gov.au:/usr/local/sics/server/config/motors/motor_configuration.tcl`

```
# Setup addresses of Galil DMC2280 controllers.
            set dmc2280_controller1(host) mc1-$animal
            set dmc2280_controller1(port) pmc1-$animal
            ...
            MakeAsyncQueue mc1 DMC2280 $dmc2280_controller1(host) \
            $dmc2280_controller1(port)
            ...
            #Measured absolute encoder reading at home position
            set mphi_Home 7781389
            ...
            # Monochromator phi, Tilt 1, upper
            Motor mphi $motor_driver_type [params \
            asyncqueue mc1\
            absEnc 1\
            absEncHome $mphi_Home\
            axis A\
            cntsPerX -8192\
            hardlowerlim -2\
            hardupperlim 2\
            maxSpeed 1\
            maxAccel 1\
            maxDecel 1\
            stepsPerX -25000\
            units degrees]

            setHomeandRange -motor mphi -home 0 -lowrange 2 -uprange 2
            mphi speed 1
            mphi movecount $move_count
            mphi precision 0.05
            mphi part crystal
            mphi long_name phi
```

Configuration checklist

Always use a positive number for the motor steps conversion multiplier.If the encoder counts decrease when the motor steps increase then the encoder counts conversion multiplier must be negative.

For each axis with an absolute encoder

1. How many motor steps are there per degree or mm?
2. How many encoder counts are there per degree or mm?
3. Move the motor a positive number of steps.If the encoder counts has increased then set the *stepsPerX* positive otherwise negative.
4. If encoder counts decrease when motor steps increase then set the sign of *cntsPerX* to the opposite sign of *stepsPerX*, otherwise the sign should be the same.
5. What is the encoder reading at the home position?

For each axis without an absolute encoder

1. How many motor steps are there per degree or mm?
2. Move the motor a positive number of steps.If the axis moved in the positive direction according to the coordinate conventions then set the *stepsPerX* positive otherwise negative.
3. Set axis home position.
   a. Make sure the axis HOME routine has been run. The axis should be at the lower limit and the motor defined position should be zero, ie TDx returns zero.
   b. Drive the axis to the home position and set *motorHome* to TDx

For all axes

1. Check that maxSpeed, maxAccel, and maxDecel are sane. NOTE: The initial speed, accel and decel will be set to the maximum values.
2. If an axis should not be powered down after each move then set noPowerSave=1.

Slits

The zero position for the slits is defined when the slits are closed but not overlapping. Since the slit motors don't have absolute encoders we need to define a zero reference for counting motor steps, we will call this reference the motorHome. The motorHome is set when the slits are fully open, there is a home subroutine (called #HOME) on the DMC2280 controller which can be called to set this position for you.

The homing code on the controller fully opens the slits and then sets the position as zero.

1. Run #HOME command on controller, ie XQ #HOME,1Useu
2. Check that the command has completed with MG _XQ1, a value of -1 means the command has finished otherwise it displays the current line number.
3. After the #HOME command has completed check that the defined motor positions has been set to zero by executing TDEFGH
4. run gap to zero, set lowerlims to -ve val if there is a gap, then run gap to -ve witdh.
5. Read position for each slit and set it as the "motorHome" parameter in the sics configuration file.

Testing

1. Check communications to all four controllers.
2. Try to run motor past limits.Does SICS reject the command?
3. Run motors to limits.Does it move in the right direction?Does it stop where expected?
4. Run motor to home position.Does it stop where expected?

5. Set limits
6. Set home
7. Set softzero
8. Set sign (direction of motion)
9. Set speed
10. Set acceleration
11. Set deceleration

Configuration reference

absEnc *integer*
Set to 1 if the axis has an absolute encoder

absEncHome *integer*
The calibrated "home" position in encoder counts

Required if **absEnc** = 1

axis *val*
The DMC2280 motor controller can control up to eight axes

Allowed *val* one of:

`A B C D E F G H`

cntsPerX *integer*
Number of absolute encoder counts per **unit** of movement along/about the axis of motion

hardlowerlim *integer*
Hardware lower limit for motor

harduppperlim *integer*
Hardware upper limit for motor

maxAccel *val*
Maximum allowed acceleration in **units** per second^2

maxDecel *val*
Maximum allowed deceleration in **units** per second^2

maxSpeed *val*
Speed in **units** per second

motorHome *integer*
The calibrated "home" position in motor steps. You only need to set this if the axis does not have an absolute encoder

motOffDelay *integer*
Number of msec to wait before switching off a motor after a move

Default = `0`

noPowerSave *val*
By default a motor will switch off after a move. If you set this to 1 the motor will stay on.

Allowed *val* one of:

`0` (default)

`1`

stepsPerX *val*
Number of motor steps per **unit** of movement along/about the axis of motion

units *val*
The units of motion for the axis, eg `degrees` for phi or two-theta, `mm` for translation

Allowed *val* one of:

`degrees`

mm

Chapter 20. Histogram Configuration - under construction

Ferdi Franceschini

Histogram Configuration

Histograms are the most complex objects in SICS, and when doing configuration you must have

The following uploads the text in the hmconfigscript dictionary variable as well as the other dictionary variables to the histogram server.

```
hmm configure init 1
hmm init
```

The following just uploads the values in the dictionary variables to the histogram server

```
hmm configure init 0
hmm init
```

The following simply updates the values of the dictionary variables listed in the http://localhost:8080/admin/textstatus.egi page.

```
hmm configure statuscheck true
hmm stop
hmm configure statuscheck false
```

Setting "statuscheck" to false prevents the dictionary variables from being updated every time there is a start, pause or stop.

OAT_TABLE

The oat_table is setup in the instrument specific configuration, the current default for all instruments is to set one large time bin with the upper bin boundary equal to the frame period (ie 20msec).

Histogram Data Axes

The x, y, theta, and time axes are calculated from the spatial and temporal bin boundaries, and a scale factor and offset.

Chapter 21. Motor Troubleshooting

Ferdi Franceschini

You can check for problems between SICS and the instrument by running the troubleshoot.tcl application in the /usr/local/sics/server/common directory.The trouble-shooter constructs a control panel from information in the SICS configuration file and from information in the troubleshoot_setup.tcl file. The trouble-shooter setup file specifies the expected configuration for the motor controllers, this file should be updated whenever the motor controller configuration is changed.

A Troubleshooting Session

Warning

This chapter requires testing. nha. 1 May 2009

If you have a computer with an X server then you can troubleshoot your instrument via remote terminal session. If you are running linux on your computer then the following will just work. If you are using an Apple computer you should have the X11 support installed. If you are running windows you will need to have something like X-Win32 or or Cygwin (with X11) installed. Otherwise you will have to run this on the instrument control computer locally.

Starting the troubleshooter

First log on to the instrument control computer by entering the following in a terminal (linux or cygwin)

```
ssh -Y uname@ic-instname.nbi.ansto.gov.au
```

Where uname is your ANSTO user id and instname is the name of your instrument (eg echidna, wombat).

Once you have logged in, go to the sics server directory,

```
cd /usr/local/sics/server
```

There should be a troubleshoot.tcl script and troubleshoot_setup.tcl file in this directory, check this by listing the directory contents with the 'ls' command.

An example showing failures

This example uses the following troubleshoot_setup.tcl file for Echidna.

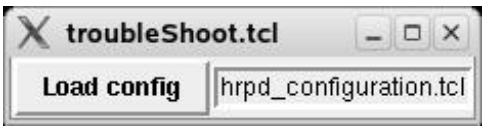
```
# ECHIDNA setupset configFileName "hrpd_configuration.tcl"# These subroutines sh
```

Two simulated failures and one real failure are demonstrated in what follows. I have simulated a missing subroutine error by adding a dummy subroutine name "#ABC" to controller one in the setup file above. A network failure is simulated by simply unplugging the ethernet cable from controller two. There is a real failure on controller three, a necessary thread was not running on that controller because a command failed in the auto start subroutine.

Start the troubleshooter with the following command

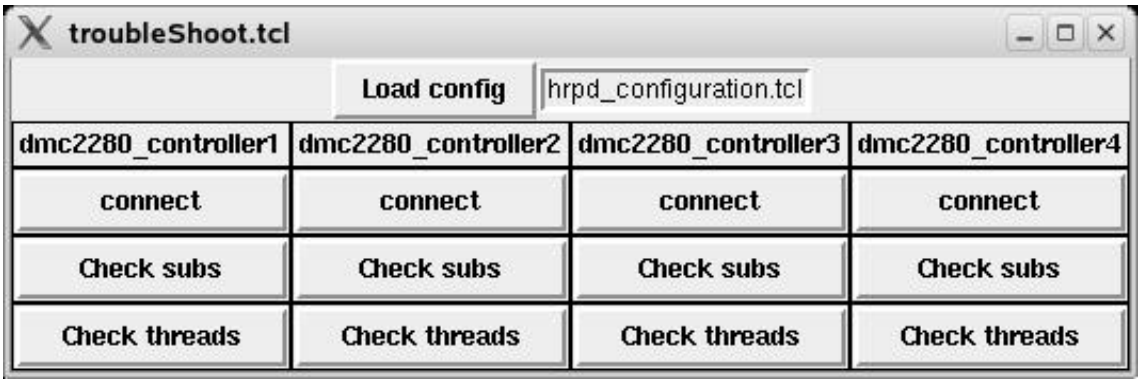
```
common/troubleshoot.tcl
```

You will see this dialog box which lets you specify the name of your instrument's configuration file.



Note: The default file name can be set in the "troubleshoot_setup.tcl" script.

When you press the "Load config" button a control window will be constructed from the information in the instrument configuration file and the "troubleshoot_setup.tcl" file.

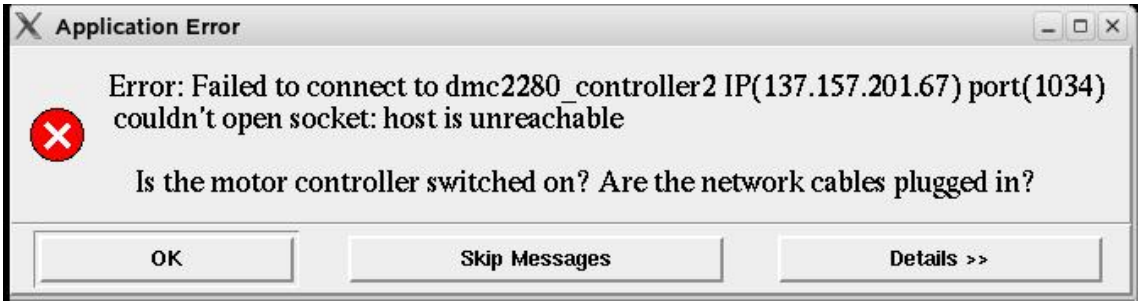


There is a column for each of the motion controllers specified in the instrument configuration file (hrpd_configuration.tcl in this example). The control buttons allow you to test the connection to each controller and then perform some tests on the controllers.

To test the communications and motor controller status just click on the buttons in each column from top to bottom. If the test succeeds the button lights up green, if it fails a message box describing the failure will pop-up. Following are some examples of the failure messages.

Motor Controller Communications Failure Example

When you press the connect button it should light up green if everything is OK, otherwise you will see the following message.



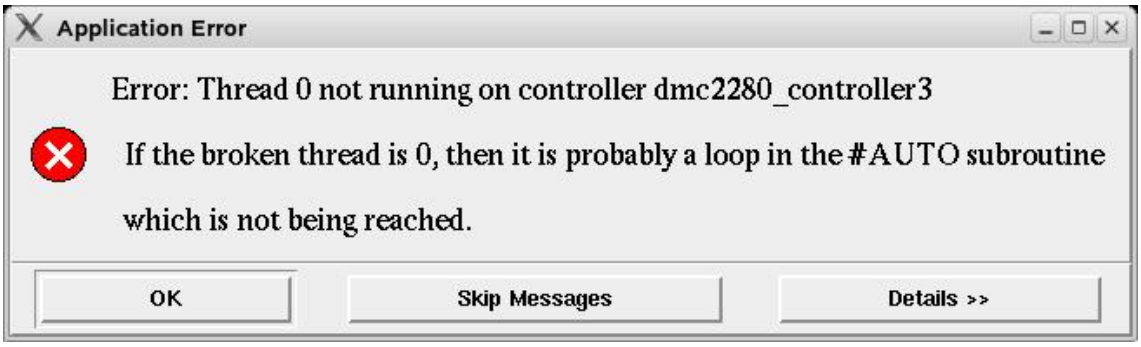
Missing motor controller subroutine example

Assuming that the connection has succeeded (ie the "connect" button is now green) then you can click on the "Check subs" button. If the check succeeds the button will light up green, if not you will see the following message.

This means the a required subroutine named "#ABC" was not found on controller one.

Motor controller thread not running example

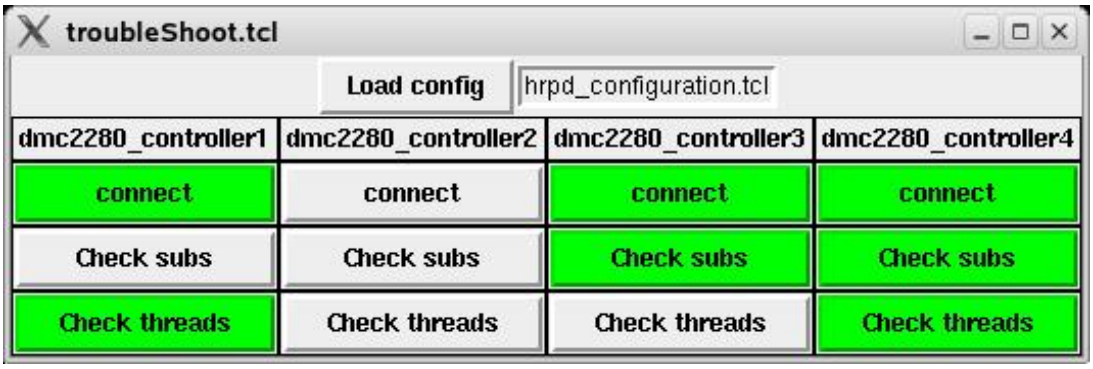
You can if necessary threads are running on the motor controller by clicking on the "Check threads" button. If the check succeeds then the button should now be green. On failure you will see the following message.



This means that something should be running in thread zero but it's not. Typically the #AUTO subroutine will be running an empty loop in thread zero to trigger trip points in the controller software.

Final status display

After completing all the tests for this example you will see the following display. This means that controller one is missing one or more subroutines, the connection failed on controller two, one or more required threads are not running on controller three, and all the tests succeeded on controller four.



Using sicsclient for troubleshoot

The **sicsclient** command line can be used for troubleshooting motors.

There can be circumstances when a third party, such as the handle-held wireless Galil controller, or a terminal client is used to control motors. In these cases, the values in SICS can be out of sync with those on the controller. The Galil controller can be interrogated using **send**.

mot1 **send** *"MG _SP`"*

In this example, the controller and axis of motor *mot1* will the sent a command which will return the speed *_SP* of the motor. Note that a substitution is made in SICS of the controller and axis using the backtick character `

The values from the controller can be compared manually with the values from SICS

mot1 **list**