AMECustom

Version 4.2 - September 2004

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Chapter 1: Introducing AMECustom

1.1 Presentation of this manual

The **AMECustom** user manual will help you to:

- understand the aim of **AMECustom** and what you can do with this complementary application of **AMESim**,
- learn how to customize submodels and supercomponents.

This user manual is split up into four chapters:

Chapter 1 introduces **AMECustom** and customized objects.

Chapter 2 gives two examples of customized submodels.

Chapter 3 gives two examples of customized supercomponents.

Chapter 4 is a reference chapter which can be used from the main index.

We recommend that you go through these examples before you attempt your own customizations.

1.2 What is AMECustom?

Before answering this question it is worth reviewing what you can do with each product of the **AMESim** suite.

AMESim

You build models by connecting together components either directly or using lines. In *Submodel* mode you attach mathematical descriptions to each component and line. These are either submodels or supercomponents. You can then change parameters, perform runs and analyze results.

You can also develop your own supercomponents.

AMERun

You cannot build models and supercomponents. But you can use models built from **AMESim** for changing parameters, performing runs and analyzing results.

AMESet

You create your own submodels for using them in **AMESim** models.

The submodels you create in **AMESet** and the supercomponents you create in **AMESim** are described as **generic**. When submodels are of a very general nature, the number of parameters to set can be very large. This is even more true for supercomponents. To overcome this problem the **customized** submodels and supercomponents were introduced.

AMECustom

In **AMECustom** you load generic objects (submodels or supercomponents) and then:

- fix and hide certain parameters,
- rename other parameters and set new default values,
- link together two or more parameters with a global parameter having a scope limited to the customized object,
- hide certain variables,
- retitle other variables and set new default values.

The result is a **customized** version of the **generic** object.

1.3 Customized submodels

An example of very simple level of customization of submodels is in the *Thermal Hydraulic* library. The fluid properties submodels *TFFD1* and *TFFD2* are generic submodels and associated with them are 10 customized versions of *TFFD1* and 10 customized versions of *TFFD2*.

Figure 1.1 shows the generic *TFFD1* with its 10 customized versions.

Figure 1.1: TFFD1 has 10 customized versions

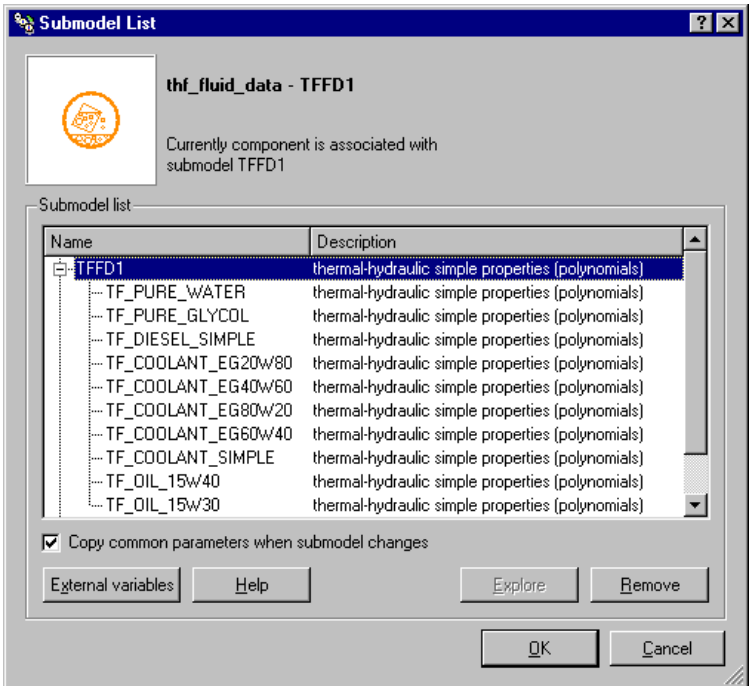
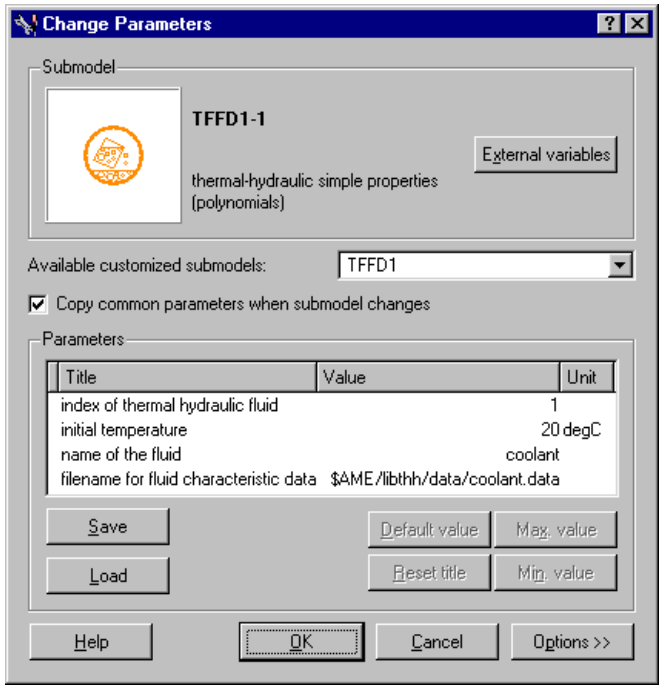


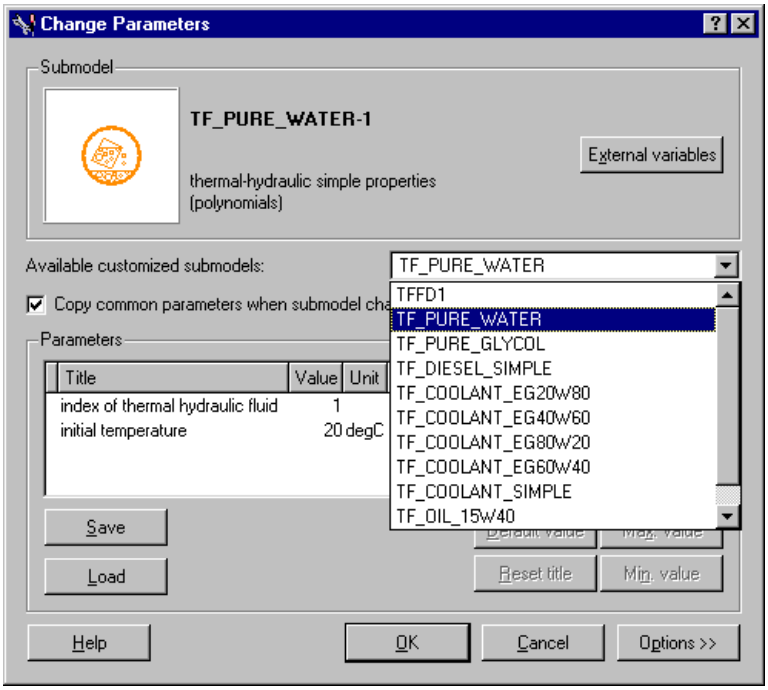
Figure 1.2 shows the generic submodel *TFFD1* in *Parameter* mode.

Figure 1.2: Generic submodel TFFD1 in Parameter mode



A customized version is shown in Figure 1.3.

Figure 1.3:Customized version in Parameter mode



Note the pulldown menu allowing switching between generic submodel and the 10 customized versions in *Parameter* mode. This does not involve any recompilation and it can be done in **AMERun** as well as **AMESim**. Note also the parameter list is shorter and simpler for the customized submodels.

This level of customization is very light but it is powerful and very valuable especially in **AMERun**. All that has happened is that in each customized versions, 2 parameters of the generic submodel are hidden. One of them is fixed to the name of a data file which supplies the information on the fluid concerned.

1.4 Customized supercomponents

When you customize a supercomponent, you make it appear in **AMESim** and **AMERun** as if it was a submodel. You can explore the contents of the customized supercomponent only in **AMECustom**, but if in **AMECustom** you saved it encrypted, you must supply the correct password to reopen it.

Customization can be multi-level: customized supercomponents can contain other customized objects.

1.5 Important rules for customized objects

Comments in this section are important but you may not fully understand their significance at a first reading. We suggest you reread it after completing the tutorial examples.

Customized submodels

For using a customized submodel in an **AMESim** model, the corresponding generic submodel must be available, and in particular its compiled code (*.o* or *.obj*) must exist.

Customized supercomponents

A customized supercomponent can be used in an **AMESim** model even if the corresponding generic supercomponent is deleted or unavailable.

Encryption

The **encryption** of a customized object in **AMECustom** does not affect anything in **AMESim**. However:

- If you look in the *.spe* and *.sub* files with an editor, you will find them rather difficult to understand!
- If you look in the *.cir* file created by **AMESim**, you will find that its relevant sections are also encrypted.
- Using **AMECustom**, when you try to open an encrypted customized object, you must enter the correct password before getting access to it.

Protection of encrypted objects

Working out the internal details of an encrypted customized submodel is possible given time. Concerning an encrypted customized supercomponent, without the corresponding generic supercomponent, it would be extremely difficult.

Distribution of systems containing customized objects

AMESim is increasingly used as a model exchange software. Customization with encryption is an important part of this process.

Suppose you send a compiled **AMESim** system containing one or more customized objects to another user. The *AMEPack* facility in **AMESim** is designed to make this easy.

The user can run the system in **AMERun**. Using **AMESim** it is also possible to run the system, but if the executable has to be recreated, **the following files are needed**:

- The object files of the generic submodels corresponding to the customized submodels,
- The object files of the generic submodels used in the customized supercomponent constituents.

However **the following files are NOT strictly needed**:

- Any *.spe* files and *.c* (or *.f*) files of generic submodels.
- Any *.spe* files of customized submodels.
- Any *.spe* and *.sub* files of any generic or customized supercomponents.

If confidentiality is important, use the above information to minimize the files you send in the package.

Chapter 2: Customizing submodels

2.1 Introduction

This chapter shows you how to customize **AMESim** submodels with simple tutorial examples. However, before attempting to read this chapter and doing the exercises, you should have experience at using **AMESim** and performing simple simulations with standard **AMESim** submodels.

Name conventions

For generic submodels and supercomponents the following restrictions apply to the names:

- Names must be of **4** to **23** characters comprising uppercase letters and digits.
- The first character must be a letter.

For customized objects the rules are the same except that the characters '-' (minus) and '_' (underscore) are permitted. It is a good idea to use these freely so as to make customized objects distinctive.

Please note also that:

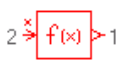
- In all the **AMESim** libraries, standard submodels and supercomponents have the first digit in their name (if any) in the range **0** to **4**, whether they are generic or customized.
- Hence, if you create your own customized objects with names that contain at least one digit and if the first digit is in the range **5** to **9**, there will be no risk of name clashes with existing standard objects.

2.2 Example 1: customized submodel of the cosine function

Objective:

- To create the simplest possible customized submodel.

The function submodel *FX00* belongs to the *Signal, Control and Observers* library. The icon it is associated with is shown. This submodel applies any user-supplied function of one variable x, to the input signal on port 2. The result is the output f(x) on port 1. The function *f* is defined by the user in *Parameter* mode.



A simple customization can be made to *FX00* to produce *COS50*, which will calculate the cosine of the input. We could also produce a sine version, an absolute value version and indeed a whole collection of customized versions of *FX00*.

For this simple example you will load the generic submodel *FX00* into **AMECustom** and customize it saving the resulting customized submodel as *COS50*. It is a good idea to create a special directory or folder called *tutorial* (for instance) and save all the customized submodels in this directory.

Step 1: Start AMECustom

Using Unix:

Talk to your system administrator who will show you how to set up your working environment so that you get access to **AMECustom**. To start **AMECustom**, in a suitable window change to the directory where you wish to work (*tutorial* for instance) and type:

```
AMECustom
```

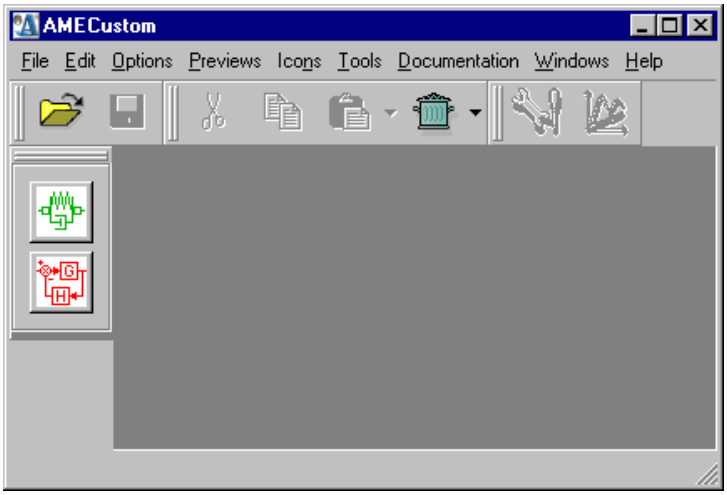
Using Windows:

Do one of the following:

- Select *AMECustom* from the menu **Program ▶ Imagine ▶ AMECustom** produced by the **Start** button, or
- Double click on the **AMECustom** icon on your desktop, or
- Type *AMECustom* in a MS DOS Command window from the directory where you wish to work (*tutorial* for instance).

The display shown in Figure 2.4: appears. It has been deliberately made similar to **AMESim** and **AMESet** but there are small differences in the display and **AMECustom** performs different functions. The main area is used to display details of submodels and supercomponents that are customized.

Figure 2.4: AMECustom main area

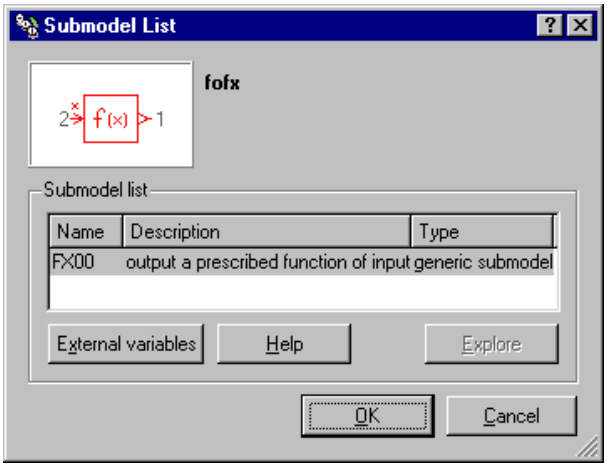


Note: For the rest of the tutorial exercises, you should save all your customized submodels in the same directory as the current one (*tutorial* directory).

Step 2: Select the *FX00* icon

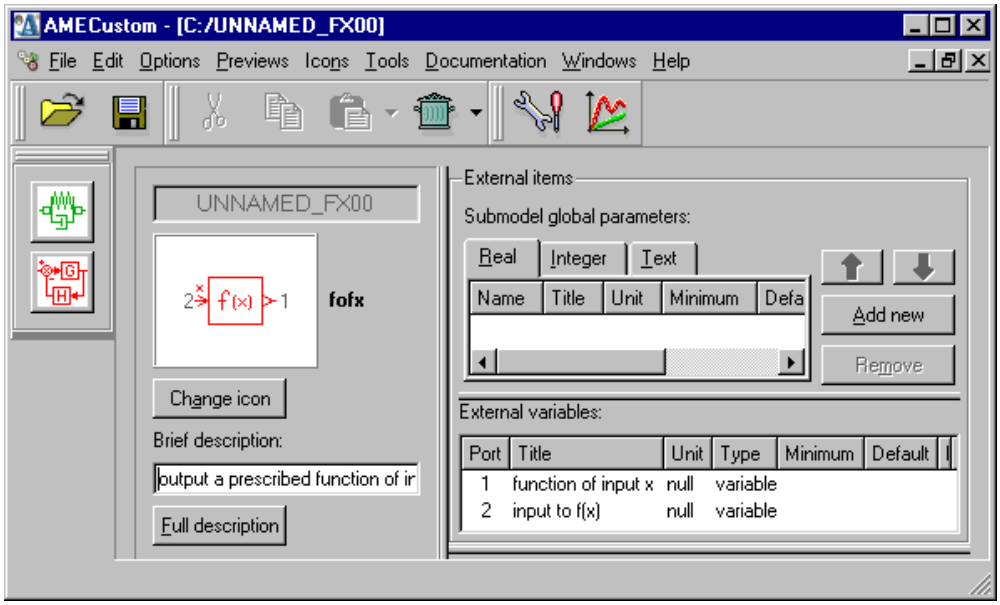
At the left hand side of the **AMECustom** display are the *Categories* buttons. Select the *Signal, Control and Observers* category and then click on the standard *f(x)* icon.The dialog box below appears:

Figure 2.5: f(x) submodel list



Select the submodel *FX00* in the list and click on *OK*: Figure 2.6: shows the new display.

Figure 2.6: AMECustom display with a submodel loaded

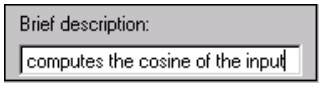


Step 3: Customize the generic submodel

The process of customizing submodels is largely a matter of filling forms. Here you are going to alter the characteristics of the submodel *FX00* to get our own submodel *COS50*:

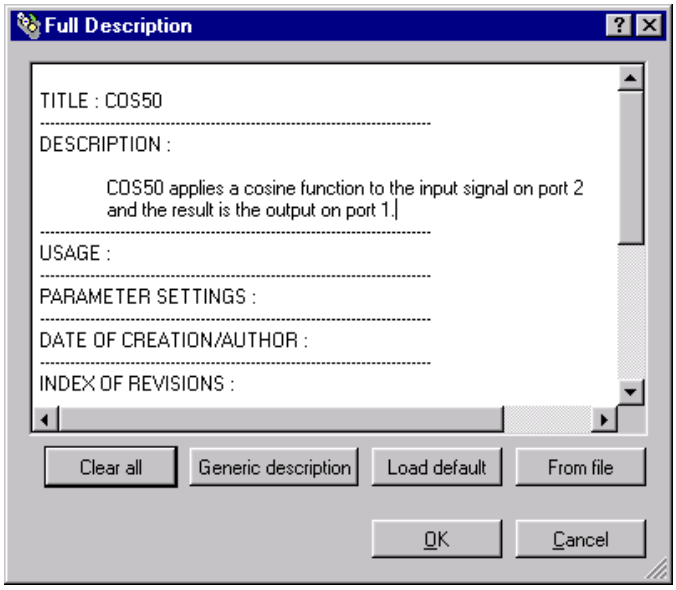
1. In the *Brief description* field, replace the current description by the following: ‘computes the cosine of the input’. This field contains text, which will be displayed when the submodel is selected in **AMESim**.

Figure 2.7: Brief description field



2. Click on the button labeled *Full description* and change the title and description as shown in Figure 2.8:

Figure 2.8: Full description



3. In the *External variables* table, modify the title of the two external variables as follows:

Figure 2.9: External variable table

External variables :

Title	Port	Unit	Type
cosine of input x	1	null	variable
input x	2	null	variable

4. Select the *Text parameters* tab from the *Internal items* table and set the default value of the *expression in terms of the input x* parameter to cos(x):

Figure 2.10: Internal variable table

Internal items :

arameters | Integer parameters | Text parameters

Title	Default value	Hidden
expression in terms of the input x	cos(x)	☐

Then click on the check box of the *Hidden* column so that a tick mark appears in it:

Note: This point is important because in **AMESim**, the parameter will not appear anymore in the submodel parameter list and its default value will be used. **Hiding a customized submodel parameter ensures that its default value will always be used in AMESim.**

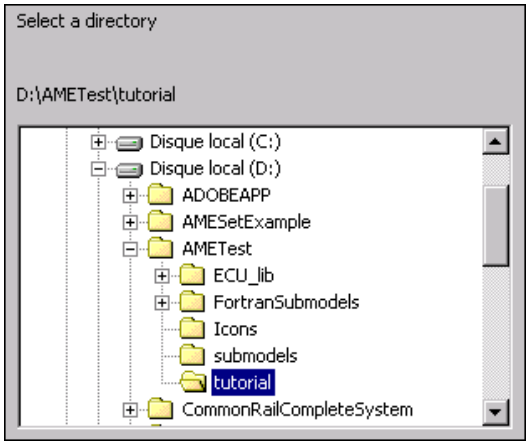
Step 4: Save the customized submodel

At this stage the customization is complete and you can save it by clicking on the  button. This will produce the dialog box below from which you can give a name to your customized submodel:

Figure 2.11: Submodel name and password

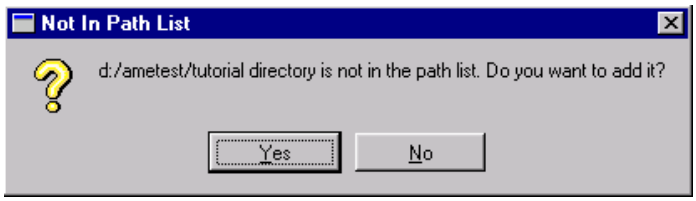
Putting a tick mark in the check box labeled *Save encrypted* is not necessary for such a simple submodel. This feature will be covered in the last example of next chapter. If you then click on *OK*, a file browser appears and you must select an **AMESim** node directory for your customized submodel.

Figure 2.12: Directory of the submodel



Note that if the directory you selected is not in the path list you will get the following message:

Figure 2.13: You can add the new directory in the path list



If you click on *Yes*, this directory will be added to your path list.

You can get a preview of the *Change Parameters* and *Variable List* dialog boxes you would get in **AMESim**. Click on the buttons  and  to get the previews shown in Figure 2.14: and Figure 2.15: respectively:

Figure 2.14: Preview of the Change Parameters dialog box

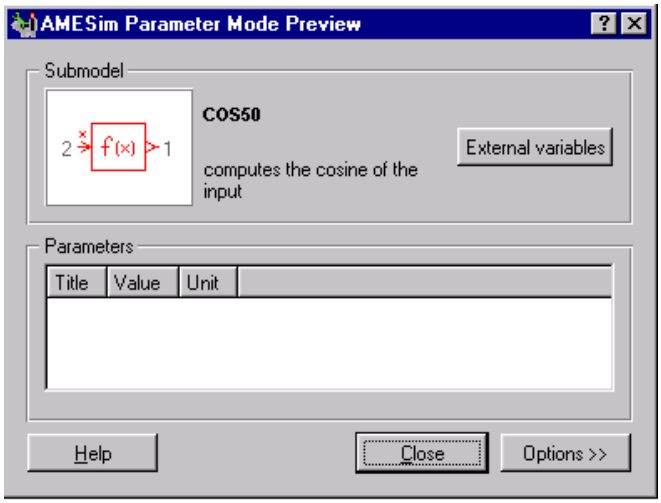
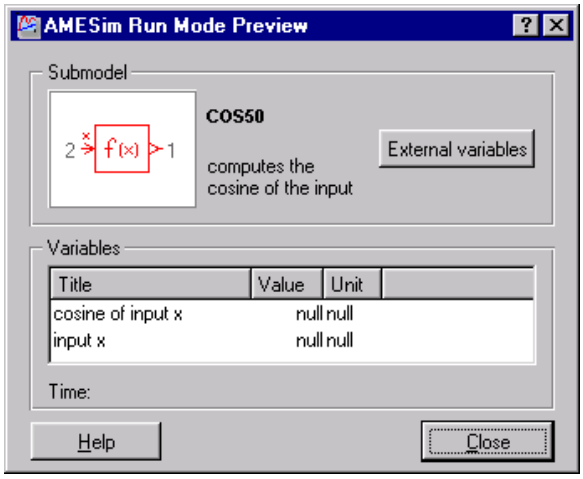


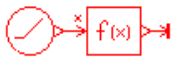
Figure 2.15: Preview of the Variable List dialog box



As you can see, the parameter list is empty since the only parameter of the generic submodel is now hidden. It is set to *cos(x)* and cannot be changed by an **AMESim** user. The variable list shows the customized names of external variables.

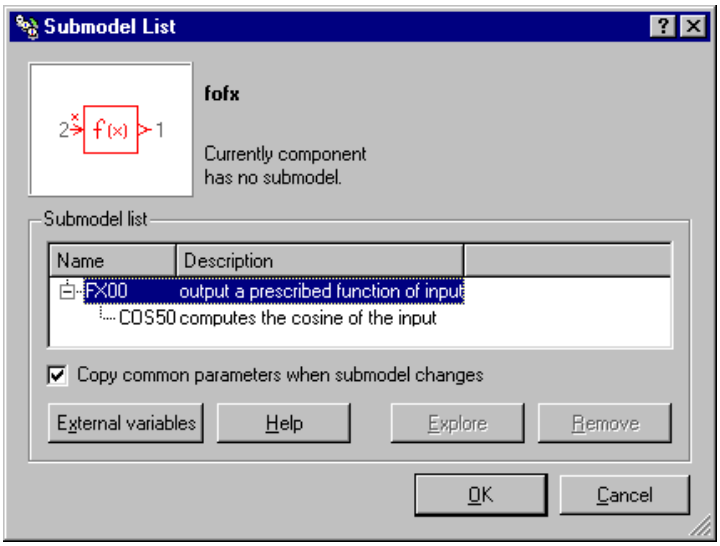
Step 5: Use the customized submodel in AMESim

1. Start **AMESim** and build the small model shown in order to test your new submodel:



2. In *Submodel* mode you will get the *Submodel List* dialog box shown below after selecting the *f(x)* icon, and after clicking on the cross that appears to the left hand side of the list:

Figure 2.16: Submodel List dialog box

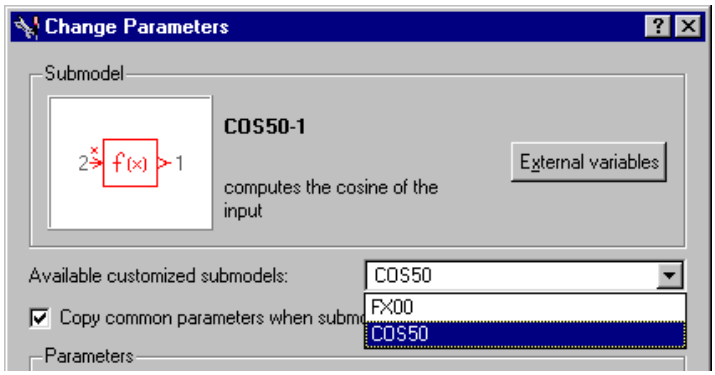


You can then select the customized submodel *COS50*.

If *COS50* does not appear in the list, check your pathlist and update it as necessary.

3. In *Parameter* mode, it is also possible to change between generic and customized submodels. The submodel currently assigned appears in a field and you can select another submodel from a list which is produced by clicking on the arrow in this field:

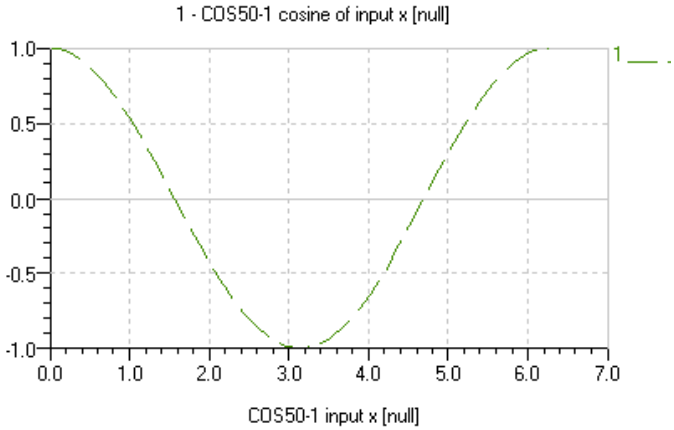
Figure 2.17: List of customized submodels



Set the *slope* parameter of the ramp submodel (*RAMP0*) to 2*PI/10.

4. In *Run* mode, start a simulation for 10 seconds with a communication interval of 0.01 second and plot the output of *COS50* against its input. You should get the following curve:

Figure 2.18: Plot the output of *COS50* against its input



As an extension to this first example, you could create other customized submodels from *FX00* such as: *SIN50, ABS50, EXP50,* etc.

2.3 Files associated with a customized submodel

Each **generic** submodel you use in **AMESim** (called *NAME* for instance) has three associated files:

- The source file *NAME.f* or *NAME.c*.
- The specification file *NAME.spe*.
- The compiled version of the source *NAME.o* (or *NAME.obj*).

If you edit this submodel with **AMECustom**, you can customize it according to your needs and save it as a different name: *CUSNAME* for instance. For this new submodel **AMECustom** will produce two new files which are:

- The customized specification file *CUSNAME.spe*.
- The customized description file *CUSNAME.des*.

If your customized submodel is encrypted, it is protected by a password.

2.4 Example 2: creating two customized sub-models from a cam generic submodel

Objective:

- To construct more complex customized submodels.

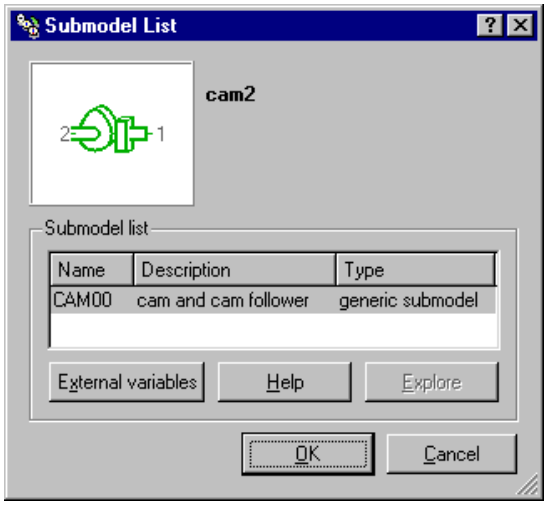
The cam submodel *CAM00* belongs to the *Mechanical* library. The icon it is associated with is shown. This is a submodel of a cam profile with cam follower. An ASCII file is read defining the linear displacement in *mm* of the contact point at various angular displacements in *degree* in the range 0 to 360. The file containing the cam profile is defined by the user in *Parameter* mode.

A simple modification can be made to *CAM00* to produce *INCAM50* and *EXCAM50*, which will be used as inlet and exhaust cam respectively.

Step 1: Load the cam submodel into AMECustom.

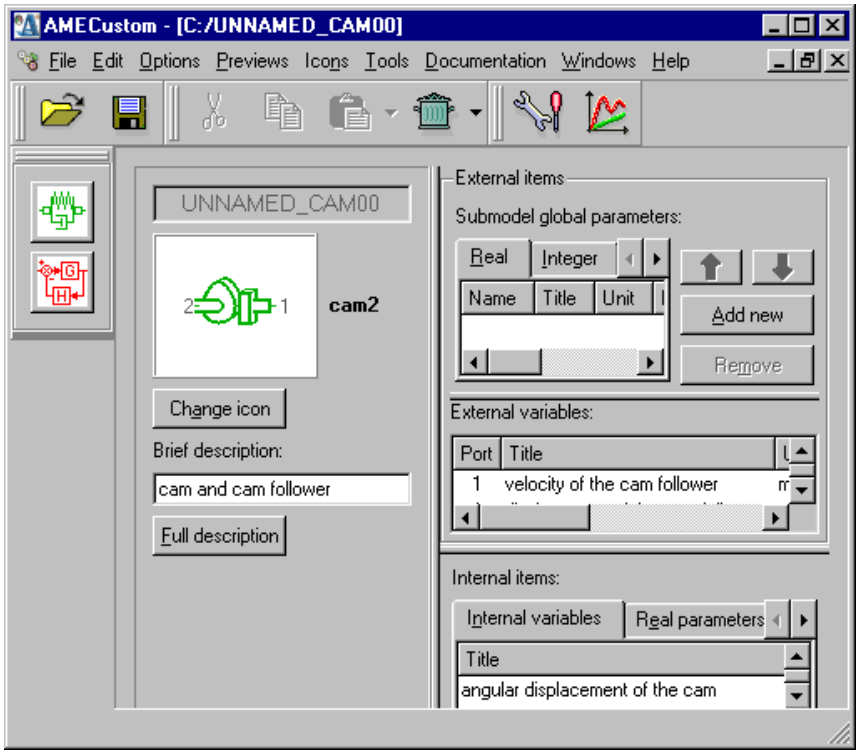
At the left hand side of the **AMECustom** display are the *Categories* buttons. Select the *Mechanical* category and then click on the standard cam icon shown. The following dialog box appears:

Figure 2.19: Submodel list dialog box



Select the submodel *CAM00* in the list and click on *OK*: Figure 2.20: shows the new display.

Figure 2.20: AMECustom main interface with submodel loaded



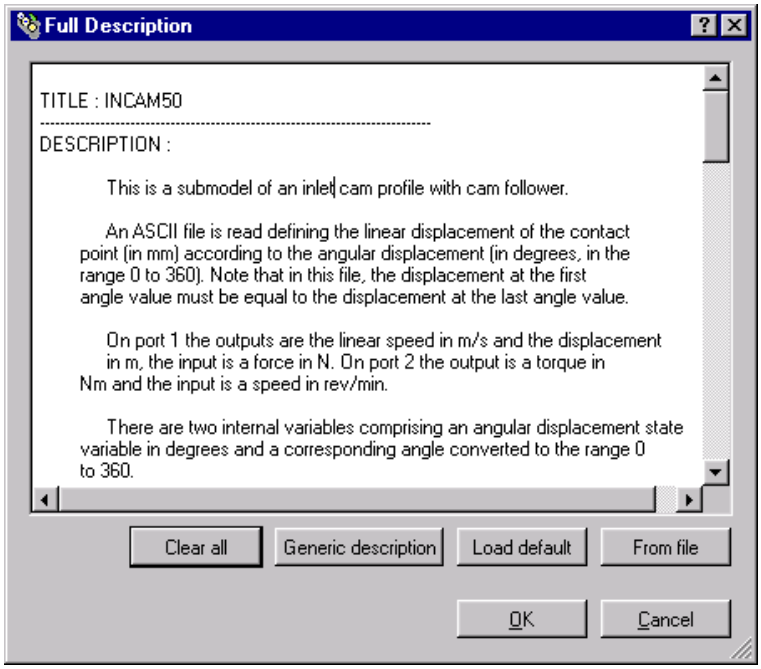
We are going to alter the characteristics of the submodel *CAM00* to get our own inlet cam submodel *INCAM50.* Then we will do the same for the exhaust cam submodel *EXCAM50*.

Step 2: Customize *CAM00* to produce *INCAM50*

1. In the *Brief description* field, replace the current description by the following: *'inlet cam and cam follower'*. This field contains text, which will be displayed when the submodel will be selected in **AMESim**.

2. Click on the button labeled *Full description* and change the title and description as shown below:

Figure 2.21: Full description



3. In the *External variables* table, modify the title of the external variables named *displacement of the cam follower* and *velocity of the cam follower* as follows:

Figure 2.22: Modify the titles of the external variables

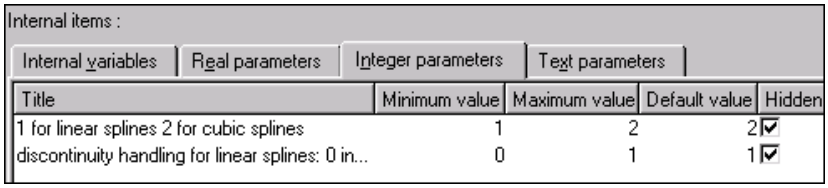
External variables :

Title	Port	Unit	Type
velocity of the inlet cam follower	1	m/s	one-line macro variable
displacement of the inlet cam follower	1	m	multi-line macro variable

Ideally we would replace the word cam in all parameters and variables with inlet cam.

4. Select the *Integer parameters* tab from the *Internal items* table and set the default value of the parameter *1 for linear splines 2 for cubic splines* to 2. Both integer parameters must be hidden:

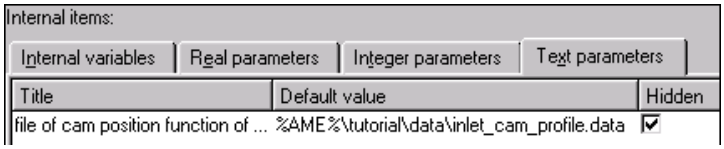
Figure 2.23: Check boxes in the hidden column



5. Select the *Text parameters* tab from the *Internal items* table and set the default value of the parameter *file of cam position function of angular displacement* to *$AME/tutorial/data/inlet_cam_profile.data* or *%AME%\tutorial\data\inlet_cam_profile.data*.

Note that you can use a file browser for this by clicking on the button ..., provided you know the value of the environment variable *AME*. Ensure this parameter is also hidden:

Figure 2.24: Ensure text parameter is hidden



6. At this stage the customization of the submodel is complete and you can save it by clicking on the *Save* button. This one will be called *INCAM50* and put in your *tutorial* directory.

Step 3: Customize *CAM00* to produce *EXCAM50*

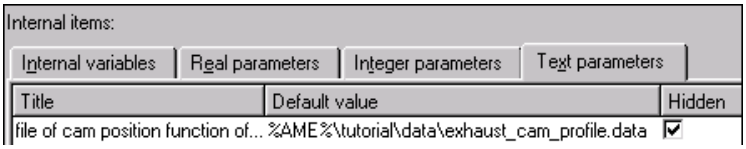
Repeat the procedure above (points 1 to 6) for *EXCAM50* ensuring that in points 1, 2 and 3:

- *inlet cam* is replaced by *exhaust cam*, and
- *INCAM50* is replaced by *EXCAM50*

(Alternatively with *INCAM50* still loaded in **AMECustom** do **File ▶ Save as** specifying *EXCAM50* and then make the changes.)

Point 4 is identical and the result of point 5 is shown below:

Figure 2.25: Result of point 5

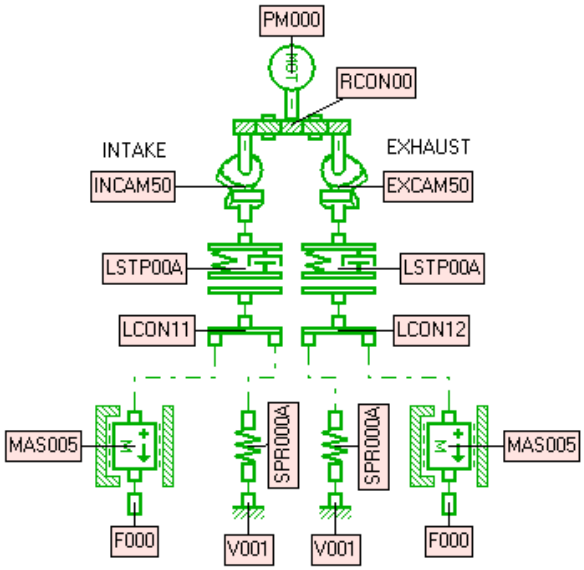


Step 4: Test your customized submodels in AMESim

1. Start **AMESim** and build the model shown in Figure 2.26: in order to test your new submodels. You might get *LCON12* instead of *LCON11*

depending on use of 'flip' operations but this is not important. Save this model in your *tutorial* directory.

Figure 2.26: Build this model

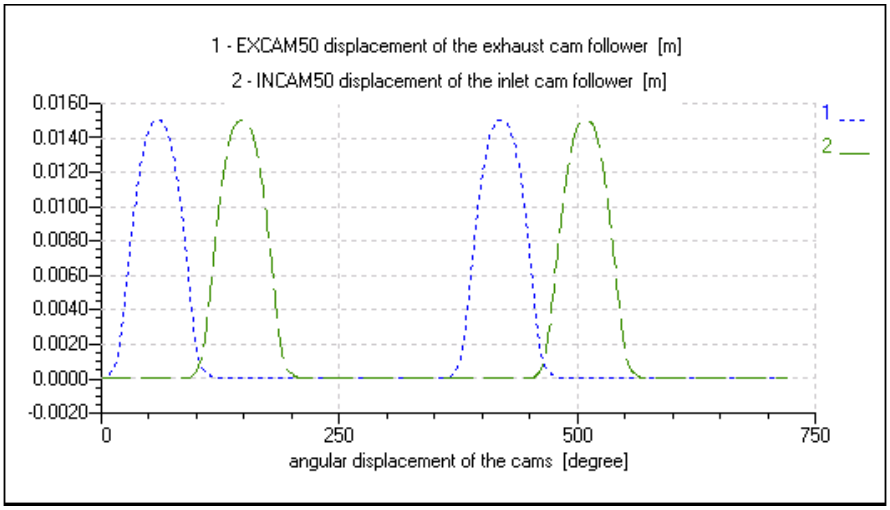


2. Use the following parameters for the inlet and exhaust side:

Submodel	Title	Value
SPR000A	spring force with both displacements zero [N]	500
MAS005	mass [kg]	0.01
	lower displacement limit [m]	0
	higher displacement limit [m]	0.03
LSTP00A	gap or clearance with both displacements zero [mm]	0.1
	contact stiffness [N/m]	1.0e9
	contact damping [N/(m/s)]	1000
	penetration for full damping [mm]	0.01

3. Run a simulation for 0.08 second with a communication interval of 0.0001 second and plot the two cam displacements against their angular displacement. You should get the following curves:

Figure 2.27: Cam displacements against their angular displacement



4. Save this model carefully because it is used again in next chapter.

Chapter 3: Customizing supercomponents

AMECustom allows you to customize supercomponents as well as submodels. In this chapter there are two examples.

In the first you construct a system which models a cam using mechanical and control library components. You then convert it to a supercomponent. This produces the same answers as the standard submodel *CAM00*. However, it is not very convenient to use. To overcome this you customize it so as to make it appear very similar to *CAM00*.

In the second example you use a customized cam in a supercomponent of an inlet and exhaust valve of a cylinder head. You then customize this to have two levels of customization.

It is useful but not essential that you have some experience of using the *Icon designer* in **AMESim** and/or **AMESet**.

3.1 Example 1: A customized cam supercomponent

Objectives of the example:

- To illustrate the process of customizing a supercomponent.
- To compare a generic submodel, generic supercomponent and customized supercomponent of the same component.

Figure 3.28 shows a system using the standard cam submodel *CAM00*.

Figure 3.28: System using the cam submodel CAM00

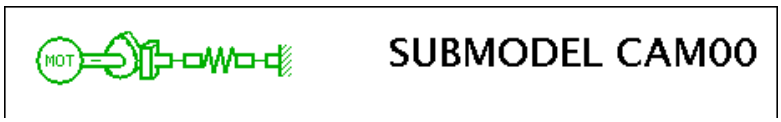
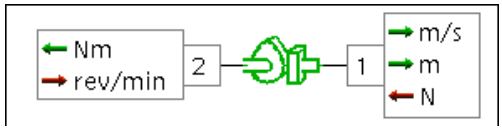


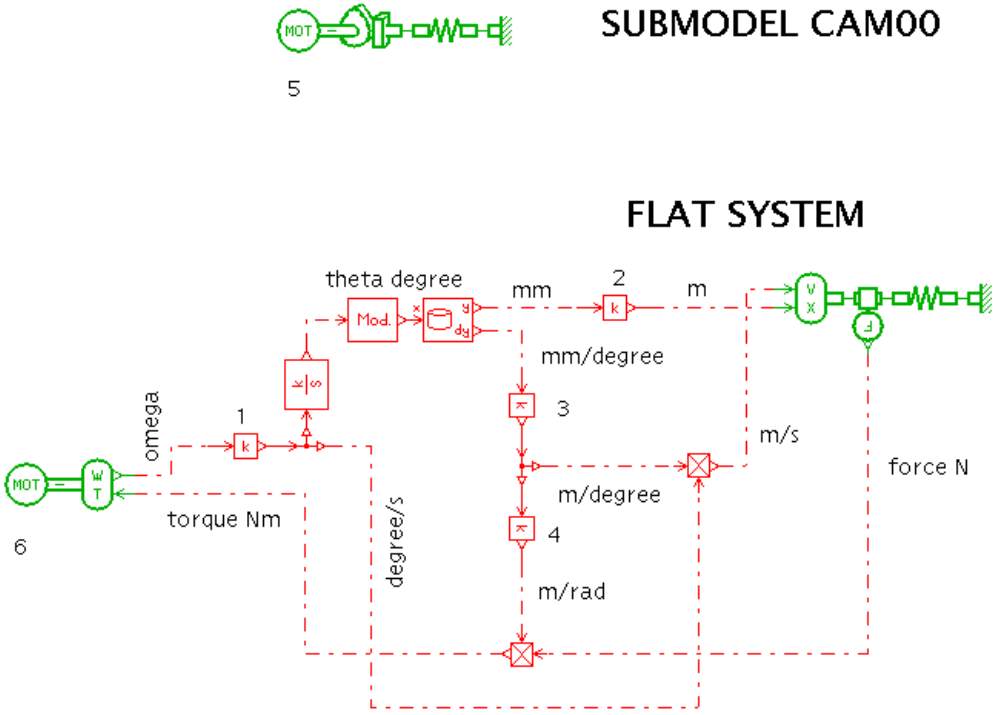
Figure 3.29 shows the external variables of the cam submodel *CAM00*.

Figure 3.29: External variables of the submodel CAM00



It is possible to produce the same results with the cam submodel replaced by mechanical and control components. Figure 3.30 shows how this can be done.

Figure 3.30: The cam submodel can be replaced by mechanical and control components



We describe this as a 'flat system' because it is single level and will soon be transformed into a supercomponent. A few words of explanation are needed.

Ignoring units by assuming everything is SI the logic is relatively simple. The rotary speed ω is integrated to produce the cam position θ.

$$\theta = \int \omega dt$$

This is used with a table of values imported from a file to produce a displacement x and the derivative $dx/d\theta$. From this we can recover the velocity v as follows:

$$v = \frac{\delta x}{\delta t} = \frac{\delta x}{\delta \theta}\frac{\delta \theta}{\delta t} = \frac{\delta x}{\delta \theta}\omega$$

For a perfect transformer we have

$$Fv = F\frac{\delta x}{\delta \theta}\omega = T\omega$$

From which

$$T = F\frac{\delta x}{\delta \theta}$$

The four gains are needed to produce the correct units. Thus the table of values used in *CAM00* and *FXA10* give a cam lift in *mm* for angles in *degree*. This is inconvenient from a modelling point of view but this is how data of this type is normally presented!

3.1.1 Constructing the flat system

Step 1: Construct both models in the same system

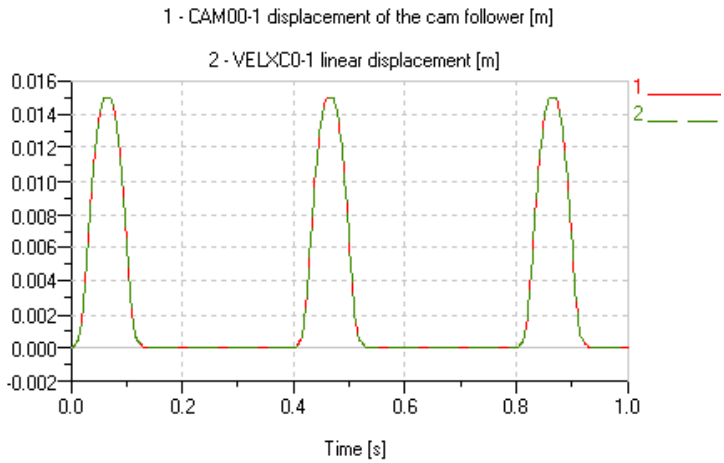
Step 2: Set the following parameters leaving all others at their default values

Submodel	Reference number on sketch if any	Title [units]	Value
GA00	1	value of gain [null]	6
GA00	2 and 3	value of gain [null]	0.001
GA00	4	value of gain [null]	180/pi
PM000	5 and 6	shaft speed [rev/min]	150
CAM00		file of cam position function of angular displacement	$AME/tutorial/data/cam.data
		1 for linear splines 2 for cubic splines	2
FXA010		name of ASCII file	$AME/tutorial/data/cam.data

Step 3: Run a simulation and check that the results from the two models are the same

Use a final time of 1 second and enable discontinuity printout.

Figure 3.31: Plot of the CAM00 and VELXC0 submodels displacement



3.1.2 Constructing the generic supercomponent

Step 1: Convert the sub-system shown in Figure 3.32 to a generic supercomponent using the cam icon

Figure 3.32: Sub-system to be converted to a generic supercomponent

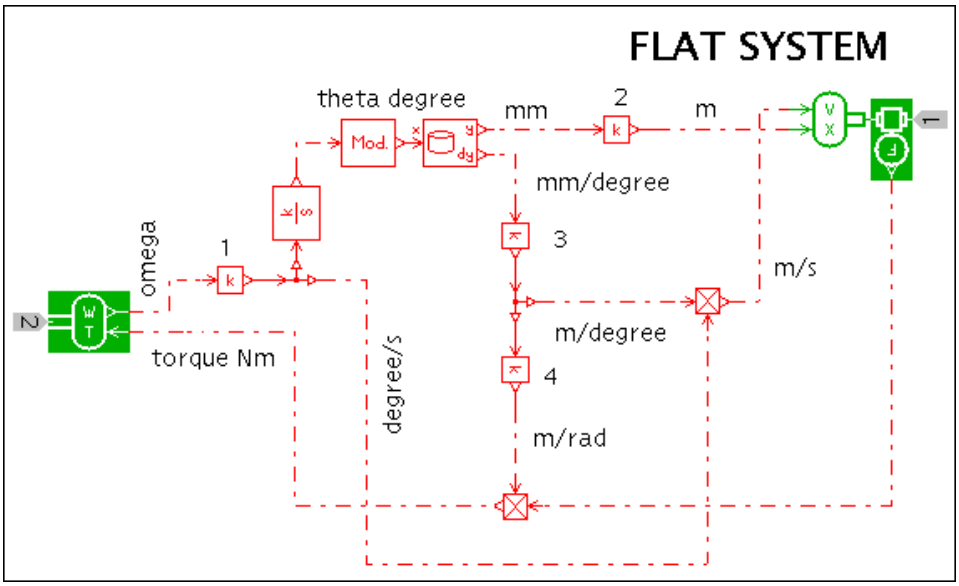
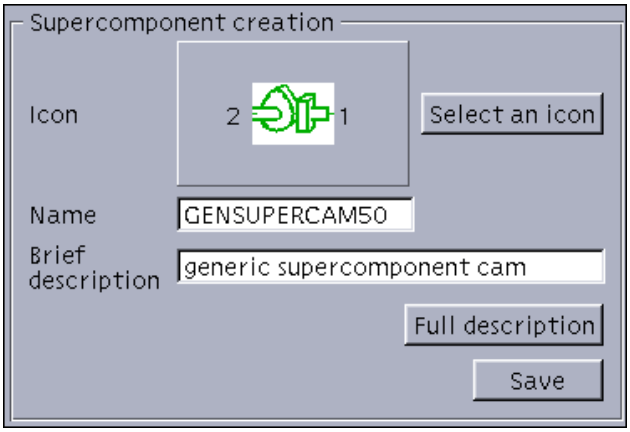
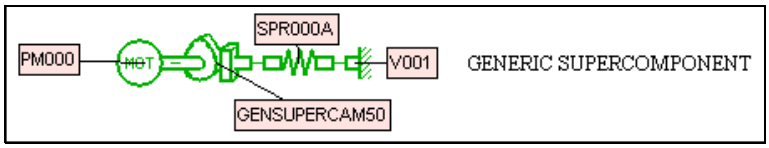


Figure 3.33: Specify an icon, a name and a brief description



Step 2: Add this to your AMESim system and check that it gives the same results as the other two versions

Figure 3.34: Generic supercomponent added to the AMESim system



Comparing the generic supercomponent with the generic submodel we have to prefer the submodel. There are far too many redundant parameters in the supercomponent which should be left at the set values. If we released the supercomponent for others to use, sooner or later some of these values will get changed. The situation is unsatisfactory so we will see what **AMECustom** can do to improve matters.

The basic idea is to get the supercomponent to behave more like the submodel *CAM00* hiding irrelevant detail. In particular we want the *Change Parameters* and *Variable List* dialog boxes to be like those in Figure 3.35 and Figure 3.36 respectively.

Figure 3.35: Change Parameters dialog box

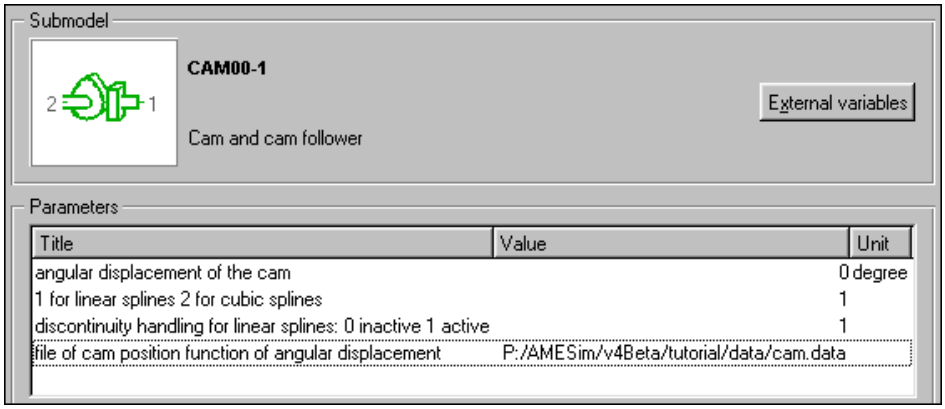
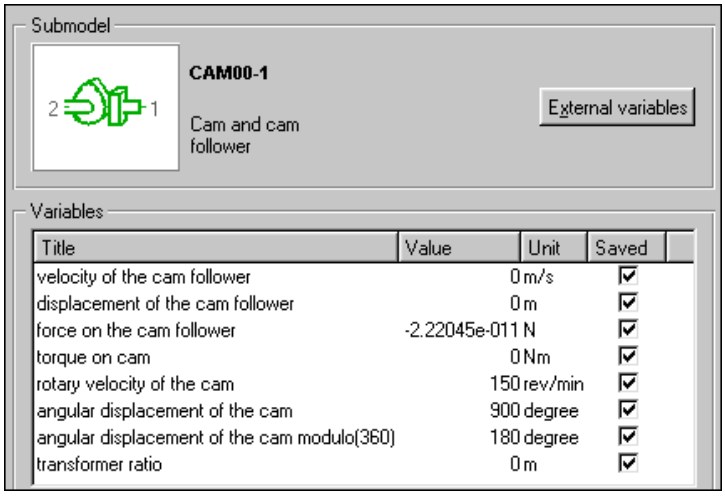


Figure 3.36: Variable List dialog box

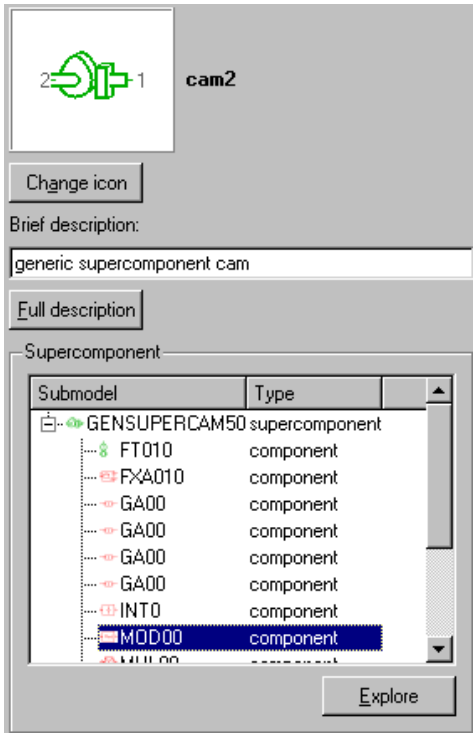


3.1.3 Customizing the supercomponent

Step 1: Load the supercomponent into AMECustom. Try the following experiments:

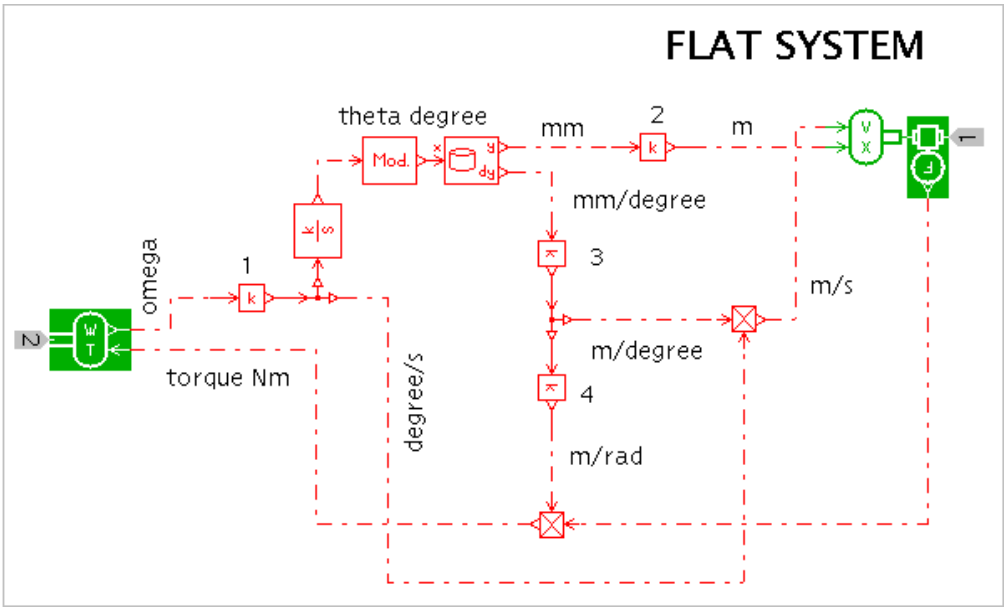
1. Open the supercomponent tree structure as in Figure 3.37.

Figure 3.37: Supercomponent tree structure



2. Click on the *Explore* button to produce the *Explore Supercomponent* dialog box part of which is shown in Figure 3.38. Click on individual constituents of the supercomponent and note how the corresponding item gets selected in the supercomponent tree.

Figure 3.38: Constituents of the supercomponent



3. Note that as you select constituents of the supercomponent, on the left side the two upper lists on the right are unchanged but the lowest list changes.

4. Do a *Parameter* mode and *Run* mode preview and note how messy it is! In particular notice how prefixes, composed from the submodel name and instance number, are added to some parameter/variable titles in order to make them unique.

Figure 3.39: Parameter and variable titles

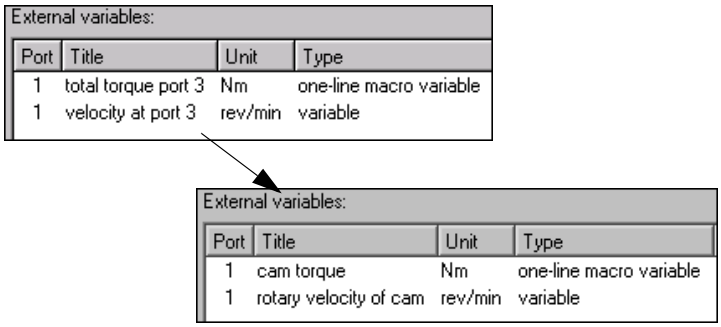
GA00-1: value of gain	6 null
INT0-1: value of gain	1 null
offset to be added to input	0 null
minimum output value	0 null
maximum ouput value	360 null
GA00-2: value of gain	0.001 null
GA00-3: value of gain	0.001 null
GA00-4: value of gain	180/pi null

Normally it is confusing to see these prefixes in a *Change Parameters* or *Variable list* dialog box. They can be removed in 2 ways:

- By hiding the parameter or variable so that it does not appear anymore.
- By changing the title. If you do this, it becomes your responsibility to ensure parameters and variables have unique titles.

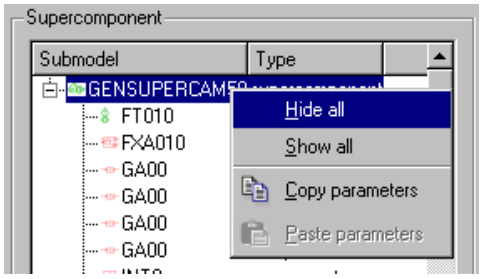
Step 2: The central list is what will become the external variables of the customized supercomponent. Alter the titles as shown below:

Figure 3.40: Alter the titles of external variables



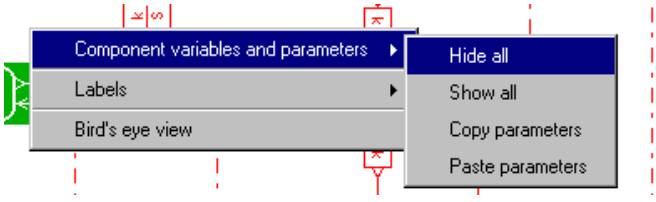
Step 3: Select the root of the supercomponent tree and right-click selecting Hide all

Figure 3.41: Hide all in the supercomponent tree



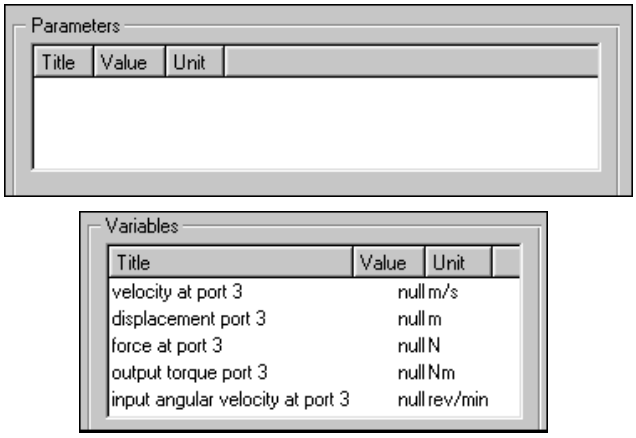
You can achieve the same thing using the right-click pulldown menu in the *Explore supercomponent* dialog box.

Figure 3.42: Hide all using the Explore supercomponent dialog box



If you look at the *Parameter* and *Run* mode previews, you will see a dramatic change! We must reintroduce a few variables and parameters that have been hidden.

Figure 3.43: Some variables and parameters are hidden

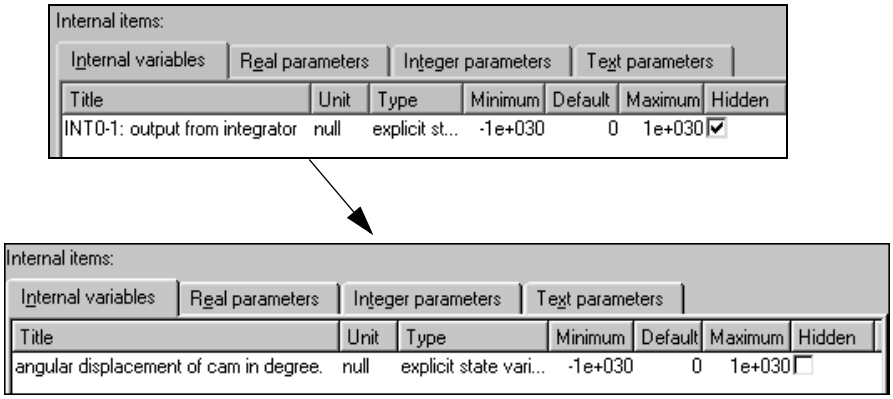


Below are summarized three very important points:

1. It is very common practice to begin by hiding ALL parameters and variables then progressively reintroducing those that are needed.
2. After making any significant change, it is essential to do a *Parameter* and *Run* mode preview. This helps you to identify mistakes at an early stage.
3. You can change titles of parameters and variables to make them more meaningful and to remove unwanted prefixes. If you do this, it becomes your responsibility to ensure the titles are unique.

Step 4: Select the integrator submodel *INT0*, then select the *Internal variables* tab and alter them as follows:

Figure 3.44: Alter the Internal variables



Note the *Hidden* flag for the variable has been changed, now it is **unticked**.

Step 5: In a similar way make the following changes. In each case ensure the *Hidden* check box is not ticked.

Submodel	Tab selected	Original title	New title if different
MOD00	Internal variables	output	angular displacement of cam modulo 360 in degree
FXA010	Integer parameters	discontinuity handling	
FXA010	Text parameters	name of ASCII file	file of cam position function of angular displacement

Do a preview of parameters (Figure 3.45) and variables (Figure 3.46) to check they are satisfactory.

Figure 3.45: Preview of parameters

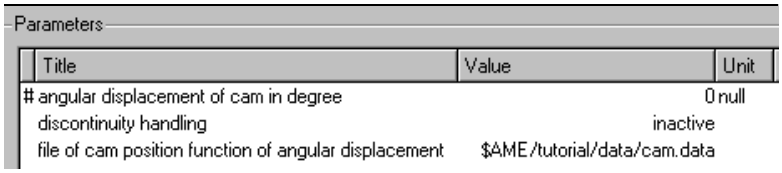
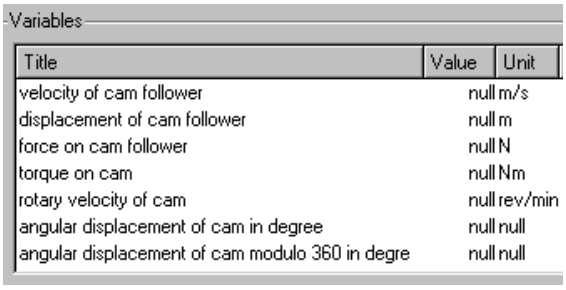


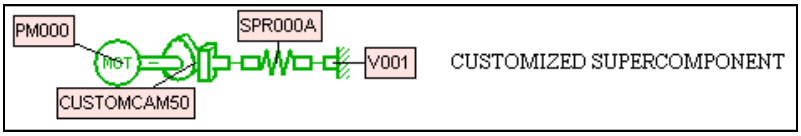
Figure 3.46: Preview of variables



Step 6: Save the customized supercomponent under the name *CUSTOMCAM50.*

Step 7: Use the customized supercomponent in AMESim adding to the three existing subsystems. Check it produces the same results as the other versions. Examine the *State count* dialog box to see how certain titles are hidden.

Figure 3.47: Supercomponent used in an AMESim system



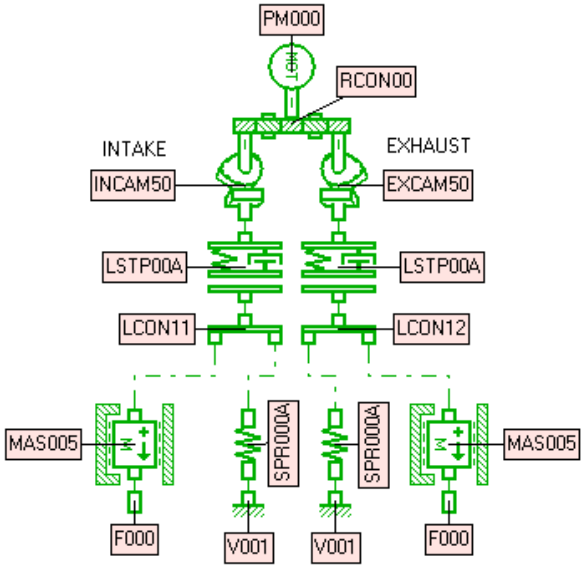
Conclusion

This customized supercomponent is an alternative to the submodel *CAM00*. Which alternative is better? In this case the submodel is less complex and has less redundancy. In other cases a customized supercomponent can be a better alternative to a huge submodel. This is probably true in the next example.

3.2 Example 2: A 2-level customized supercomponent with global parameters

3.2.1 Introduction

Figure 3.48: Two valves operating within a cylinder head



Objectives:

- To construct a customized supercomponent with two levels of customization;
- To use parameters global to the supercomponent;
- To demonstrate encryption facilities.

The system is shown in Figure 3.48 and represents two valves operating within a cylinder head of an engine. The exercise that follows is constructed to show features of **AMECustom** not to serve as instruction on how to design efficient cylinder head valve systems!

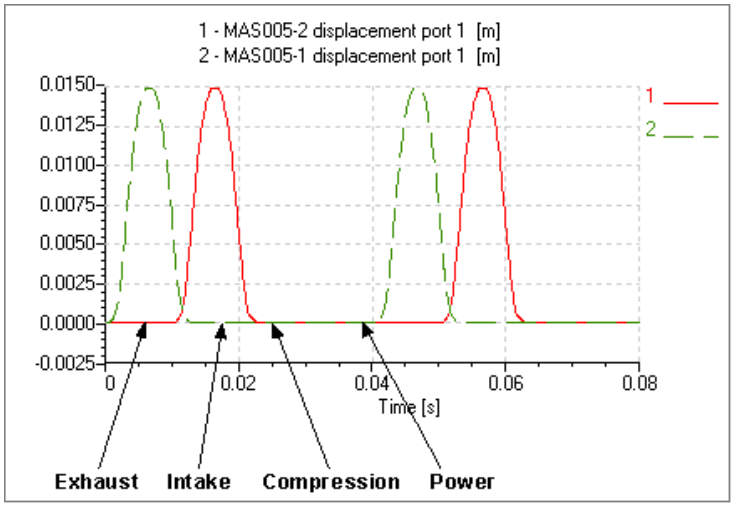
Note that the system is precisely the same as the second example in chapter 2. Remember that:

- There are two camshafts running at the same speed which is defined by *PM000*.
- *INCAM50* and *EXCAM50* are customized submodels. This will give two levels of customization.
- The submodels *LSTP00A* induce a valve clearance when the valve is closed.
- *MAS005* features a limit in the movement of the valves.

3.2.2 Constructing the flat system

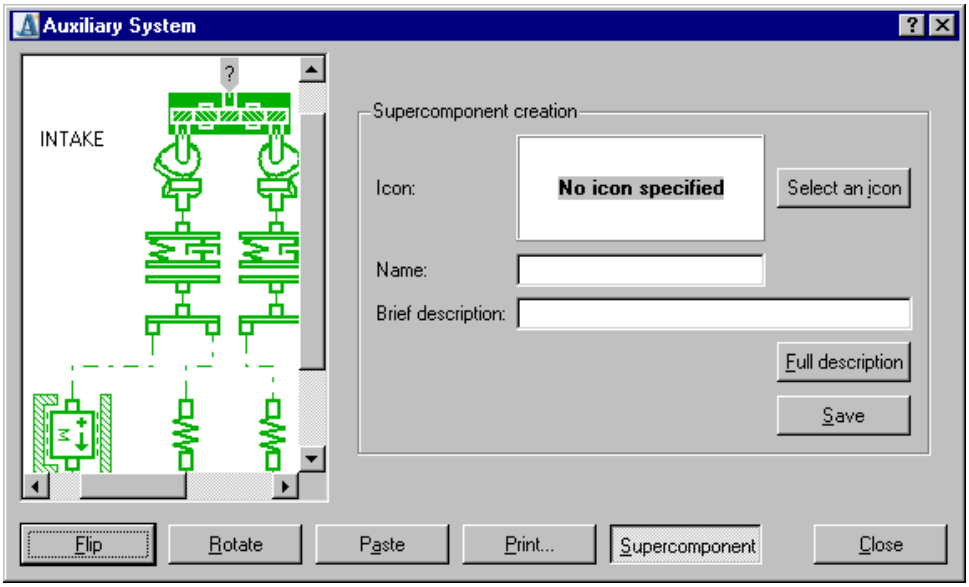
Reload the old system and check the results against Figure 3.49. This is the valve lift and the reference set of results we will use to check the new generic supercomponent and its customized version.

Figure 3.49: Reconstructing the generic supercomponent



Step 1: Create a generic supercomponent including all components except *PM000*.

Figure 3.50: Create the supercomponent



There is no very suitable standard **AMESim** icon for this supercomponent. If you are very short of time you can use any icon of the *Mechanical* category which has a single rotary port such as the following one: 

.

However, for a more artistic solution we suggest you do the following:

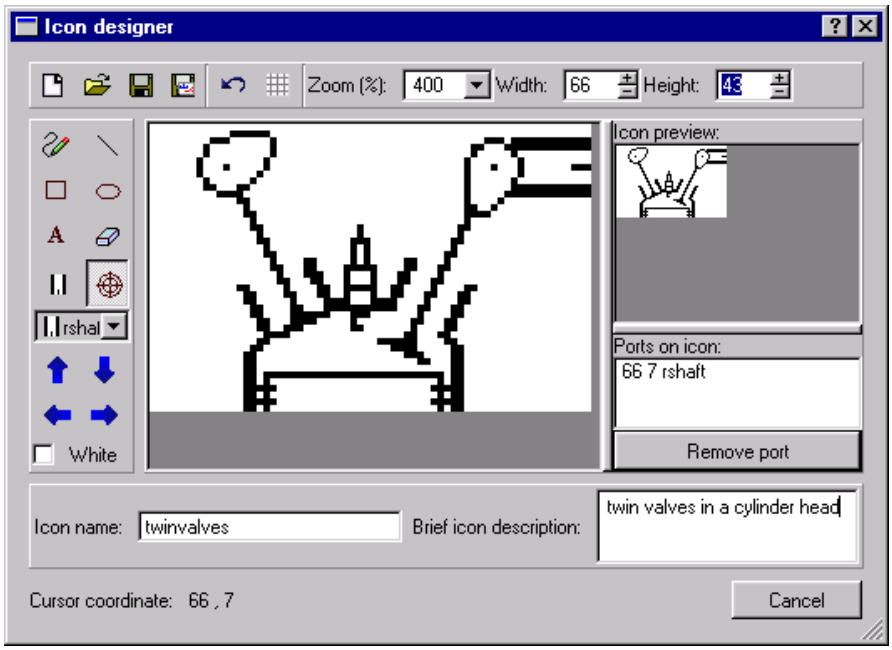
1. Click on *Select an icon*.
2. You should select a category for which you have write permission. If you do not have one, you must create it by clicking on the *New Category* button.
3. Click on *New Comp Icon.*
4. Click on the *Load icon file*  button of the *Icon designer* dialog box.
5. There is an existing icon in a folder of the **AMESim** system area. Enter the following name:

   $AME/tutorial/Icons/twinvalves.xbm

   or

   %AME%\tutorial\Icons\twinvalves.xbm
6. The icon should now be loaded into the *Icon designer*. Define a rotary port, an icon name and a brief description.

Figure 3.51: Draw the icon



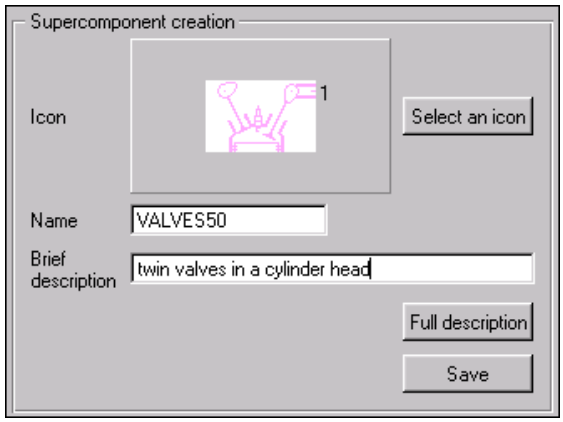
Step 2: Save the icon.

Make sure you do this in **AMESim** format  .

Step 3: Select the icon you have just created from the tree structure of the *Icon selection* dialog box.

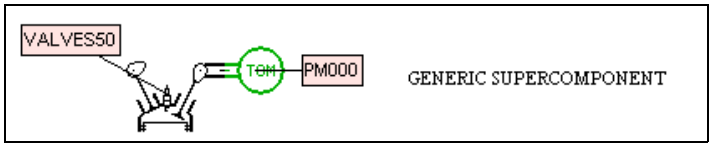
1. Give a name the generic supercomponent (e.g. *VALVES50*),
2. Give it a brief description,
3. Save it.

Figure 3.52: Give a name and brief description



Step 4: Add the generic supercomponent to your AMESim system and run a simulation to check that the results are correct (as in Figure 3.49).

Figure 3.53: Add the supercomponent to the AMESim system



3.2.3 Constructing the customized supercomponent

Step 1: Load the generic supercomponent into AMECustom. Hide all variables and parameters.

Step 2: The original external variable names shown in Figure 3.54 have very inappropriate names. Change them to those indicated.

Figure 3.54: Alter the external variable names

External variables:

Port	Title	Unit	Type
1	total torque port 3	Nm	one-line macro variable
1	velocity at port 3	rev/min	variable

External variables:

Port	Title	Unit	Type
1	cam torque	Nm	one-line macro variable
1	rotary velocity of cam	rev/min	variable

For the time being, only external variables of the supercomponent are visible. We must decide on what else is to be visible. There are many pairs of submodels in this supercomponent. In order to demonstrate the use of global parameters, we will assign the same values to many parameters from the intake side and from the exhaust side. This symmetry is of course not necessary and may not be desirable from a design point of view, but this is not the point of the exercise.

It would be convenient to have the following parameters to set in AMESim:

- *valve spring preload*
- *valve spring stiffness*
- *valve clearance*
- *valve mass*
- *maximum possible valve lift*

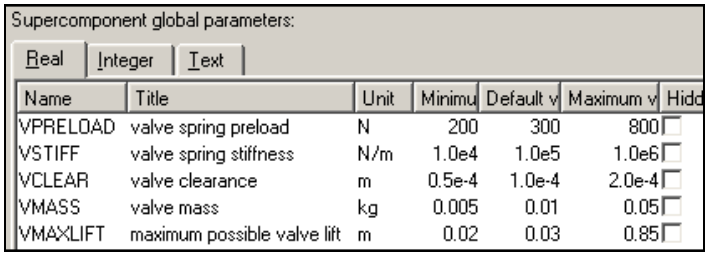
We set these parameters once and they are applied to both the intake and the exhaust side. To do this we introduce customized supercomponent global parameters in **AMECustom**. These are like global parameters in **AMESim** but their scope is solely the customized supercomponent.

The table below shows the global parameters we will use and an indication of where they will be used. They are all *Real parameters* but we could also use *Integer* and *Text parameters*.

Global type and name	Title [units]	Min./Default/ Max.	Submodel, parameter/variable and title
Real VPRELOAD	valve spring preload [N]	200/300/800	*SPR000A,* real parameter, free length of spring
Real VSTIFF	valve spring stiffness [N/m]	1.0e4/1.0e5/ 1.0e6	*SPR000A,* variable, spring rate
Real VCLEAR	valve clearance [mm]	0.05/0.1/0.2	*LSTP00A,* variable, gap or clearance with both displacements zero
Real VMASS	valve mass [kg]	0.005/0.01/ 0.05	*MAS005,* real parameter, mass
Real VMAXLIFT	maximum possible valve lift [m]	0.02/0.03/ 0.085	*MAS005,* real parameter, higher displacement limit

Step 3: Introduce the supercomponent real global parameters shown below. Make sure that none of them are hidden.

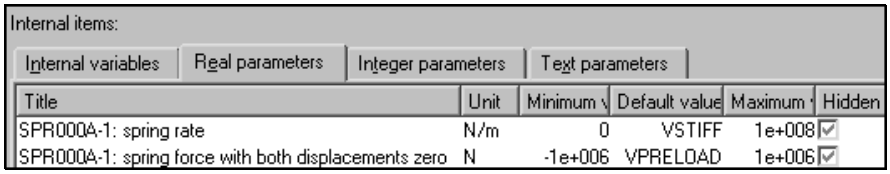
Figure 3.55: Alter the external variable names



Note that you click on the *Add new* button to introduce each new real parameter.

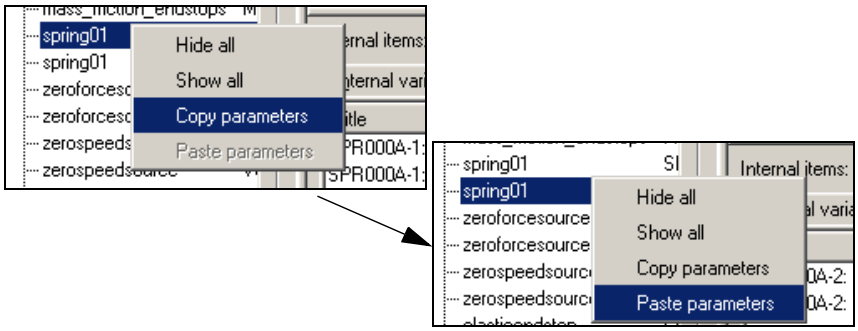
Step 4: Use the *VPRELOAD* and *VSTIFF* global variables in both *SPR000A* spring submodels *Real parameters* as shown below.

Figure 3.56: Global variables



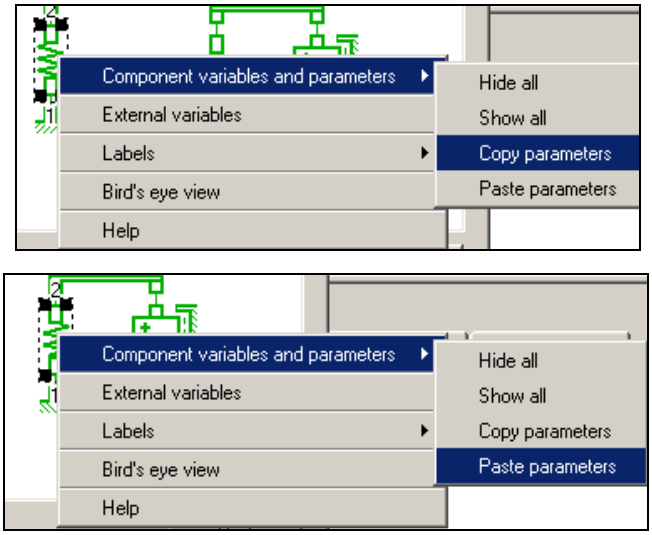
Note that you can copy/paste from one spring to the other using the tree structure.

Figure 3.57: Copy/paste using the tree structure



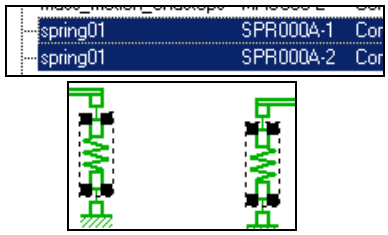
You can do the same thing in the *Explore Supercomponent* window.

Figure 3.58: Copy/paste using the Explore Supercomponent window



A third technique is to select **both** springs in the tree structure or both springs in the *Explore supercomponent* window. This works like *Common Parameters* in **AMESim** and you can set the values for both springs simultaneously.

Figure 3.59: spring values can be set simultaneously



Step 5: Using the same techniques set the *VCLEAR* global parameter in both LSTP00A submodels as indicated.

Figure 3.60: VCLEAR global parameter

Internal items:

Internal variables | Real parameters | Integer parameters | Text parameters

Title	Unit	Minimum v	Default va	Maximum va	Hic
LSTP00A-1: gap or clearance with both displacements zero	mm	-0.001	VCLEAR	1000	☑
LSTP00A-1: contact stiffness	N/m	1e-020	1e+009	1e+030	☑

Step 6: For both *MAS005* submodels make the modifications shown below.

Figure 3.61: Modifications for both MAS005

Internal items:

Internal variables | Real parameters | Integer parameters | Text parameters

Title	Unit	Minimum v	Default valu	Maximum v	Hid
MAS005-1: mass	kg	1e-006	VMASS	1e+006	☑
MAS005-1: coefficient of viscous friction	N/(m/s)	0	0	1000	☑
MAS005-1: coefficient of windage	N/(m/s)**2	0	0	1000	☑
MAS005-1: Coulomb friction force	N	0	0	10000	☑
MAS005-1: stiction force	N	0	0	10000	☑
MAS005-1: lower displacement limit	m	-1e+030	0	1e+030	☑
MAS005-1: higher displacement limit	m	-1e+030	VMAXLIFT	1e+030	☑
MAS005-1: inclination (+90 port 1 lowest, -90 port 1 highest)	degree	-90	0	90	☑

Step 7: In the inlet *MAS005* submodel alter the Internal variables as shown. Make the corresponding changes in the exhaust side.

Figure 3.62: Alter the Internal variables of MAS005

Internal items:

Internal variables | Real parameters | Integer parameters | Text parameters

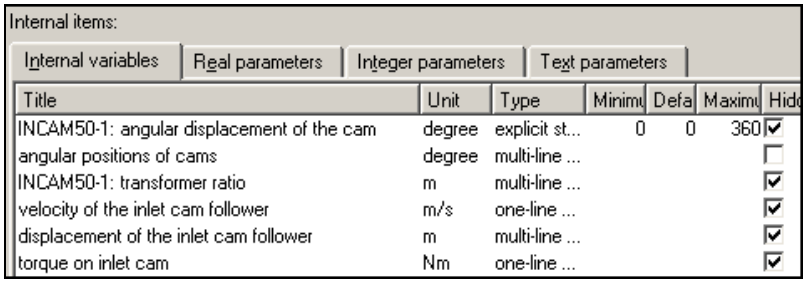
Title	Unit	Type	Minimum	Default	Maximum	Hid
MAS005-1: activity of mechanical dissipation (frict)	J	activity variable				☑
MAS005-1: activity of mechanical inertia (mass)	J	activity variable				☑
inlet valve velocity	m/s	explicit state variable	0	0	0	☐
inlet valve lift	m	explicit state variable	0	0	0	☐
inlet valve acceleration	m/s/s	variable				☐

Note: • 3 (x2) *Internal variables* have had their titles altered and are not hidden anymore.

• 2 (x2) *Internal variables* have their minimum, maximum and default values set to 0. This makes them invisible in *Parameter* mode but as they are no longer hidden, you will see them with their new titles in *Run* mode.

Step 8: In the inlet cam *INCAM50* submodel alter the second Internal variable as shown. Do not change the exhaust side.

Figure 3.63: Uncheck the Hidden box for the second variable



Note: • We have forced both cams to have a starting angle of 0. We will not be able to change this.

• We have forced the starting value of the *gap or clearance* in both *LSTP00A* submodels to be *VCLEAR*.

• With both cam profiles starting on a flat part the starting values of various state variables are consistent.

Step 9: Do a Parameter mode preview (Figure 3.64) and a Run mode preview (Figure 3.65).

Figure 3.64: Parameter mode preview

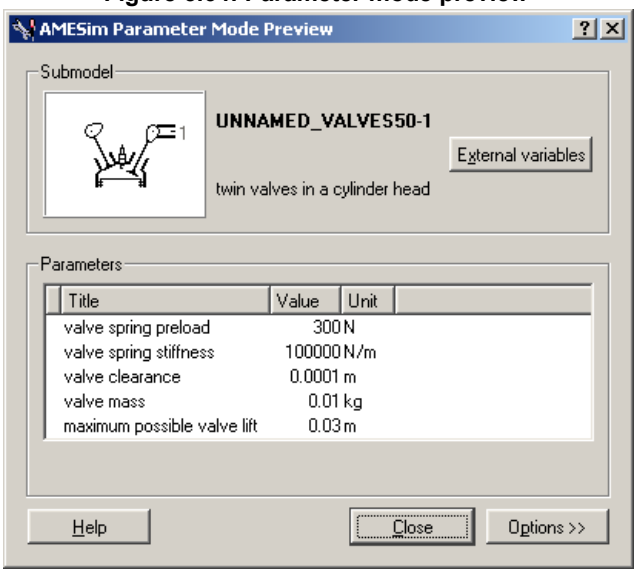
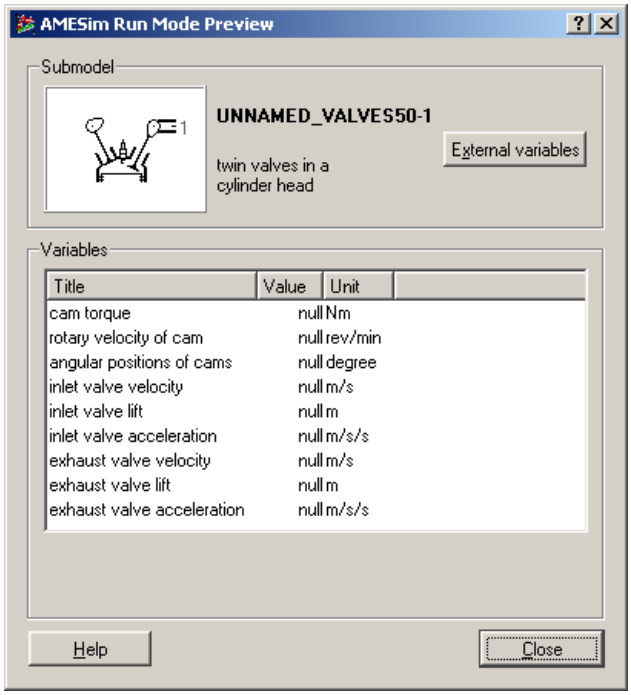


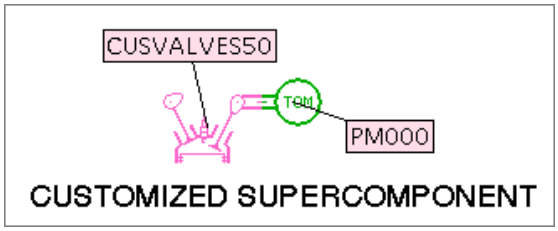
Figure 3.65: Run mode preview



Step 10:Save the customized supercomponent as *CUSVALVES50*. This time specify a password, but do not forget it!

Step 11:Add the customized supercomponent to your AMESim sketch and check that it produces the same results.

Figure 3.66: Add the customized supercomponent to the sketch

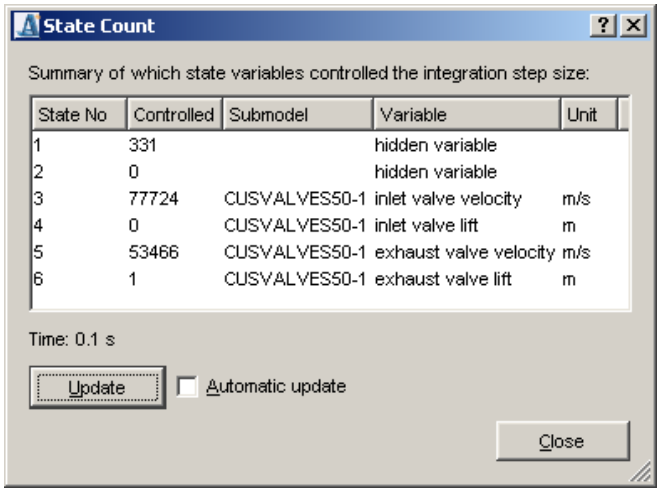


We hope that you find using *CUSVALVES50* within **AMESim** more pleasant than the generic equivalent.

Step 12: Use the state count facility and also examine in an editor the *.state* and *.var* files produced by AMESim.

The important thing to realize is that things hidden by **AMECustom** appear under very unhelpful names (Figure 3.67). This is true even if it is not encrypted. In **AMECustom** you define what is private and what is public. **AMESim** only shows the public part.

Figure 3.67: State count dialog box



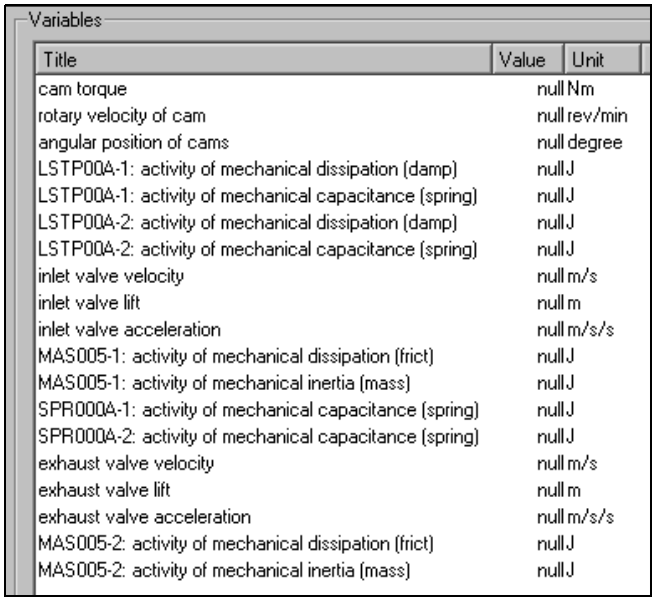
3.2.4 Activity variables and customized supercomponents

Following the steps in the previous section the status of all activity variable are hidden. For this reason you will not have access to these variables in **AMESim** regardless of the state of the *Activity index calculations* check box in the *Run Parameters* dialog box.

We will now reintroduce these activity variables.

1. In **AMECustom** uncheck the hidden box for all activity variables. You will then get the following *Run* mode preview.

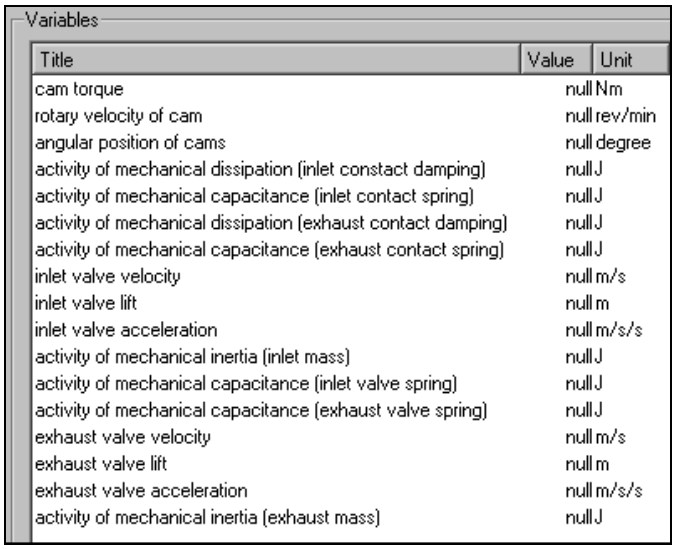
Figure 3.68: Run mode preview



Actually since there is no friction in the *MAS005* submodels and no possibility of adding friction in **AMESim**, these two particular activities will always be zero and hence can be hidden.

2. Take each activity variable in turn and remove the unwanted prefix and adjust the titles to make them unique. Below are some suggestions.

Figure 3.69: You can remove unwanted prefixes



Variables

Title	Value	Unit
cam torque	null	Nm
rotary velocity of cam	null	rev/min
angular position of cams	null	degree
activity of mechanical dissipation (inlet constact damping)	null	J
activity of mechanical capacitance (inlet contact spring)	null	J
activity of mechanical dissipation (exhaust contact damping)	null	J
activity of mechanical capacitance (exhaust contact spring)	null	J
inlet valve velocity	null	m/s
inlet valve lift	null	m
inlet valve acceleration	null	m/s/s
activity of mechanical inertia (inlet mass)	null	J
activity of mechanical capacitance (inlet valve spring)	null	J
activity of mechanical capacitance (exhaust valve spring)	null	J
exhaust valve velocity	null	m/s
exhaust valve lift	null	m
exhaust valve acceleration	null	m/s/s
activity of mechanical inertia (exhaust mass)	null	J

3. Save the customized supercomponent and load the revised version into **AMESim**.

4. Enable *Activity index calculations* and do a run. 

5. Use **Tools ▶ Activity index** to produce an *Activity Index List* dialog box.

Figure 3.70: Activity Index List dialog box

Submodel	Title	Value	Unit	Type	Index	%
CUSVALVES50-1	activity of mechanical dissipation (exhaust contact damping)	1.966e-004	J	R	1.467e-004	%
CUSVALVES50-1	activity of mechanical dissipation (inlet constact damping)	3.962e-004	J	R	2.955e-004	%
CUSVALVES50-1	activity of mechanical capacitance (inlet contact spring)	2.791e-002	J	C	2.082e-002	%
CUSVALVES50-1	activity of mechanical capacitance (exhaust contact spring)	3.007e-002	J	C	2.243e-002	%
CUSVALVES50-1	activity of mechanical inertia (inlet mass)	1.059e+000	J	I	7.896e-001	%
CUSVALVES50-1	activity of mechanical inertia (exhaust mass)	1.444e+000	J	I	1.077e+000	%
CUSVALVES50-1	activity of mechanical capacitance (inlet valve spring)	6.474e+001	J	C	4.829e+001	%
CUSVALVES50-1	activity of mechanical capacitance (exhaust valve spring)	6.676e+001	J	C	4.980e+001	%

3.3 Conclusion

You should now have some idea of what **AMECustom** does. At this point it is appropriate to reread section 1.5 where ideas on how **AMECustom** can be used are presented.

Chapter 4: Reference Guide for AMECustom

4.1 Introduction

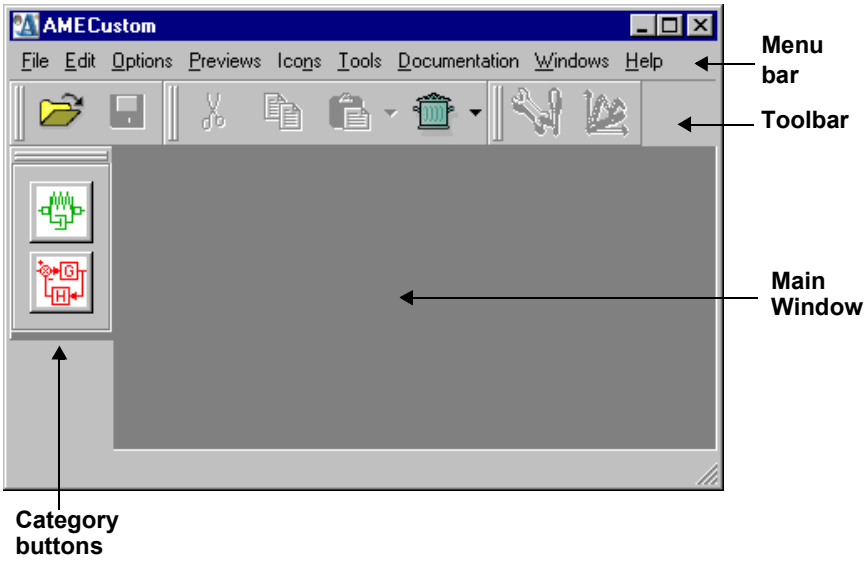
This guide is designed to be used for reference from the main index. It is organized as follows:

- a description of The AMECustom main window,
- features available from The AMECustom menu bar,
- features available from The AMECustom Toolbar,
- categories available from The Category buttons,
- a description of The customized object general features,
- a presentation of The global parameter lists,
- a presentation of The External variables list,
- a presentation of The Internal items lists.

4.2 The AMECustom main window

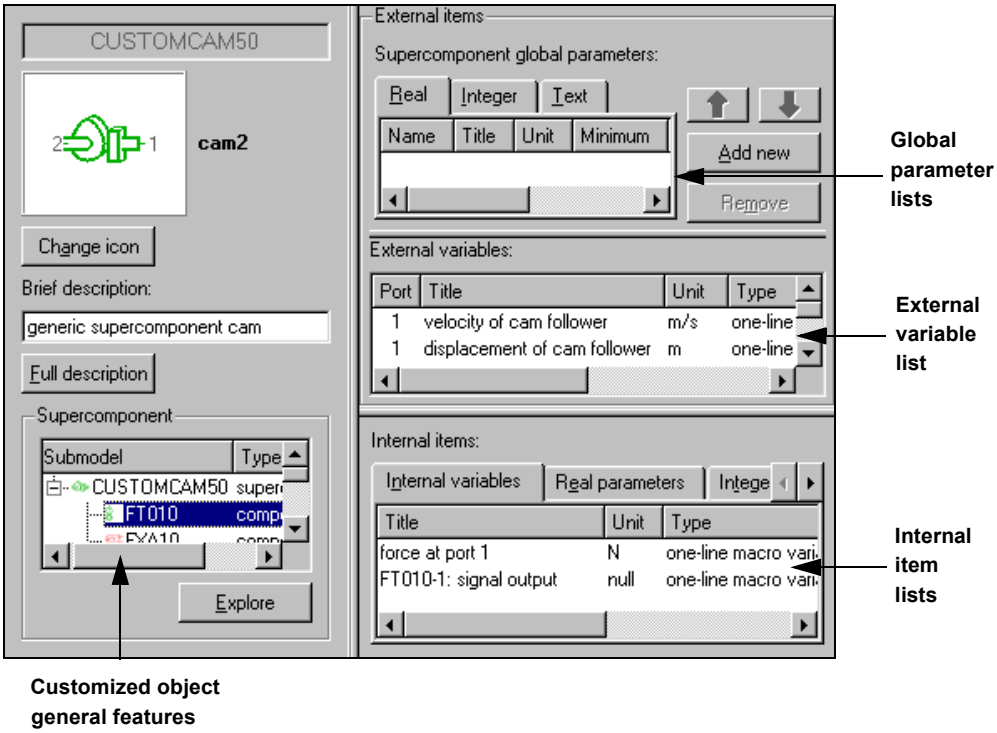
The empty main window of **AMECustom** is shown in Figure 4.71. Click on the menu bar or move your mouse pointer on the toolbar and the category buttons to have more details:

Figure 4.71: AMECustom display



When an object is loaded, the main window looks like in Figure 4.72.

Figure 4.72: Main window with a submodel loaded



This nomenclature will be used throughout this chapter.

> **Note:** If a customized submodel is loaded rather than a customized super-component, the customized object general feature area is simpler than the one shown in Figure 4.72.

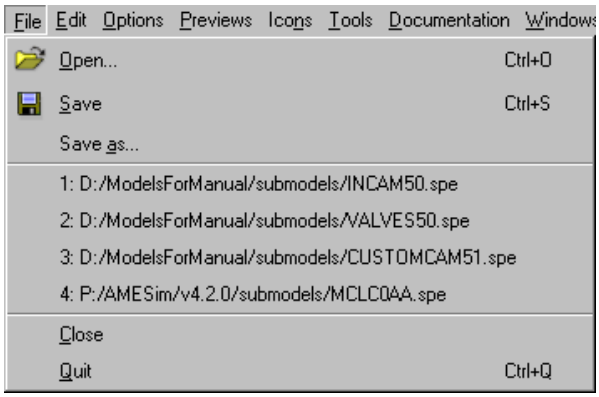
4.3 The AMECustom menu bar

Each menu allows you to access the main **AMECustom** commands. See the details in the following sections:

- Icons menu
- Documentation menu

4.3.1 File menu

Figure 4.73: File menu



Open

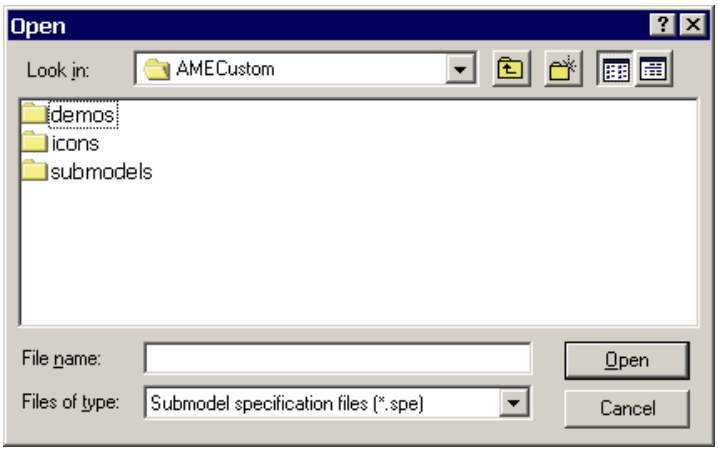

This method allows you to select generic or customized objects by name rather than by icon.

To open an object you can also:

- click on the button in the *Toolbar,*
- use the **Ctrl+O** shortcut.

If you select *Open* in the *File* menu, you will get a file browser to enable you to look for *.spe* files. Hence you should normally search in the *submodels* folder of **AMESim** nodes.

Figure 4.74: File browser in the Open dialog box



You can open *.spe* files of:

- generic submodels,
- generic supercomponents,
- customized submodels,
- customized supercomponents.

Any object selected that can be read will be loaded into the **AMECustom** main window.

Note that all successful save operations in **AMECustom** will always produce **customized** objects.

Save

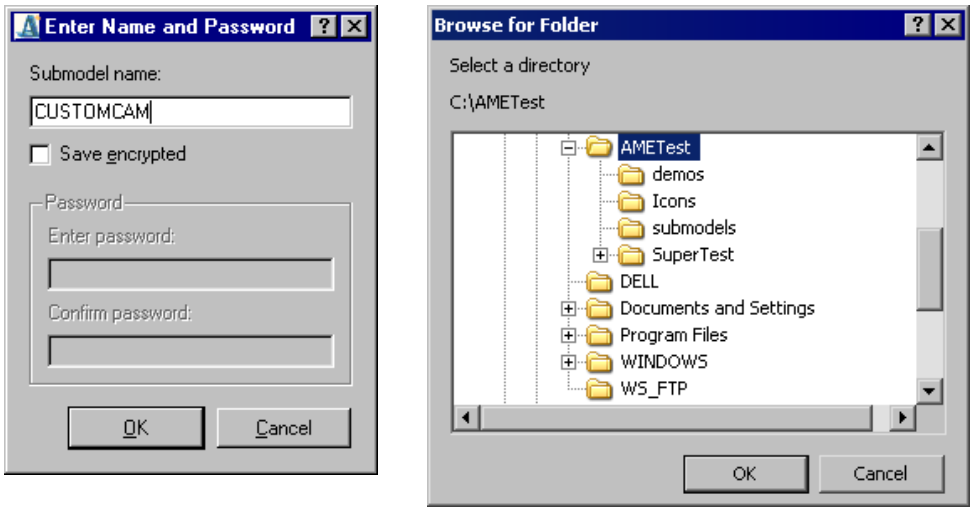
Select this menu item when you think your customization is complete and you want to save it. If the customized object is new, *Save* behaves like *Save as*.

You can also click on the *Save*  button in the *Toolbar* or use the **Ctrl+S** shortcut.

Save as

Select this menu item when you want to save a customized object under a new name and/or in a different **AMESim** node. You must specify the name and also the **AMESim** node (Figure 4.75).

Figure 4.75: Save as process



Note: You can save a customized object encrypted. If you do this, you will have to set a password. Encrypted objects cannot be opened in **AMECustom** without their password.

Last opened files list

This section of the menu displays the last opened submodels or supercomponents.

You can change the number of the last opened files to display by using **Options ▶ AMECustom Preferences...**

Close

Select this item when you wish to clear the active submodel or supercomponent.

If **AMECustom** thinks it has changed, you will be invited to save it.

Quit

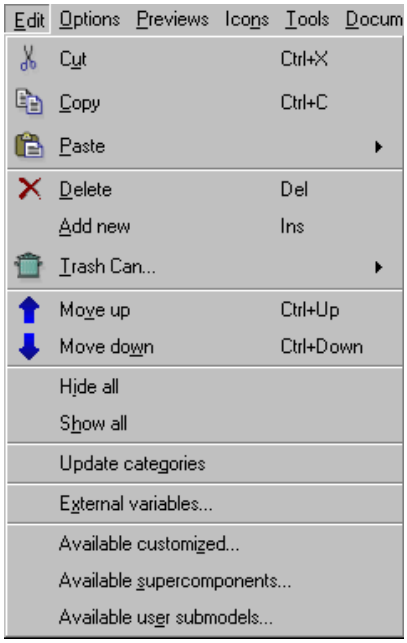
Select this item when you wish to leave **AMECustom**. If loaded objects have changed, you will be invited to save them.

You can use the **Ctrl+Q** shortcut.

4.3.2 Edit menu

The first eight items only operate on a selected global parameter.

Figure 4.76: Edit menu



Cut

The selected global parameter is removed. The shortcut is **Ctrl+X**. The facility is also available by clicking on the *Cut global parameter* button in the toolbar.

Copy

The selected global parameter is copied into a special buffer or clipboard. The shortcut is **Ctrl+C**. The facility is also available by clicking on the *Copy current item* button in the toolbar.

Paste

The contents of the selected global parameter are overwritten with the contents of the clipboard. The shortcut is **Ctrl+V**. The facility is also available by clicking on the *Paste current item* button in the toolbar.

Delete

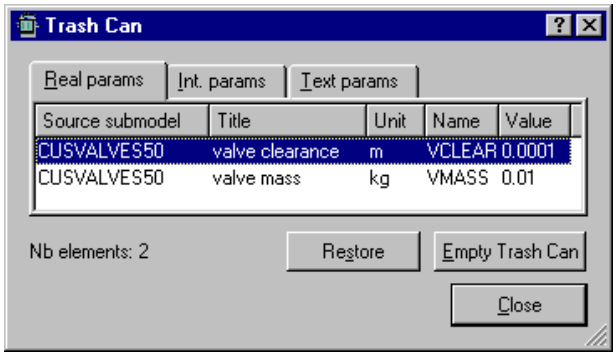
The selected global parameter is deleted. The shortcut is **Del**.

Add new

A new global parameter is appended at the end of the list. The shortcut is **Ins**.

Trash can

This opens a dialog box from which the latest global parameters that have been deleted are shown:



It is then possible to restore some of these or to empty the trash can. The shortcut is **Ctrl+T**.

Move up

If it is possible, the selected global parameter is moved up one position in the list. The shortcut is **Ctrl+Up**.

Move down

If it is possible, the selected global parameter is moved down one position in the list. The shortcut is **Ctrl+Down**.

Hide all

This option hides all internal items of the customized object currently selected: a tick mark appears in every check box of the *Hidden* column.

Show all

This option shows all the internal items of the customized object currently selected: all the tick marks in the check boxes of the *Hidden* column are removed when possible.

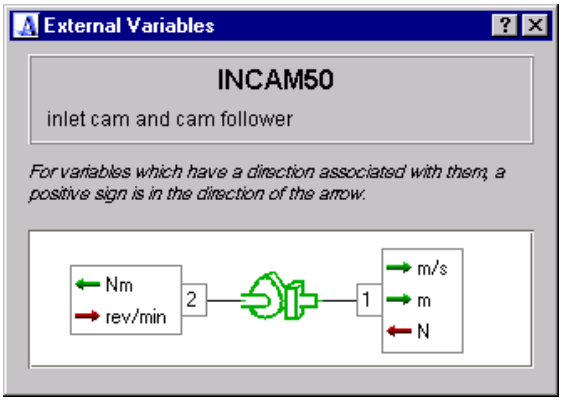
Update categories

This option updates the categories and their contents according to the current path list.

External variables

This option produces a dialog box showing the external variables associated with each port of the selected customized object.

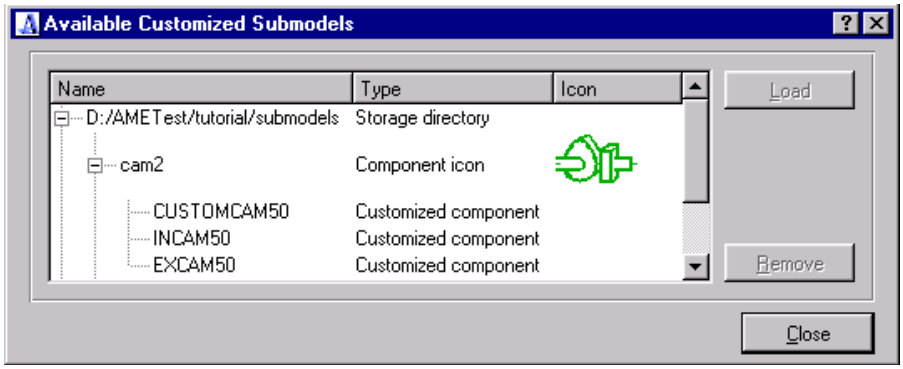
Figure 4.77: External Variables window



Available customized

This option produces the list of available customized objects (submodels or supercomponents) from the current path list. You can select from this list and load into **AMECustom** for editing (click on *Load*) or deleting (click on *Remove*) any existing customized object.

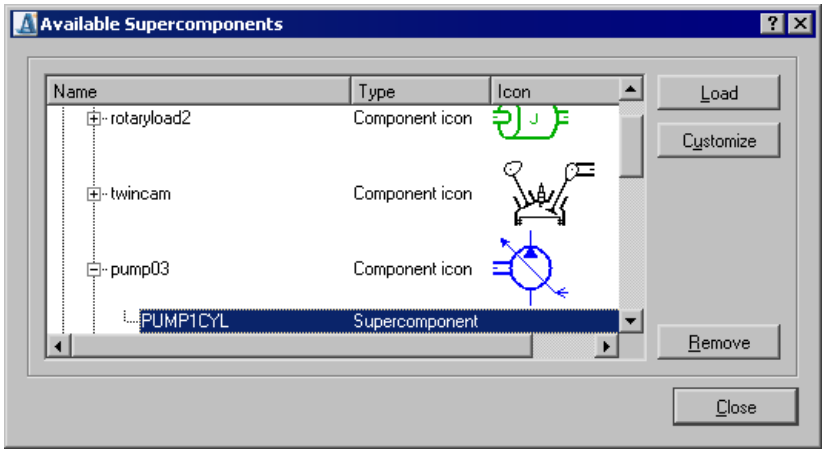
Figure 4.78: Available Customized Submodels dialog box



Available supercomponents

This option produces the list of both generic and customized supercomponents that are available from the current path list. You can select from this list and load into **AMESim** (click on *Load*) or load into **AMECustom** (click on *Customize*) or remove (click on *Remove*) any existing supercomponent.

Figure 4.79: Available Supercomponents dialog box

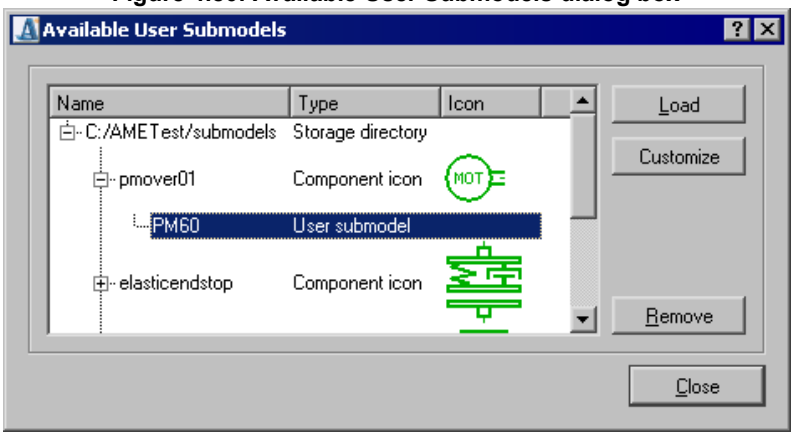


Available user submodels

This option produces a list of both generic and customized submodels that are available from the current path list. This list is limited to user submodels only. This means submodels that do not belong to any standard **AMESim** library.

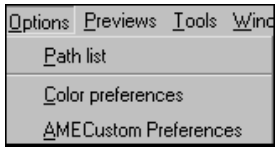
You can select from this list and load into **AMESim** (click on *Load*) or load into **AMECustom** (click on *Customize*) or remove (click on *Remove*) any existing user submodel.

Figure 4.80: Available User Submodels dialog box



4.3.3 Options menu

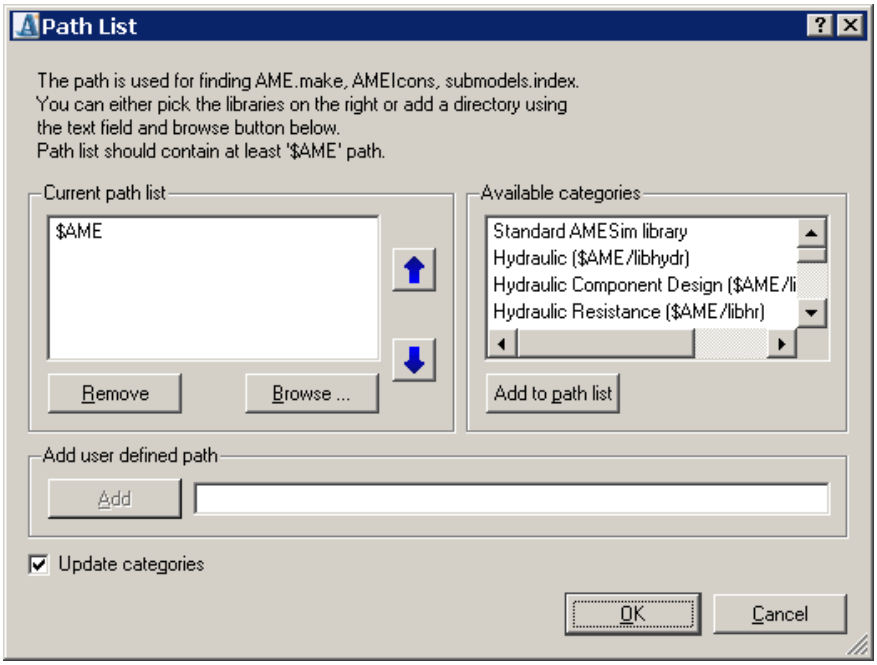
Figure 4.81: Options menu



Path list

Select this item to change the **AMESim** path list. This functionality is precisely the same as in **AMESim**.

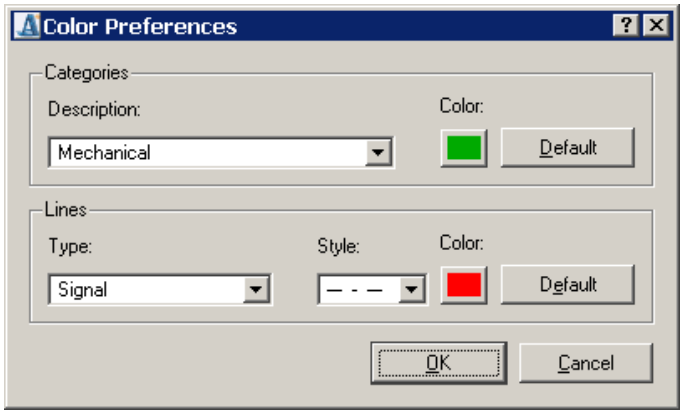
Figure 4.82: Path list dialog box



Color preferences

Select this item to change colors assigned to categories and lines as well as line styles. This functionality is precisely the same as in **AMESim**.

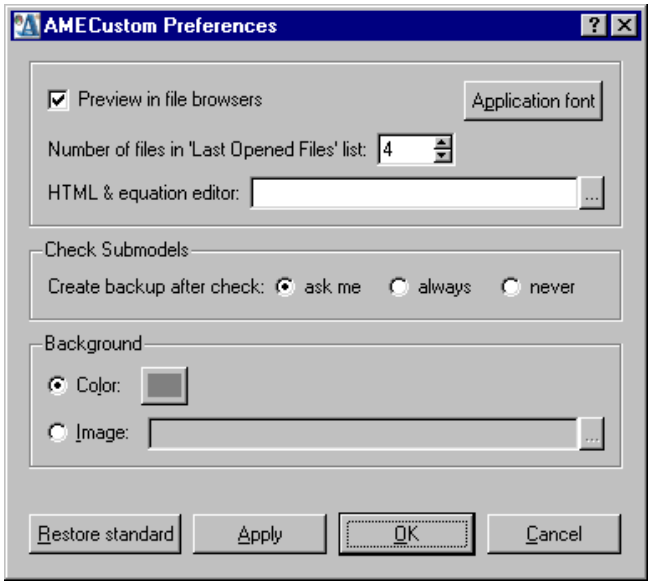
Figure 4.83: Color preferences dialog box



AMECustom Preferences

Select this item to produce the *AMECustom Preferences* dialog box. Figure 4.84 shows the options set to their default values.

Figure 4.84: AMECustom Preferences dialog box



The *Preview in file browsers* check box applies to the *Background* area when the *Image* button is selected and the browse button is clicked.

If you click on *Application font*, you can select a different default font for **AMECustom**.

Number of files in 'Last Opened Files' list allows you to change the number of files displayed in the *Files* menu.

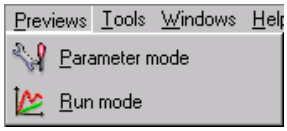
You can select the HTML editor you wish to use from **AMECustom** in order to complete or modify the documentation associated with your customized objects.

After a check submodels is applied to a customized supercomponent you have the possibility to create a backup of its original version. You can choose this backup is created always, never or on demand.

The two radio buttons under the label *Background* allow you to change the default main window when no objects are loaded. If *Color* is checked, you can select a particular color. If *Image* is checked, you can enter the path and name of a file to specify an image to be used. Alternatively you can browse for the file and if the *Preview in file browsers* check box is ticked, you will see a reduced size image of the selected file in the browser.

4.3.4 Previews menu

Figure 4.85: Previews menu



Parameter mode

This option takes the active object in its current state and shows how the *Change Parameters* dialog box will look like for this object in **AMESim**. You can also click on the button in the *Toolbar*.

Use this facility frequently when you are customizing submodels and supercomponents as you can identify mistakes at an early stage.

Run mode

This option takes the active object in its current state and shows how the *Variable List* dialog box will look like for this object in **AMESim**. You can also click on the button in the *Toolbar*.

Use this facility frequently when you are customizing submodels and supercomponents so that you can identify mistakes at an early stage.

4.3.5 Icons menu

Figure 4.86: Icons menu

Add category

If you do not want to use a component icon from the available **AMESim** libraries, you must create your own component icons and these must be stored in your own category icon. Category icons are the ones you see at the left side of the **AMECustom** window.

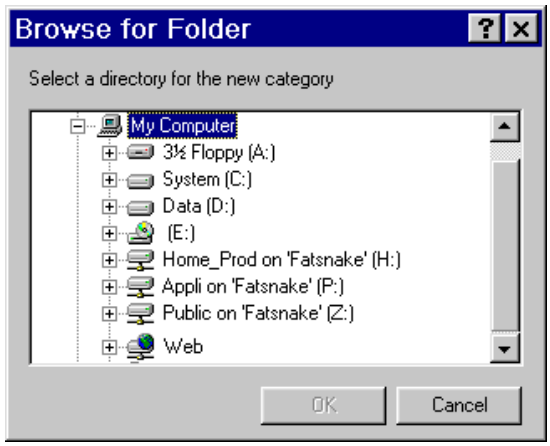
The steps involved in creating a new category icon are the following:

1. Select **Icons ▶ Add category...**

A browser appears.

2. Select a directory for your category.

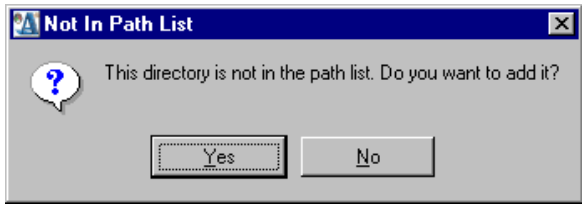
Figure 4.87: Browsing for a Folder for an AMESim category.



3. Click on *OK*.

If the selected directory is not in the **AMECustom** path list, the following dialog box is produced:

Figure 4.88: Adjusting the Path List.



You can then update your path list and you will be asked for the category name and description. As soon as the description is validated, the *Icon Designer* appears. You can now create an icon for the new category.

Remove category

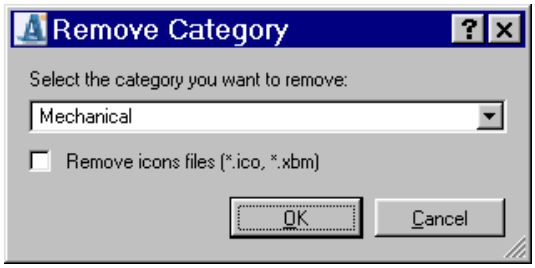
To be able to remove a category

- there must be no component icons in this category and
- you must have write permission for the appropriate *.xbm*, *.ico* and *AMEIcons* files.

1. Select **Icons ▶ Remove category...**

The *Remove Category* dialog box appears:

Figure 4.89: Removing a Category.



2. Select the category you want to remove.
3. Check the box *Remove icons files* if you want to remove also the files of the icon (*.ico*, *.xbm*).
4. Click on *OK*.

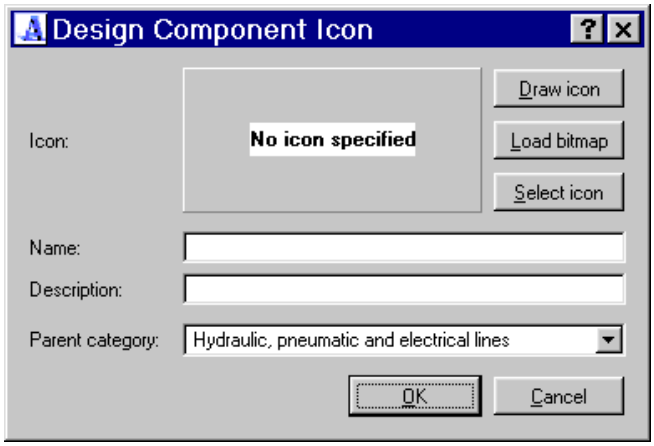
Add component

Step 1: Create a new component

1. Select the *Add component* item of the *Icons* menu.

   The dialog box shown below is displayed:

Figure 4.90: Adding a New Component Icon.



2. Fill in the *Name*, *Description* and *Parent category* fields to give the necessary information on your new icon.

Step 2: Specify an icon for the new component.

There are 3 different ways of assigning an icon:

- **Draw a new icon:** Click on the *Draw icon* button to produce the *Icon Designer*. Design the icon and set its ports: please refer to the **AMESim** manual section 6.5.2.Creating a supercomponent icon (step 1 to step 6) to learn how to create an icon and add ports to it. Finally click on the *Save icon to AMESim files* button of the *Icon Designer* dialog box.

- **Load a bitmap from a file:** A file browser allows you to load a bitmap from a file.
- **Select an existing icon from another category:** Select the icon you want within a list of existing icons.

When you have designed the icon and set its fields properly, click on the *OK* button.

Remove component

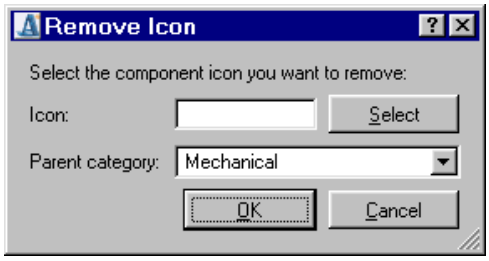
To be able to remove a component icon:

- there must be no submodel or supercomponent associated with the icon and
- you must have write permission for the associated *.ico* file.

1. Select **Icons ▶ Remove component...**

   The *Remove Icon* dialog box appears.

Figure 4.1: Removing a Component Icons.



2. Select the component icon you want to remove using the *Select* button.
3. Select the parent category of the component icon.
4. Click on *OK*.

Icon designer

The Icon designer facility can be started as a general facility if you select **Icons ▶ Icon designer...** It can also be started when creating a new category icon or when creating an icon for a customized object.

With the **AMECustom** *Icon Designer*, you can create and save one or more icons and specify their ports. Please refer to the **AMESim** manual section 6.5.2.Creating a supercomponent icon (step 1 to step 6) to learn how to achieve this.

Change object icon

Use **Icons ▶ Change object icon...** if you want to replace the existing icon which the current active customized object is associated with. You can do the same thing by clicking on the *Change icon* button. In either case an *Icon selection* dialog box is created.

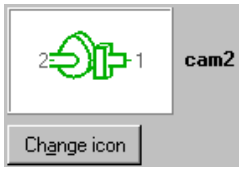
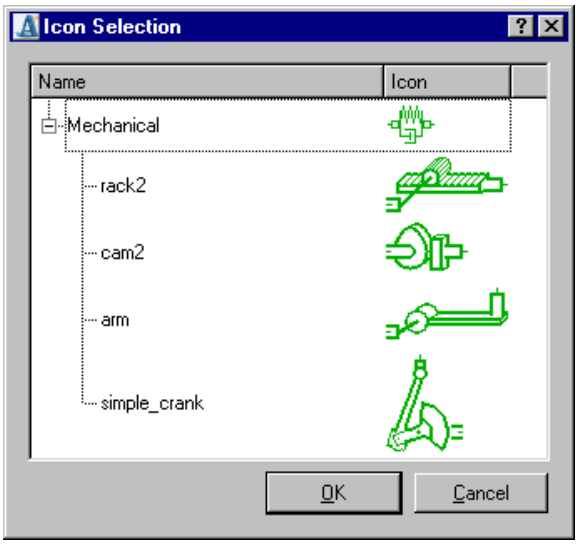


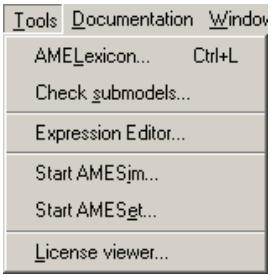
Figure 4.2: The Icon selection dialog box



Expand the tree structure and select the new icon.

Note that you will be presented with subset of icons. These are the ones that are compatible with the active customized object. It is possible that no icons are suitable! In this case you will have to create one. Naturally you must create your new icon before you can attach a customized object to it.

4.3.6 Tools menu



The items on this menu are a reduced set of those available in **AMESim**. The *Check submodels* item needs further explanation in the special context of **AMECustom**.

AMELexicon

You can use *AMELexicon* at any time while working with **AMECustom**. The main function of the *AMELexicon* utility is to help you to make the titles of the parameters and variables consistent. When you create your own customized objects, it is extremely easy to have titles that almost the same as the titles in other related generic or customized objects. Unfortunately 'almost' is not good enough for facilities like *Common Parameters*!

Basic rules

- When you select a library in the path list within the *Build* tab, *AMELexicon* scans the submodels of this library.
- You have the option to restrict the search by filtering according to submodel name, variable/parameter title and unit.
- Results of a search are shown under the *Titles* tab.
- In the *Titles* tab you have a *Variable titles* and a *Submodels list*. The *Submodels list* displays the submodels with titles with in the *Variable titles*.
- *AMELexicon* recognizes the difference between variables/parameters with identical titles but different units

- **You can drag and drop the title you want onto a variable/parameter in you active AMECustom object.**

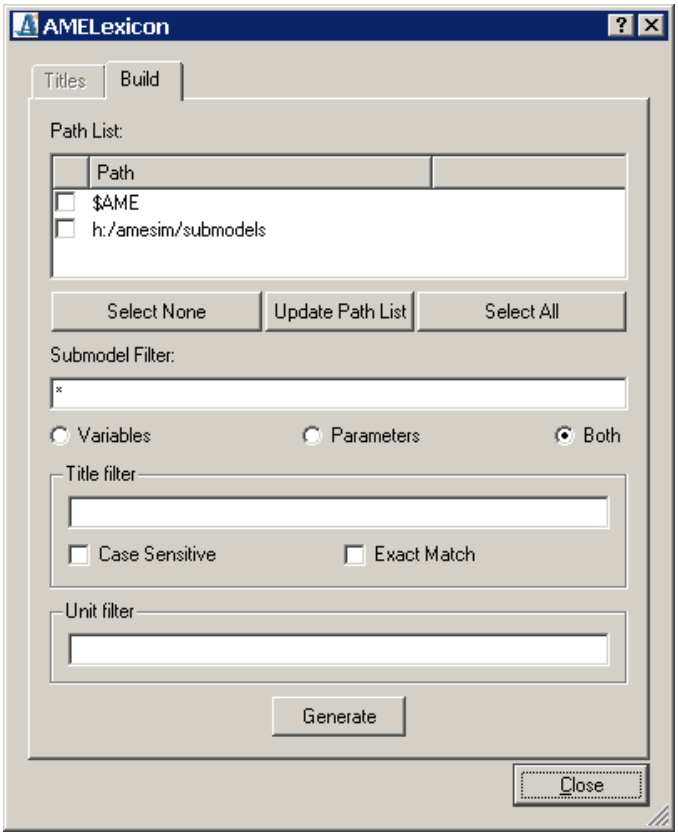
- If you double-click on a submodel in the *Submodel lists*, **AMECustom** attempts to open **AMESet** with the submodel loaded.
- If a title seems to appear twice in the list with the same unit, this probably means that there is a spelling mistake on one of the two titles.

AMELexicon dialog box

To produce *AMELexicon* dialog box, select the menu **Tools ▶ AMELexicon...**

When you open the *AMELexicon* dialog box, the *Build* tab is displayed first.

Figure 4.91: Build tab



The *Build* tab contains four groups of options:

Path list

This is the current **AMECustom** path list.

The buttons *Select None* and *Select All* are obvious.

The button *Update Path List* is useful if you have modified your path list and you want to update it in this dialog box.

Submodel filter

In the white field you can enter a name of a submodel from which you want to check the parameter and variable titles. Alternatively you can use wildcards like * and ? to specify a collection of submodels.:

To find	Do this	Example
Zero or more characters, excluding spaces and punctuation	Enter an asterisk (*).	HL*4 finds submodels such as HL04 and feet.

To find	Do this	Example
Any single character, excluding spaces and punctuation	Enter a question mark (?).	F??4 finds submodels with four-letter names that begin with F and end with 4--for example, FP04.

You can filter variables, parameters or both.

Title filter

You can enter one or several words in the white field.

If you tick the *Case sensitive* box, *AMELexicon* will take into account the case of the words you typed in.

If you tick the *Exact Match* box, *AMELexicon* will take into account the exact text string you typed otherwise it takes the words in the string as key words.

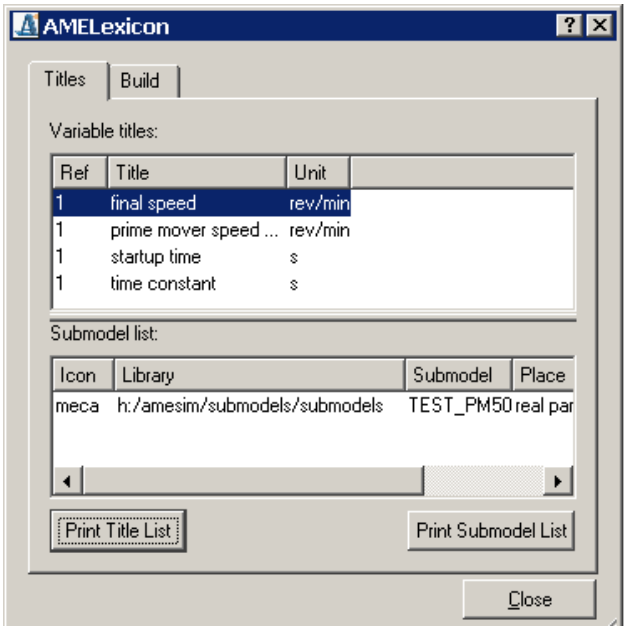
Unit filter

You can type several units in the white field separated by a space. *AMELexicon* will give you the list of parameters and variables which have the same units.

Generate button

When you have entered the characteristics of the search, click on the *Generate* button. This produces the *Titles* tab containing the title list corresponding to your search. By selecting a particular title, the *Submodel list* is reconstructed to show the submodels associated with this title.

Figure 4.92: Titles tab



You can drag and drop a title from *AMELexicon* to a title of a parameter or a variable within **AMESet** or **AMECustom**. This can be done only for titles. If you place the cursor in the wrong place, it becomes a ⃠.

Check submodels

In **AMESim** *Check Submodels* is used to check the active **system** or **generic supercomponent**. The idea is to provide a mechanism for painlessly updating the system or supercomponent with respect to changes in the specification of the constituents.

In **AMECustom** the check can be applied to the active:

- **customized submodel** or
- **customized supercomponent**

In the first case, the specification file of the customized submodel is compared with the specification file of its generic version. This is what we call a *Check consistency*.

In the second case a full *Check submodels* is applied as in **AMESim**, since a supercomponent is just like a piece of an **AMESim** system.

Basic rules

The following basic rules apply to *Check Submodels* in **AMECustom**:

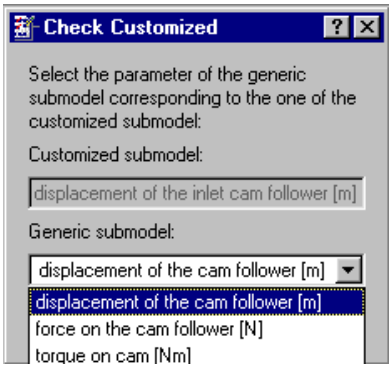
- *Check Submodels* starts automatically when you load an object.
- When it starts automatically and there is no problem, no dialog box appears.
- You can also start it manually using **Tools ▶ Check Submodels...** you should do this when you are altering a generic object or its constituents and simultaneously its customized version is used in **AMECustom**.
- If you start *Check Submodels* manually and have made changes to the object in **AMECustom**, do a *Save* first.

Check submodels of a customized submodel

This is the simplest case, **AMECustom** compares the specifications of the customized submodel with the specifications of its generic version.

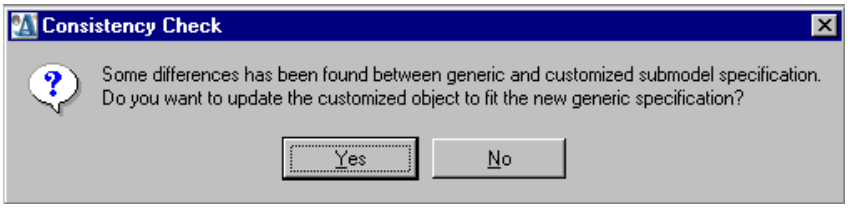
- If there are important differences (the number of ports has changed) you should completely rebuild the customized submodel.
- If there are just differences between the titles of the variables or parameters, **AMECustom** will ask you to make the link between the customized and the generic versions:

Figure 4.93: Check customized submodel



- In other cases, **AMECustom** will give you the possibility to update the customized version according to the new specifications of the generic submodel. This can happen when the unit of a parameter or variable has changed, or when the number of parameters or variables is different:

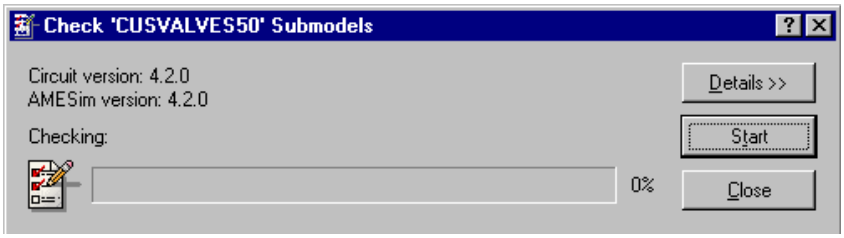
Figure 4.94: You can update the customized version



Check submodels of a customized supercomponent

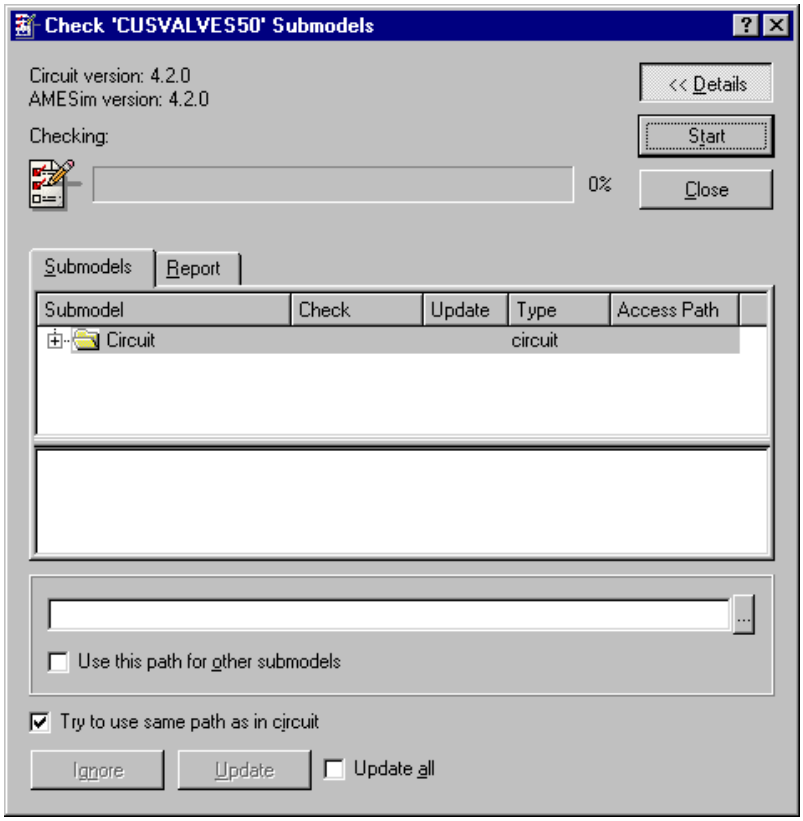
It you start the process manually, a *Check Submodels* dialog box is produced:

Figure 4.95: Check submodels dialog box



You can click on *Start* with the dialog box in this state or expand it by clicking on *Details*: the dialog box then takes on the form shown below.

Figure 4.96: Check submodels extanded dialog box



Note the *Try to use same path as in circuit* check box. By default this is enabled. Normally we expect supercomponent constituents not to have moved and so you do not need to change the default. However, if you move a supercomponent from one computer system to another, the paths used in the supercomponent file is likely to become irrelevant and hence you should disable this check box.

Note also the tabs labeled *Submodels* (selected by default) and *Report*. The first show the tree structure of the supercomponent circuit as the check proceeds and the second is more detailed and contains no graphics. It is of a form that can be printed.

Submodel location

AMECustom checks the constituents of the loaded supercomponent against their specification. This involves finding the constituent *.spe* files (and *.sub* files if appropriate). It locates these from the specification of the loaded supercomponent, from the current **AMECustom** path list or, if it is unsuccessful, it will ask for your help in locating these files.

Note:
- It is worth reviewing the current path list first and adjusting it if necessary.
- In most situations the *Try to use same path as in circuit* check box should be left checked. However, if the object loaded into **AMECustom** has just been moved from one computer system to another, its path name may be wrong and it is more efficient if this box is unchecked.
- If **AMECustom** needs help finding a file, it will tell you the name of the file. You can then enter the path in the input box or use the *Browse* button to search for it.
- If you think that this path may need to be used again, check the *Use this path for other submodels* box.

Check submodels starting

Start the process by clicking on *Start*. A check finished message is displayed with no report of any problem if the supercomponent is up-to-date.

However, the process will stop if a problem is found. There is an entry in the *Report* window explaining the nature of the problem. Note that the procedure is the same as for an **AMESim** model. For more details please refer to the *Check submodels* section of the **AMESim** manual.

It is vitally important that after an update you examine the customized object very thoroughly.

Remember that it is not possible to reconstruct an egg from an omelette! For catastrophic changes it may be better to remove the old customized object and create a new one.

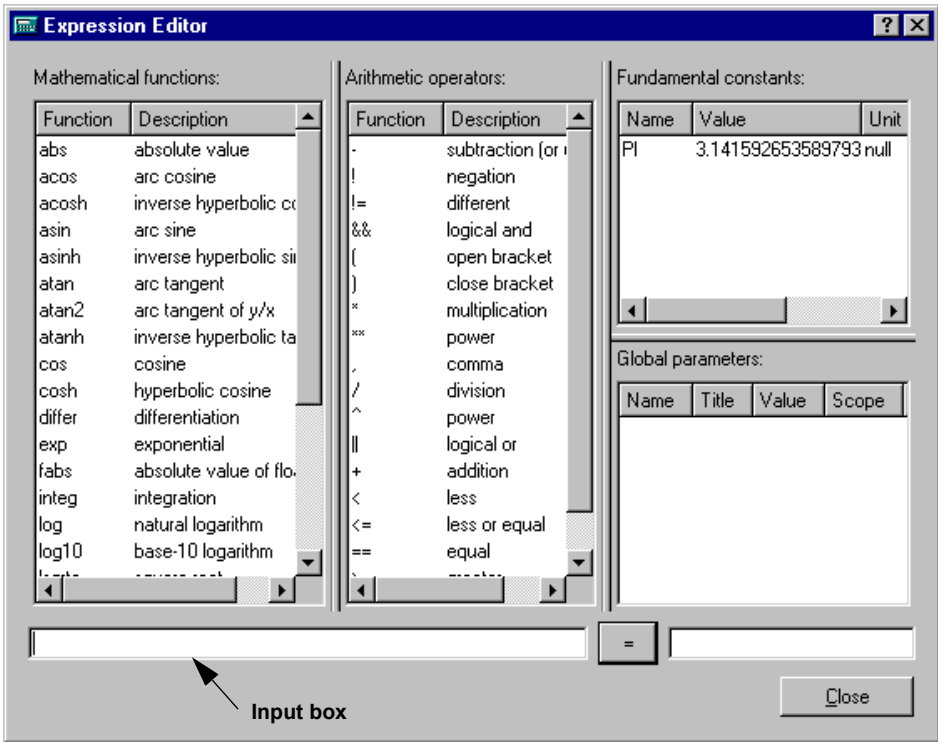
Expression Editor

Start of the Expression Editor

There are two different ways to start the *Expression Editor*:

- when setting a value for a parameter or variable, click on  to display the *Expression Editor*,
- use the menu **Tools ▶ Expression Editor...**

Figure 4.97: Expression Editor



Use of the Expression Editor

You can use the *Expression Editor* for:

- calculation,
- entering mathematical functions and expressions as a parameter value.

Procedure

1. To enter a mathematical function in the input box, select a function in the *Mathematical functions* list.
2. Double-click on the mathematical function.

   The mathematical function is placed in the input box.
3. Enter one or several values in the brackets.

   You can select values in the *Fundamental constants* and *Global parameters* lists by double-clicking on the values.
4. If necessary complete the expression by selecting operators and functions in the two lists.
5. When your expression is complete, click on the *equal* button.

   The result is displayed, when possible, in the grey box next to the *equal* button.

Expressions

The expressions that you can enter in the input box can be made up of:

- global parameters;
- real and integer constants;
- the label PI which is taken to be an approximation to π ;
- the arithmetic operations +, -, *, / and for raising to a power ^ or **;
- the boolean operations: !, !=, &&, ||, >, <, >=, <=,= =;
- parentheses '(' and ')' with their usual mathematical significance;
- coma ',' for seperating variables;
- the following functions of one variable:

sin	*cos*	*tan*	*acos*	*asin*	*atan*	*log*	*log10*
sinh	*cosh*	*tanh*	*acosh*	*asinh*	*atanh*	*exp*	*abs*
sqrt	*integ*	*differ*	*lsqrta*	*fabs*			

- the following functions of two variables:

  atan2 sign

- and the following functions of two or more variables:

  min max

AMESim will first check your expression. If it finds it is acceptable, it will enter the expression as a value of a parameter if you started the *Expression Editor* from the value field of a parameter or variable.

Note: The maximum size for an expression is 255 characters.

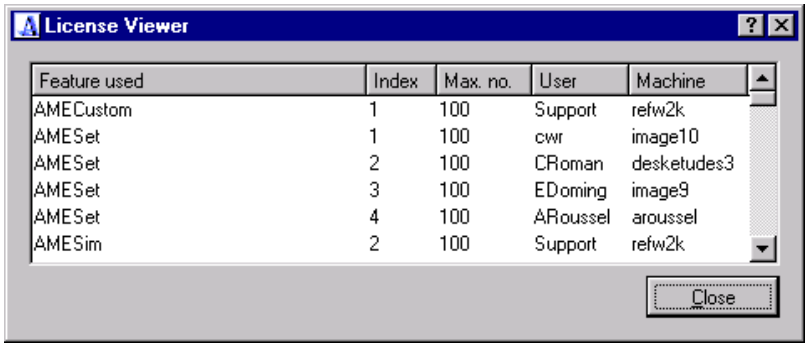
Start AMESim/Start AMESet

Just click on these items to start **AMESim** or **AMESet**.

License viewer

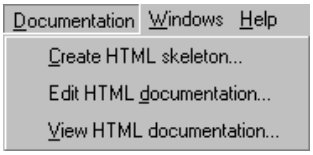
Select this item to see who is currently using **AMESim** product licenses. Normally this is only useful for clients who have multiple licenses. Note that you do not use a license for an **AMESim** library to use this library in **AMECustom**. For example you can use a pneumatic library icon and make a copy of a pneumatic library submodel for customizing without using a pneumatic library license token.

Figure 4.98: License Viewer displays the available features



4.3.7 Documentation menu

Figure 4.99: Documentation menu



Create HTML skeleton

Select this item to create HTML documentation for the active customized object.

Note:

- The name of the file is inherited from the customized object with an *html* extension.
- This *.html* file is put in the *doc* directory of the **AMESim** node in which the customized object is stored.
- The *.html* file is constructed from the specification (*.spe*) and source code (*.c* and *.f*, if any) of the generic version of the customized object. For customized submodels, fill in the full description part of the source code as this forms a major part of the documentation.

Edit HTML documentation

Use **Documentation ▶ Edit HTML documentation** to modify and complete the various sections of your customized object documentation. If no *HTML* editor is specified in the **AMECustom** preferences, you will be asked to select one.

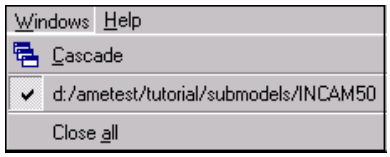
View HTML documentation

Use **Documentation ▶ View HTML documentation** to view the documentation of the active customized object. In contrast if you use **Help ▶ OnLine,** you get documentation on all submodels.

4.3.8 Windows menu

Use the Windows menu to modify the display of your systems.

Figure 4.100: Windows menu



Cascade

This option arranges the windows corresponding to the customized objects currently used so that they overlap with their titles remaining visible.

List of currently opened files

This part of the *Windows* menu shows the list of currently opened files.

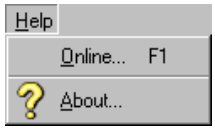
You can bring an object to the top by selecting it, it becomes the **active object**.

close all

This option initiates the process of closing all the windows associated with customized objects. If there are unsaved changes, you will be asked to save them.

4.3.9 Help menu

Figure 4.101: Help menu



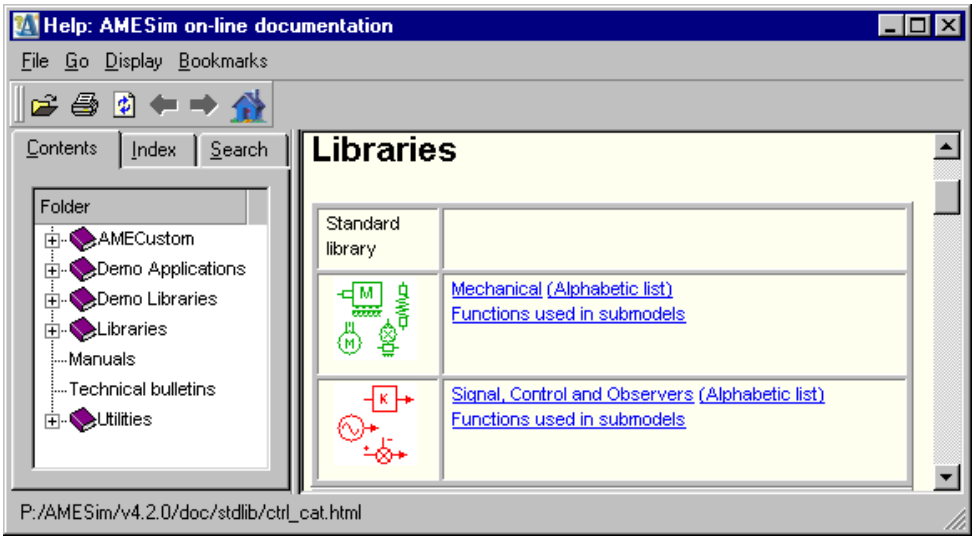
Online

Select this item to view the documentation of **AMESim** submodels. These may be in libraries supplied as an **AMESim** product, generic or customized submodels or supercomponents produced by you or by a colleague. At the left side of the screen you can find the three following tabs:

- Contents, which shows the list of the documentation topics.
- Index, from which you can type in a keyword and get the related entries.

- Search, from which you can get the list of all the documents containing at least one occurence of a given keyword.

Figure 4.102: On-line help window



About

This option gives a lot of information on the version of **AMECustom** you are using and the libraries to which you have access. If you contact the **AMESim** hotline, you may need to give information from this dialog box to the support team.

4.4 The AMECustom Toolbar

Each button of the toolbar is equivalent to a menu item of the menu bar.

 **File ▶ Open** or **Ctrl+O** (see Open)

 **File ▶ Save** or **Ctrl+S** (see Save)

 **Previews ▶ Parameter mode** (see Previews menu)

 **Previews ▶ Run mode** (see Previews menu)

 **Edit ▶ Cut** or **Ctrl+X** (see Edit menu)

 **Edit ▶ Copy** or **Ctrl+C** (see Edit menu)

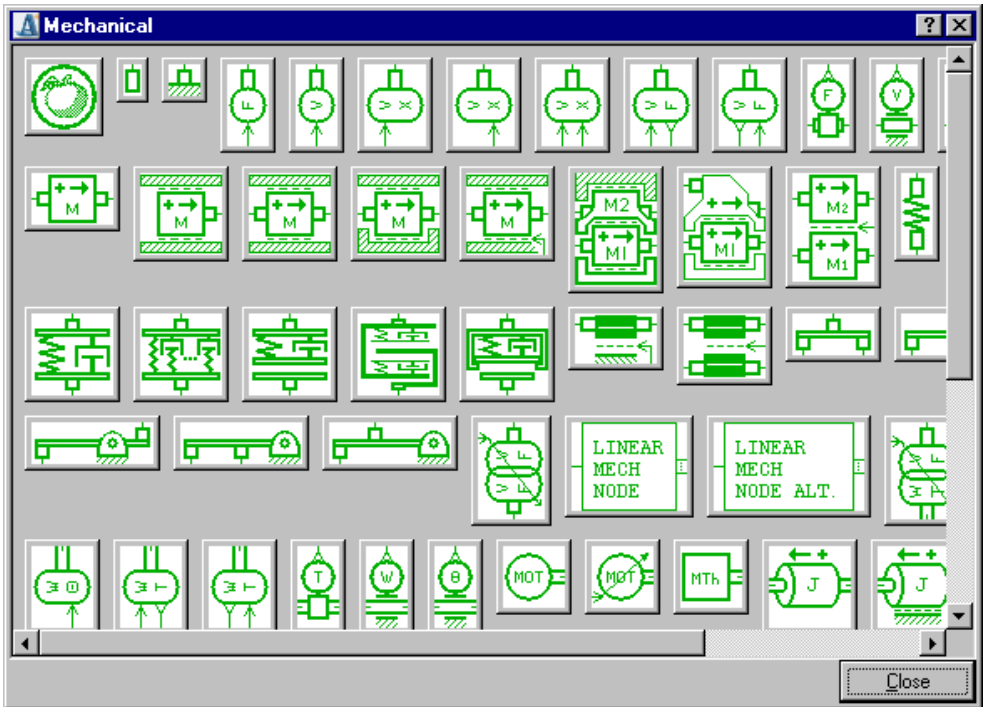
Edit ▶ Paste (see Edit menu)

Edit ▶ Trash can (see Edit menu)

4.5 The Category buttons

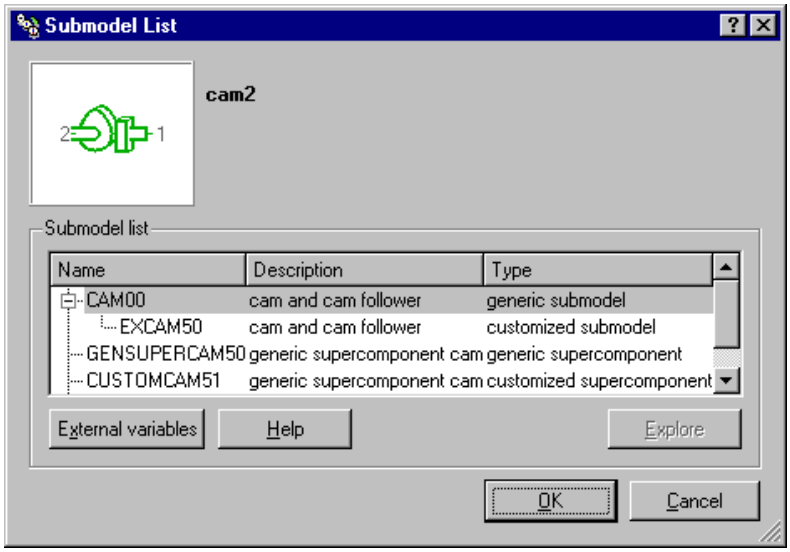
The category buttons are located at the left side of The AMECustom main window. When you click on one of these, a dialog box of component icons appears (Figure 4.103) which will be familiar with all users of **AMESim**, **AMERun** and **AMESet**.

Figure 4.103: Mechanical component icons dialog box



In **AMECustom**, when you select one of these icons you get a *Submodel List* dialog box (Figure 4.104).

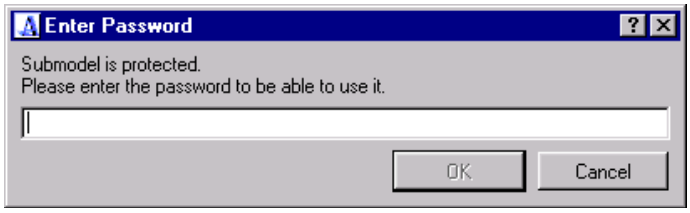
Figure 4.104: Submodel List dialog box



This contains a list of generic and customized submodels and supercomponents associated with the selected icon that **AMECustom** can find using the current path list. You can select one item in this list.

- Click on *OK* to load the object into **AMECustom**. If it is encrypted, you will be asked for a password.

Figure 4.105: You must know the password if the submodel is encrypted



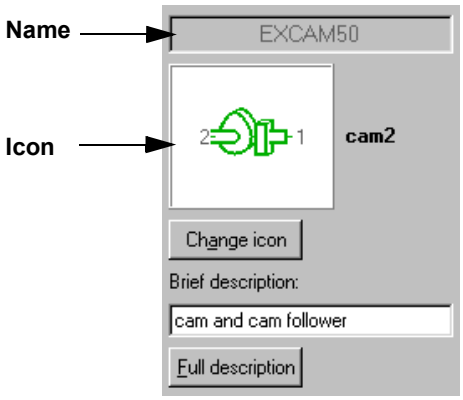
- The *Explore* button is sensitive only if it is a supercomponent. Click on this to see the supercomponent constituents. If it is encrypted, you will be asked for the password.
- Click on *External variables* to display the external variables of the object.
- If you click on *Help*, **AMECustom** will attempt to load and display documentation on the selected object.
- Click on *Cancel* if you have lost interest in the objects displayed.

4.6 The customized object general features

4.6.1 General features of a submodel

These are shown on the left hand side of the **AMECustom** main window when a **submodel** is selected for customization:

Figure 4.106: General features of the submodel



Some Right-click menus (page 90) are also available.

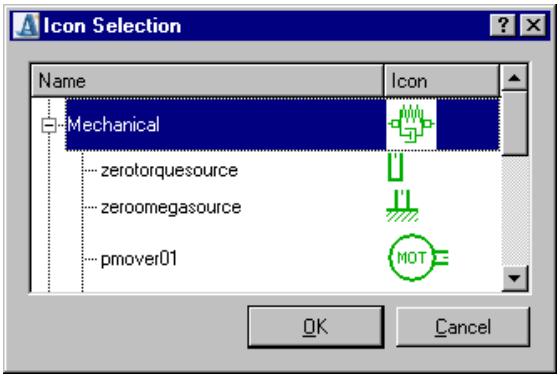
Name

When a new customized submodel is being created, **AMECustom** assigns a default name to it. If the name of the associated generic submodel is *GENNAME*, then the default name is *UNNAMED_GENNAME*. The first time you save your customized submodel, **AMECustom** asks you to replace the default name by a new one. Submodel name conventions are discussed in the introduction of Chapter 2:Customizing submodels (page 7) .

Icon

The default icon of a customized submodel is the same as the icon of the generic submodel it is associated with. However you can change this using the *Change icon* button:

Figure 4.107: Select an icon



This produces an *Icon selection* dialog box which allows you to select a different icon. Note that you will be presented with subset of icons. These are compatible with the active customized submodel. It is possible that no icons are suitable! In this case you will have to create your own one. Naturally you must create a new icon before attaching any customized submodel to it.

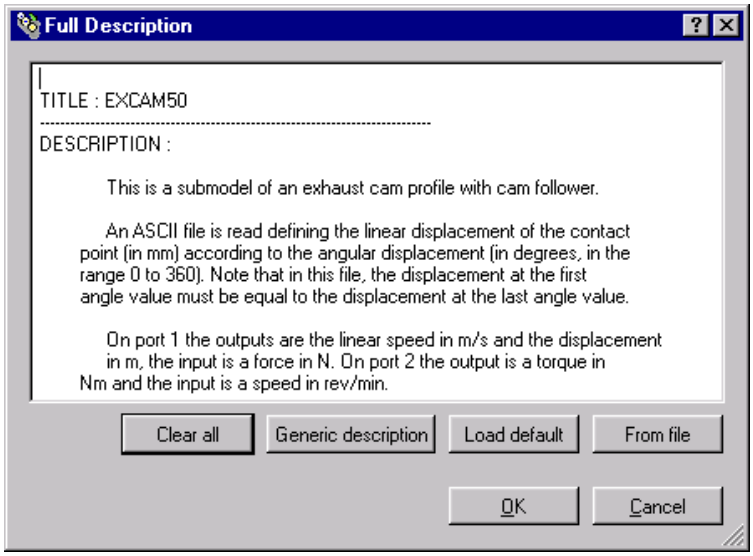
Brief description

This appears in an editable field which contains, by default, the generic submodel description. You should replace this by the description of your customized submodel.

Full description

If you click on the button labeled *Full description*, the dialog box below appears. By default this shows the full description of the associated generic submodel. You must alter it in order to take into account the modifications done in your customized submodel.

Figure 4.108: Full description dialog box



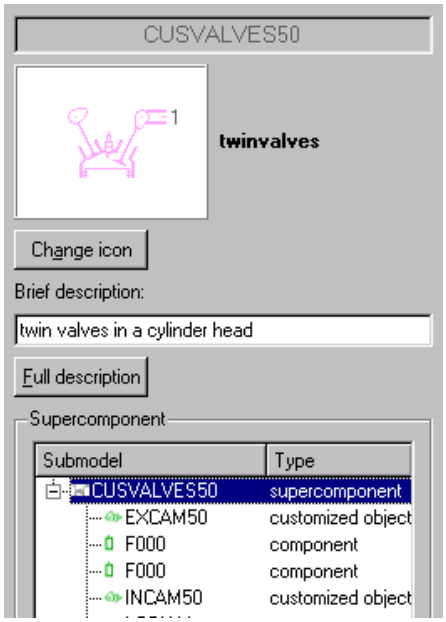
This dialog box also contains the four buttons described below:

- *Clear all*: delete the content of the description.
- *Generic description*: replace the text currently shown by the description of the associated generic submodel.
- *Load default*: replace the text currently shown by a template containing the headers TITLE, DESCRIPTION...
- *From file*: produce a file browser from which you can pick up a text file containing a description. This could be a description of the specific customized object you have produced in another editor or your own private template that you prefer to use.

4.6.2 General features of a supercomponent

These are shown on the left hand side of the **AMECustom** main window when a **supercomponent** is selected for customization:

Figure 4.109: General features of the supercomponent



Some Right-click menus (page 90) are also available.

Name, Icon, Brief description, Full description

These features are identical to the ones described in previous section.

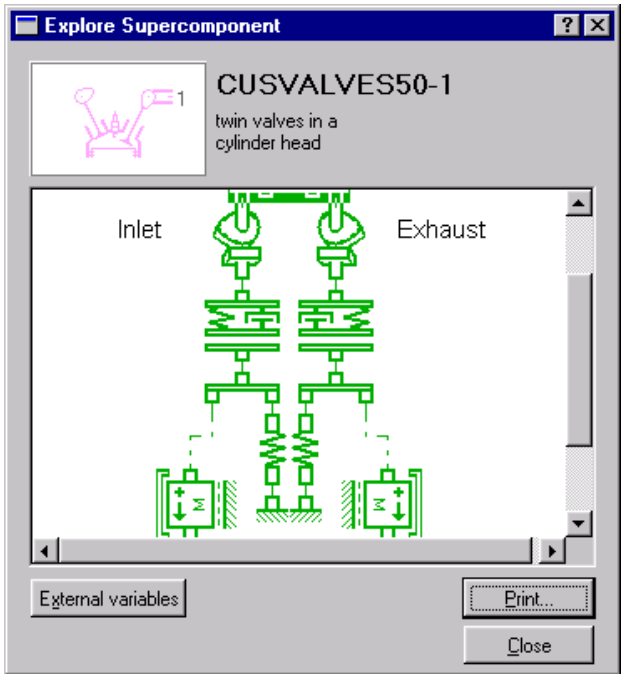
List of constituents

This list contains two columns indicating the icon, the submodel name and the type of each constituent (component, line or customized object) of the selected supercomponent.

Note that when you select a constituent in this list, the table of the *Internal items* is updated accordingly (see section The Internal items lists (page 92)).

Below this list the *Explore* button produces a dialog box showing the circuit associated with the supercomponent. If you click on a constituent of this circuit then the corresponding line is selected in the list and the table of the *Internal items* is updated accordingly. **AMECustom does not allow you to change the circuit of a supercomponent**.

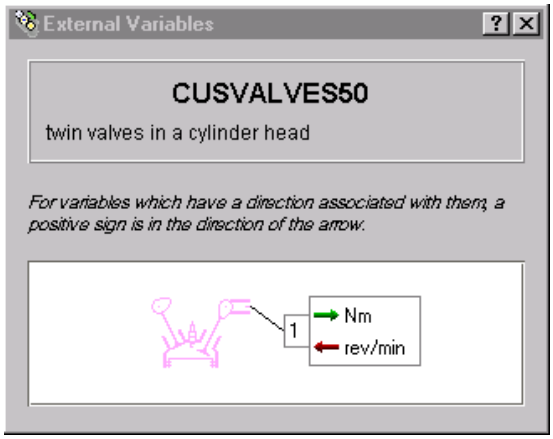
Figure 4.110: Circuit associated with the supercomponent



The *Explore Supercomponent* dialog box also contains the following two buttons:

- *External variables*: show the external variables of the supercomponent.

Figure 4.111: External variables of the supercomponent



- *Print*: print the supercomponent circuit.

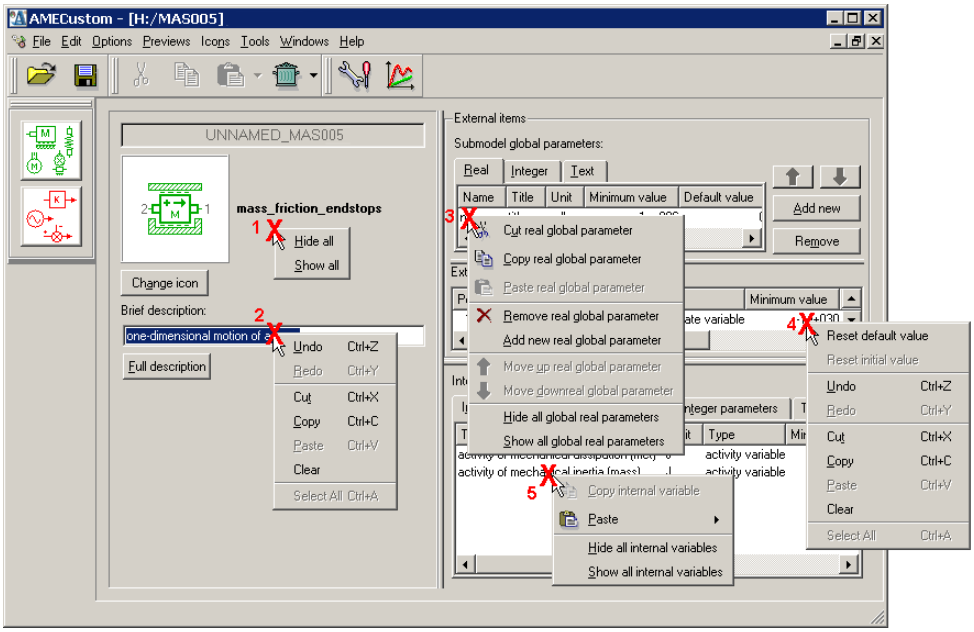
4.6.3 Right-Click Menus

- Main right-click menus
- Main functions available from the right-click menus

Main right-click menus

Different right-click menus are available from the main interface depending on the part you click on.

Figure 4.112: the different right-click menus



	Right-click on...	to access the following commands...
1	the left part of the display	• hide all • show all
2	the brief description	• undo, redo last action • cut, copy, paste, clear text • select all text

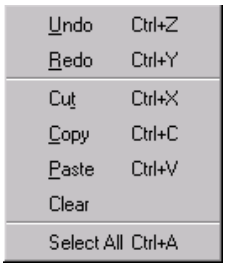
3	a submodel global parameter	• cut, copy, paste real global parameter • remove, add new real global parameter • move up, move down real global parameter • hide all, show all real global parameter
4	an external item title or value	• reset default value, reset initial value • undo, redo • cut, copy, paste, clear • select all
5	an internal item	• copy internal variable, paste internal or external variable • hide, show all internal variables

Main functions available from the right-click menus

Modifying the brief description

If you right-click on the object brief description, a menu appears. This is similar to the menu produced with most text (as opposed to numerical) fields and it is shown in Figure 4.113. It contains items the function of which is obvious. These menu items apply to the text in the *Brief description* field.

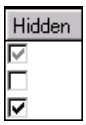
Figure 4.113: Right-click menu



Hiding status of variables and parameters

We can alter the status of an individual internal variable or parameter using the special check boxes but often it is useful to operate on a whole group of variables and parameters. We can do this using various right-click menus.

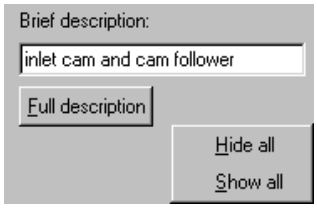
Figure 4.114: Hidden status check boxes



Changing the hidden status of all variables and parameters of a customized submodel

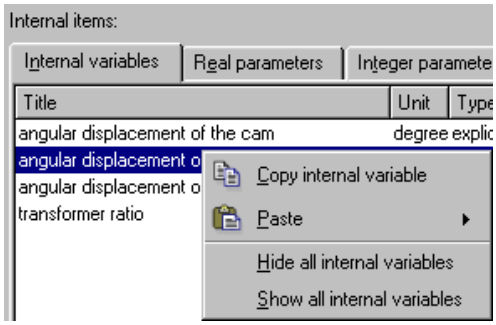
When the object being customized is a submodel, the area below the *Full description* button is blank but a right-click produces a menu. This can be used to hide or show all parameters and internal variables of the current object.

Figure 4.115: Right-click menu in the Full description area



The same menu can be produced with a right-click in the internal item area.

Figure 4.116: A right-click menu is available in the internal item area



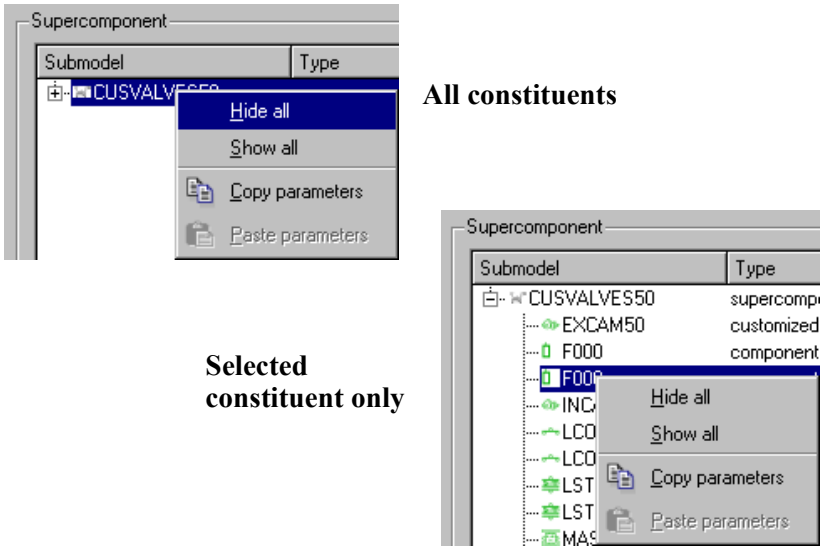
Changing the hidden status of all variables and parameters of a customized supercomponent

When the object being customized is a supercomponent, right-button menus are available using:

- the supercomponent tree structure,
- the *Explore Supercomponent* dialog box or
- the internal item area.

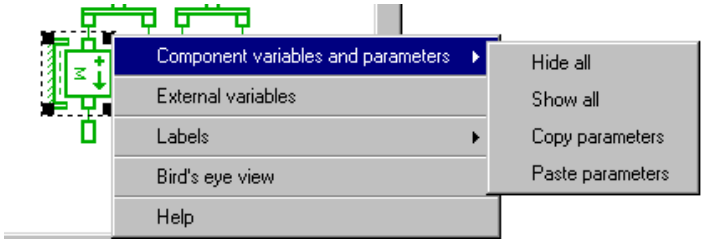
For the supercomponent tree structure, select (highlight) an item in the tree structure and operate the right button. If the selected item is the supercomponent being customized (i.e. the root of the tree), the hide/show applies to **all** the constituents. If the selected item is a constituent, it applies only to this constituent.

Figure 4.117: Show or hide the constituents



For the *Explore Supercomponent* dialog box, if a constituent component is selected as in Figure 4.118, a right-click menu applies only to the selected component. If no component is selected, it applies to all constituent components.

Figure 4.118: Right-click menu applied to a selected component



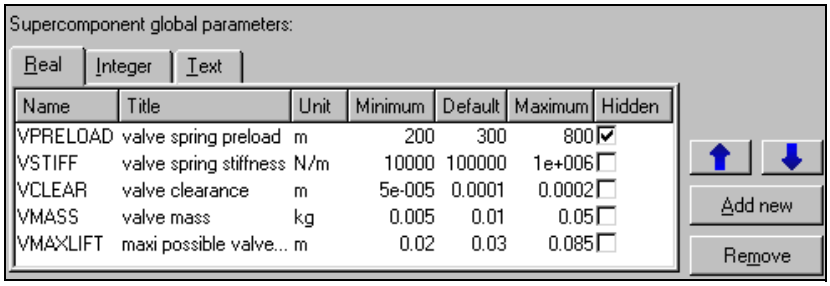
You can also hide or show labels with this menu, get help on a constituent component or get a bird's eye view (for big supercomponents).

The right button menu for the *Internal items* area is active only if a constituent component is selected and the result applies only to this component.

4.7 The global parameter lists

These lists show the global parameters currently defined for the selected customized object (submodel or supercomponent). It contains the following three tabs: *Real*, *Integer*, *Text*.

Figure 4.119: Supercomponent global parameters



You can:

- **Add** a global parameter by clicking on the *Add new* button after selecting the tab associated with its type. When it is created, default values are assigned to each of its characteristics.
- **Delete** a global parameter by clicking on the *Remove* button after selecting it in the list.
- **Move up and down** a global parameter using the arrow buttons. However, when you save **AMECustom** does a check to ensure a variable is not expressed in terms of another later in the list.

You **cannot**:

- Express a global parameter in terms of itself.

Real

Real global parameters have the characteristics described below:

Name

Click on the column *Name* and type in a name for the real global parameter. This name will be used in the column *Default value* of the *External variables* or *Internal items* list.

Title

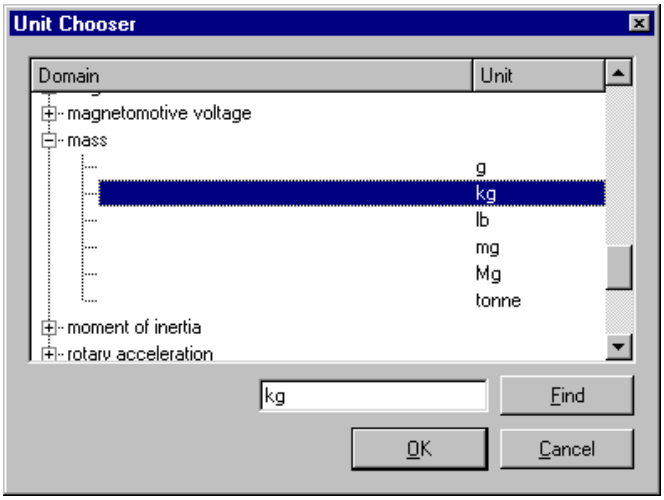
Click on the column *Title* and type in a title for the real global parameter. This title is a short description of the parameter which will appear in **AMESim**.

Unit

Click on the *Unit* column and type in the unit of the real global parameter.

Alternatively you can click on the  button in this column, and you will get a dialog box for selecting the unit.

Figure 4.120: Unit chooser dialog box



Minimum value, Maximum value and Default value

These characteristics are assigned by entering a value in the corresponding column. If the three values are identical, the real global parameter will not appear in **AMESim** and it will not be possible to change its value.

Hidden

Put a tick mark in this check box if you do not want this global parameter to be available from the **AMESim** *Change parameters* dialog box.

Integer

Integer global parameters have the characteristics described below:

Type

Select *Standard* or *Enumeration*. An enumeration parameter can have several values and each value is associated with a text string. This association is done in the *Enumeration list* column.

Name

Click on the column *Name* and type in a name for the integer global parameter. This name will be used in the *Default value* column of the *External variables* or *Internal items* list.

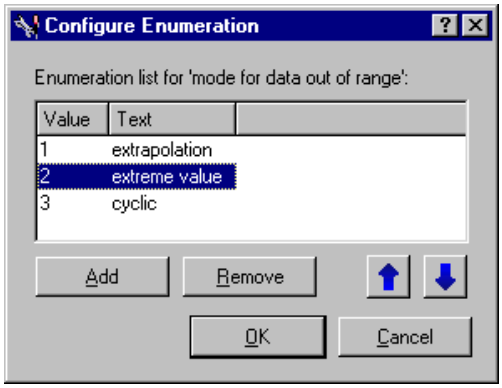
Title

Click on the *Title* column and type in a title for the integer global parameter. This title is a short description of the parameter which will appear in **AMESim**.

Enumeration list

This column is editable only if the type is set to *Enumeration*. Click on the ... button in this column, and you will get a dialog box for defining and associating each value of the parameter to a text string.

Figure 4.121: Configure Enumeration dialog box



Minimum value, Maximum value and Default value

These characteristics are assigned by entering a value in the corresponding column for a standard parameter. If the three values are identical, the standard integer global parameter will not appear in **AMESim** and it will not be possible to change its value.

For enumeration integer global parameters, only the default value is required.

Hidden

Put a tick mark in this check box if you do not want this global parameter to be available from the **AMESim** *Change parameters* dialog box.

Text

Text global parameters have the characteristics described below:

Name

Click on the *Name* column and type in a name for the text global parameter. This name will be used in the *Default value* column of the *Internal items* list (in the tab labeled *Text parameters*).

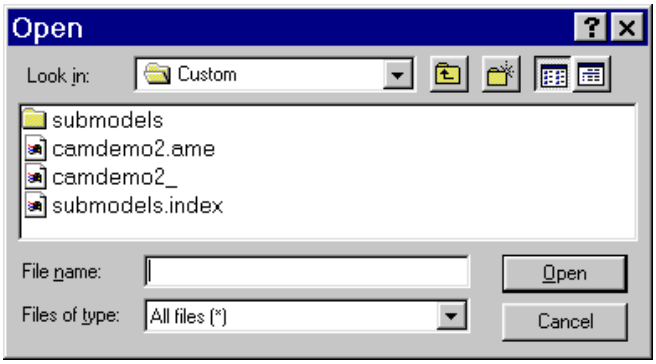
Title

Click on the *Title* column and type in a title for the text global parameter. This title is a short description of the parameter which will appear in **AMESim**.

Default value

Click on this column and type in the text you want to assign. Often text parameters are used to specify the full pathname of a file. In this case, you can use the  button to browse the default file instead of typing its name and path:

Figure 4.122: Browser of the Open dialog box



Hidden

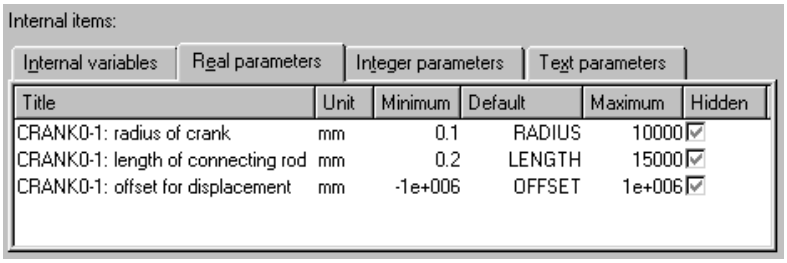
Put a tick mark in this check box if you do not want this global parameter to be available from the **AMESim** *Change parameters* dialog box.

Using global parameters

Global parameters of appropriate type can be assigned as default values to:

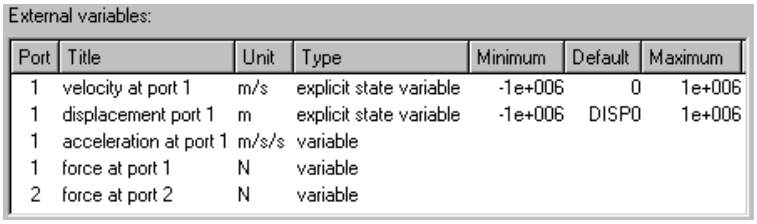
- **Any internal variable of the customized object, provided it has a default value**. This means it must be an explicit or implicit state, a fixed variable or a constraint which is accessed in the *Internal items* area. The global parameter must be of integer or real type. The original internal variable will be hidden and the global parameter will appear in the *Change Parameters* list.
- **Any real, integer or text parameter of the customized object**. In this case, a tick mark is automatically added in the corresponding *Hidden* column and this tick mark cannot be removed. This means that this item will not appear in **AMESim** anymore, it will be replaced by the global parameter.

Figure 4.123: Real parameters tab



- **Any external variable of the customized object, provided it can be assigned a default value**. However, since external variables cannot be hidden and both the global parameter and the external variable in its own right will appear in the *Change Parameters* list. **It is normally better to customize an external variable in its own right rather than using a global parameter.**

Figure 4.124: External variables

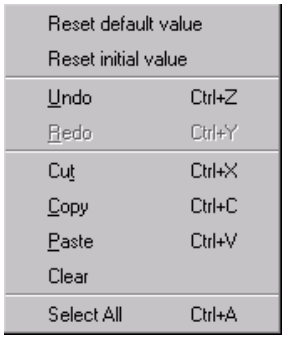


Right-click menus

Title / Value

If you select the title or a value (Minimum, Default or Maximum) of a global parameter and you right-click on it, a menu similar to the one shown in Figure 4.125 appears.

Figure 4.125: Right-click menu

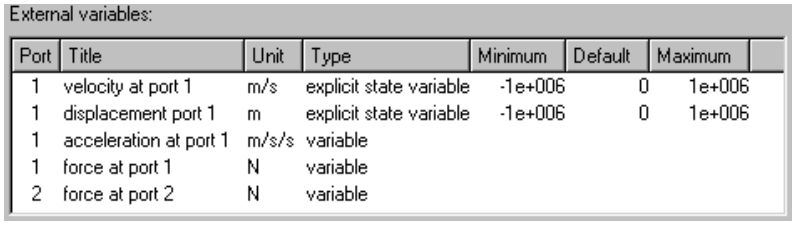


This menu contains items which functions are obvious. They apply to the selected title or value.

4.8 The External variables list

This list shows the external variables of the customized object (submodel or supercomponent) currently selected.

Figure 4.126: External variables list


External variables:

Port	Title	Unit	Type	Minimum	Default	Maximum
1	velocity at port 1	m/s	explicit state variable	-1e+006	0	1e+006
1	displacement port 1	m	explicit state variable	-1e+006	0	1e+006
1	acceleration at port 1	m/s/s	variable			
1	force at port 1	N	variable			
2	force at port 2	N	variable			

In this section, you can have information about:

External variable characteristics

Port

This column shows the port number associated with external variables. **This characteristic cannot be changed.**

Title

This column shows the generic short descriptions of external variables. You are allowed to modify them for customizing the object.

Unit

This column shows the unit associated with external variables. **This characteristic cannot be changed.**

Type

This column shows the type of external variables. **This characteristic cannot be customized.**

Minimum value, Maximum value and Default value

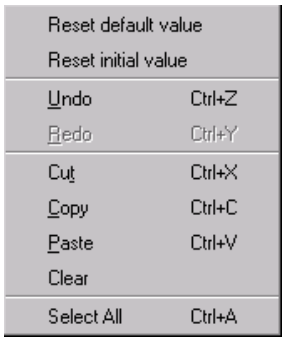
These characteristics are initially set to their generic values but you can modify them for customizing the object. If the three values are identical for a given external variable, it will not be possible to change its value in **AMESim**. The default value can be assigned an integer or real global parameter.

Right-click menus

Title / Value

If you select the title or a value (Minimum, Maximum or Default) of an external variable and you right-click on it, a pulldown menu similar to the one shown in Figure 4.127 appears.

Figure 4.127: Right-click menu



This menu contains items the functions of which are obvious. They apply to the selected title or value.

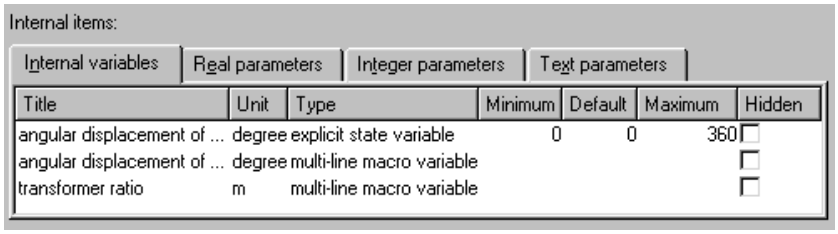
4.9 The Internal items lists

These lists show internal variables, real parameters, integer parameters and text parameters currently defined for:

- the current customized submodel or
- the selected constituent of the current customized supercomponent.

It contains four tabs: *Internal variables*, *Real parameters*, *Integer parameters* and *Text parameters*.

Figure 4.128: Internal items list



In this section, you can have information about:

Internal variables

Internal variables have the characteristics described below:

Title

This column shows the short descriptions of internal variables. They may include a prefix to make the title unique. You are allowed to modify them for customizing the object.

Unit

This column shows the unit associated with internal variables. **This characteristic cannot be changed.**

Type

This column shows the type of external variables. **This characteristic cannot be changed.**

Minimum value, Maximum value and Default value

These characteristics are initially set to their generic values but you can modify them for customizing the object. If the three values are identical for a given internal variable, it will not be possible to change its value in **AMESim**. The default value can be assigned an integer or real global parameter.

Hidden

Put a tick mark in this check box if you **do not** want the selected internal variable to appear in **AMESim**. This option is automatically selected if you assign a global parameter to the internal variable.

Real parameters

Real parameters have the characteristics described below:

Title

This column shows the short descriptions of real parameters. They may include a prefix to make the title unique. You are allowed to modify them for customizing the object.

Unit

This column shows the unit associated with real parameters. **This characteristic cannot be changed.**

Minimum value, Maximum value and Default value

These characteristics are initially set to their generic values but you can modify them for customizing the object. If the three values are identical for a given real parameter, it will not be possible to change its value in **AMESim**. The default

value can be assigned an integer or real global parameter.

Hidden

Put a tick mark in this check box if you do not want the selected real parameter to appear in **AMESim**. This option is automatically selected if you assign a global parameter to the real parameter.

Integer parameters

Integer parameters have the characteristics described below:

Title

This column shows the generic short descriptions of integer parameters. You are allowed to modify them for customizing the object.

Minimum value, Maximum value and Default value

These characteristics are set to their generic values but you can modify them for customizing the object. If the three values are identical for a given integer parameter, it will not be possible to change its value in **AMESim**. The default value can be assigned an integer or real parameter.

Hidden

Put a tick mark in this check box if you do not want the selected integer parameter to appear in **AMESim**. This option is automatically selected if you assign a global parameter to the integer parameter.

Text parameters

Text parameters have the characteristics described below:

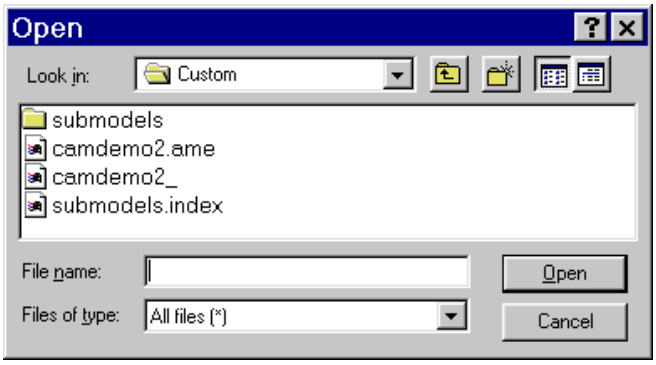
Title

This column shows the short descriptions of text parameters. They may include a prefix to make the title unique.You are allowed to modify them for customizing the object.

Default value

This characteristic is set to its generic value but you can modify it for customizing the object. You can directly type in its value, or it can be assigned a text global parameter. Often text parameters contain a file name associated with a path. In this case, you can use the  button to browse the default file instead of typing its name and path:

Figure 4.129: Browser of the Open dialog box



Hidden

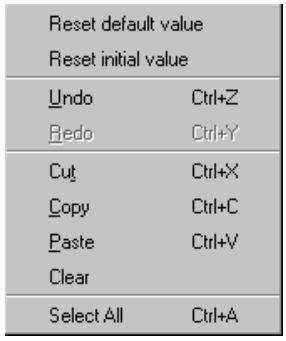
Put a tick mark in this check box if you do not want the selected text parameter to appear in **AMESim**. This option is automatically selected if you assign a global parameter to the text parameter.

Right-click menus

Title / Value

If you select the title or a value (Minimum, Maximum or Default) of an internal item and you right-click on it, a pulldown menu similar to the one shown in Figure 4.130 will appear.

Figure 4.130: Right-click menu

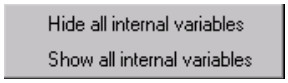


This menu contains nine items the functions of which are obvious. They apply to the selected title or value.

Hide/Show

If you right-click on any column title in the tab of an internal item, the following menu appears:

Figure 4.131: Right-click menu in the tab of an internal item



This menu provides two facilities allowing you to hide or show all internal variables displayed in the tab currently selected.

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Reporting Bugs and using the Hotline Service

AMECustom is a large piece of software containing many hundreds of thousands of lines of code. With software of this size it is inevitable that it contains some bugs. Naturally we hope you do not encounter any of these but if you use **AMECustom** extensively at some stage, sooner or later, you may find a problem.

Bugs may occur in the pre- and post-processing facilities of **AMESim**, **AMERun**, **AMESet**, **AMECustom** or in one of the interfaces with other software. Usually it is quite clear when you have encountered a bug of this type.

Bugs can also occur when running a simulation of a model. Unfortunately it is not possible to say that, for any model, it is always possible to run a simulation. The integrators used in **AMECustom** are robust but no integrator can claim to be perfectly reliable. From the view point of an integrator, models vary enormously in their difficulty. Usually when there is a problem it is because the equations being solved are badly conditioned. This means that the solution is ill-defined. It is possible to write down sets of equations that have no solution. In such circumstances it is not surprising that the integrator is unsuccessful. Other sets of equations have very clearly defined solutions. Between these extremes there is a whole spectrum of problems. Some of these will be the marginal problems for the integrator.

If computers were able to do exact arithmetic with real numbers, these marginal problems would not create any difficulties. Unfortunately computers do real arithmetic to a limited accuracy and hence there will be times when the integrator will be forced to give up. Simulation is a skill which has to be learnt slowly. An experienced person will be aware that certain situations can create difficulties. Thus very small hydraulic volumes and very small masses subject to large forces can cause problems. The *State count* facility can be useful in identifying the cause of a slow simulation. An eigenvalue analysis can also be useful.

The author remembers spending many hours trying to understand why a simulation failed. Eventually he discovered that he had mistyped a parameter. A hydraulic motor size had been entered making the unit about as big as an ocean liner! When this parameter was corrected, the simulation ran fine.

It follows that you must spend some time investigating why a simulation runs slowly or fails completely. However, it is possible that you have discovered a bug in an **AMESim** submodel or utility. If this is the case, we would like to know about it. By reporting problems you can help us make the product better.

On the next page is a form. When you wish to report a bug please photocopy this form and fill the copy. You telephone us, having the filled form in front of you means you have the information we need. Similarly include the information in an email.

To report the bug you have three options:

- reproduce the same information as an email
- telephone the details
- fax the form

Use the fax number, telephone number or email address of your local distributor.

HOTLINE REPORT

Creation date: *Created by:*

Company: *Contact:*

Keywords (at least one):

Problem type: ☐ **Bug** ☐ **Improvement** ☐ **Other**

Summary:

Description:

Involved operating system(s):

☐ **All**	☐ **Unix (all)**	☐ **PC (all)**
	☐ **HP**	☐ **Windows 2000**
	☐ **IBM**	☐ **Windows NT**
	☐ **SGI**	☐ **Windows XP**
	☐ **SUN**	☐ **Linux**
	☐ **Other:**	☐ **Other:**

Involved software version(s):

☐ **All**	☐ **AMESim (all)**	☐ **AMERun (all)**	☐ **AMESet (all)**	☐ **AMECustom (all)**
	☐ **AMESim 4.0**	☐ **AMERun 4.0**	☐ **AMESet 4.0**	☐ **AMECustom 4.0**
	☐ **AMESim 4.0.1**	☐ **AMERun 4.0.1**	☐ **AMESet 4.0.1**	☐ **AMECustom 4.0.1**
	☐ **AMESim 4.0.2**	☐ **AMERun 4.0.2**	☐ **AMESet 4.0.2**	☐ **AMECustom 4.0.2**
	☐ **AMESim 4.0.3**	☐ **AMERun 4.0.3**	☐ **AMESet 4.0.3**	☐ **AMECustom 4.0.3**
	☐ **AMESim 4.1**	☐ **AMERun 4.1**	☐ **AMESet 4.1**	☐ **AMECustom 4.1**
	☐ **AMESim 4.1.1**	☐ **AMERun 4.1.1**	☐ **AMESet 4.1.1**	☐ **AMECustom 4.1.1**
	☐ **AMESim 4.1.2**	☐ **AMERun 4.1.2**	☐ **AMESet 4.1.2**	☐ **AMECustom 4.1.2**
	☐ **AMESim 4.1.3**	☐ **AMERun 4.1.3**	☐ **AMESet 4.1.3**	☐ **AMECustom 4.1.3**
	☐ **AMESim 4.2**	☐ **AMERun 4.2**	☐ **AMESet 4.2**	☐ **AMECustom 4.2**

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