FOI

AFE 3.11
Reference Manual

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Windows XP

AFE
ADVANCED FRONT END

A general
graphical
user interface
for simulation
models

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Department of Electronic Warfare Assessments
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Reference Manual

Sammanfattning

Programvaran AFE är ett försök att skapa ett generellt grafiskt användargränssnitt för simuleringsmodeller, speciellt för duellen mellan en anfallande robot och ett mål, som utför tekniska och taktiska motåtgärder. Denna rapport beskriver mjukvaran, hur den används för att köra en färdig simuleringsmodell, och hur den anpassas för att passa till en viss simuleringsmodell.

Nyckelord: Visualisering, Simulering, Modellering, Telekrig, Robotar

Summary

The software AFE is an attempt to create a general, graphical user interface for simulation models, specifically the duel between an attacking missile and a target, which performs technical and/or tactical countermeasures. This paper describes the software, how it is used to run a ready-made simulation model, and also how it is configured to fit a particular simulation model.

Keywords: Visualization, Simulation, Modeling, Electronic Warfare Assessment, Missiles

Content

1 INTRODUCTION

AFE is a computer program intended to provide a simulation model with an easy to use graphical interface in order to make it possible for non-specialists to operate the model. AFE has an interface to the model that allows it to send start parameters and to receive data from the model, and also control the execution of the model. AFE can also be used for visualization of data from other sources. The simulation model is not included in AFE.

1.1 Conclusion

The software AFE is an attempt to create a general, graphical user interface for simulation models, specifically the duel between an attacking missile and a target, which performs technical and/or tactical countermeasures. This paper describes the software, how it is used to run a simulation model, and also how it is configured to fit a particular simulation model. Earlier versions are described in [AFE 1.1], [AFE 2.3] and [AFE 3.3].

1.2 Background

The rational for this software is the need for a simple packaging and delivery of a simulation model in such a way that it will be easy for the end user to run the model, and also simplify maintenance and further development of a delivered model.

1.3 Intended use

AFE can be used when a simple and user-friendly interface is wanted to a simulation model. The user interface in AFE is designed to make it possible to replace and hide the interface of the development environment, thereby achieving simplification of use. For example, start parameters can be provided with a descriptive prompt and unit, and also given an explanation that is easily accessible by the user. The target user group is primarily users who are not experts on simulation models. The intention of the design is to make it fast and easy for a user to become comfortable in running the model, thereby quickly be able to concentrate on the properties of the simulation model in it self.

1.4 Development environment

AFE has been developed with Microsoft Visual Studio 2008 [VISUAL] and is written in C# and Managed C++. It makes use of the class libraries "Microsoft Foundation Classes", and the ".NET Framework Class Library 3.5". The graphical package "DirectX 9" [DIRECTX] is also used. The program is currently composed of approximately 40.000 lines of code, separate libraries and simulation models not included. The development is being done on Windows XP SR2, and AFE is intended for use on Windows XP SR2 and Windows Vista.

1.5 Usefulness for the defense

- Makes it possible to deploy simulation models in various technical and/or tactical user environments for both evaluation and study.

- Increased understanding of essential missile systems performance and countermeasures.

- Easy to understand visualization of simulation output data as graphs and animation's.

- Simplifies simulation and modeling by visualization of complex events.

2 EXAMPLES

This chapter shows some output window examples from AFE.

2.1 Simple X-Y plot

The color of the grid, axis, and text can be set individually. The color and width of the plot can be static or controlled by variables, one for each basic color. Also the axis scales can be individually set to a maximum and a minimum value. The lengths of the scales are automatically adjusted between these values. The grid spacing is automatically adjusted when the window is resized. Axis can also be individually reversed.

2.2 A more complex X-Y plot
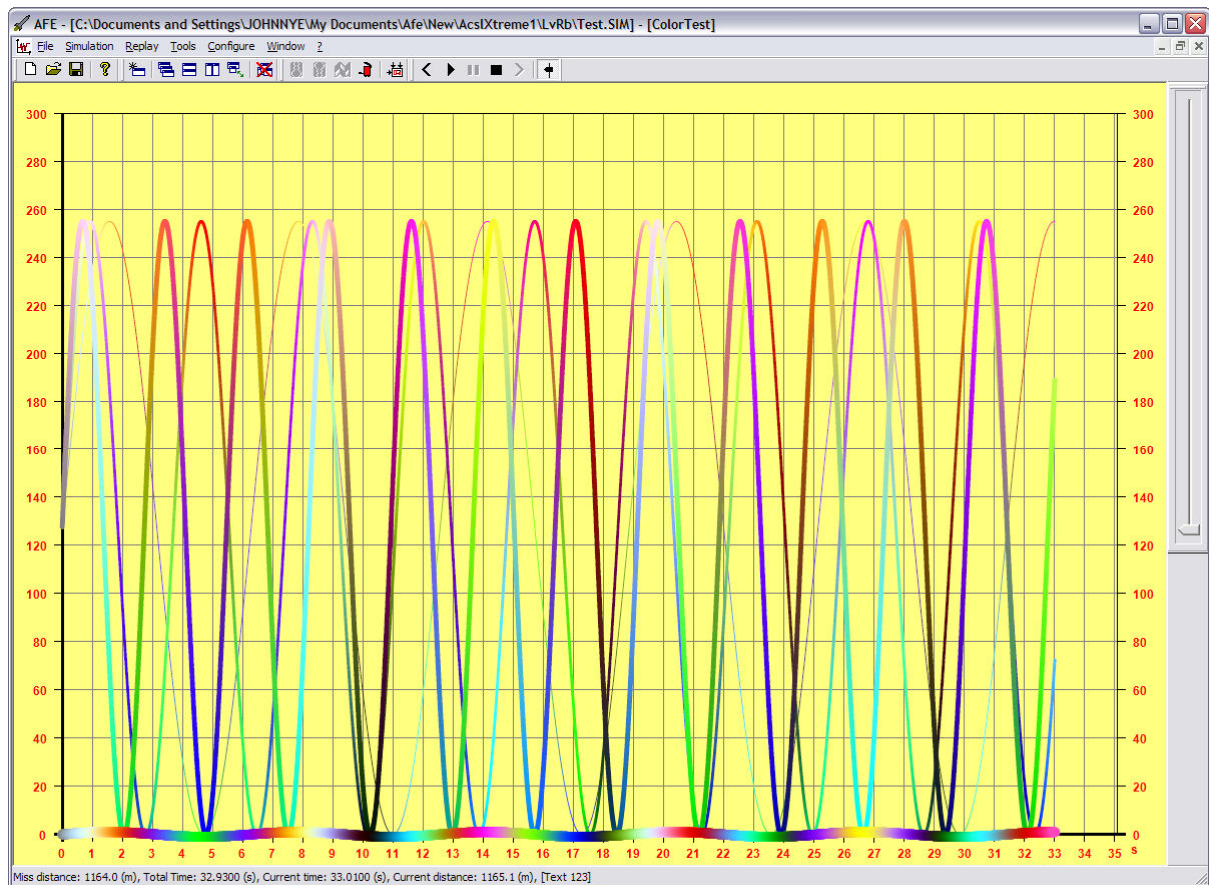
The colors and width of each plot can be varied by separate variables.

2.3 A polar plot
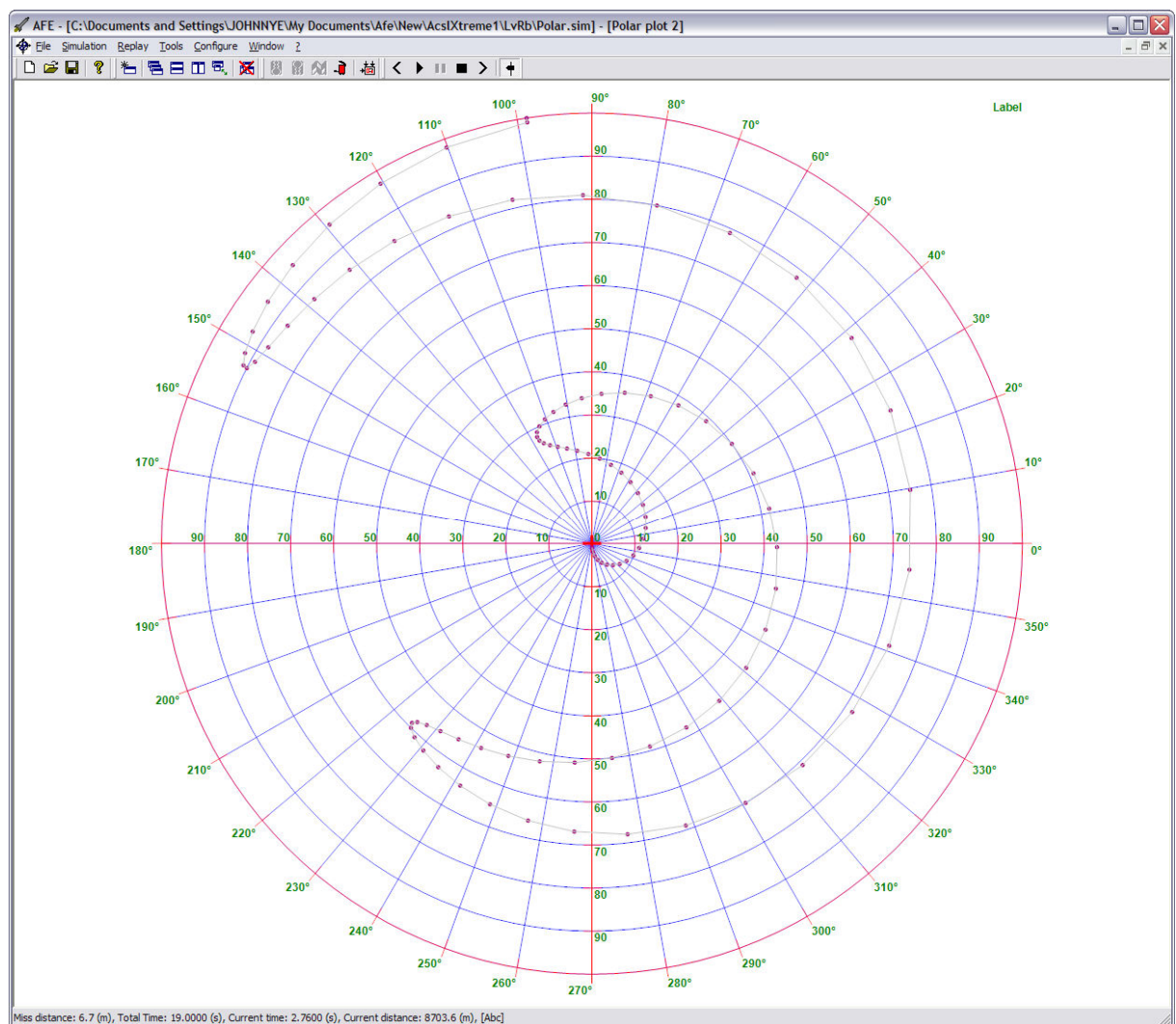
This is an example of a polar plot window. As in the X-Y plots, color and width of the plot can be controlled from variables.

2.4 Animation of a 3D object
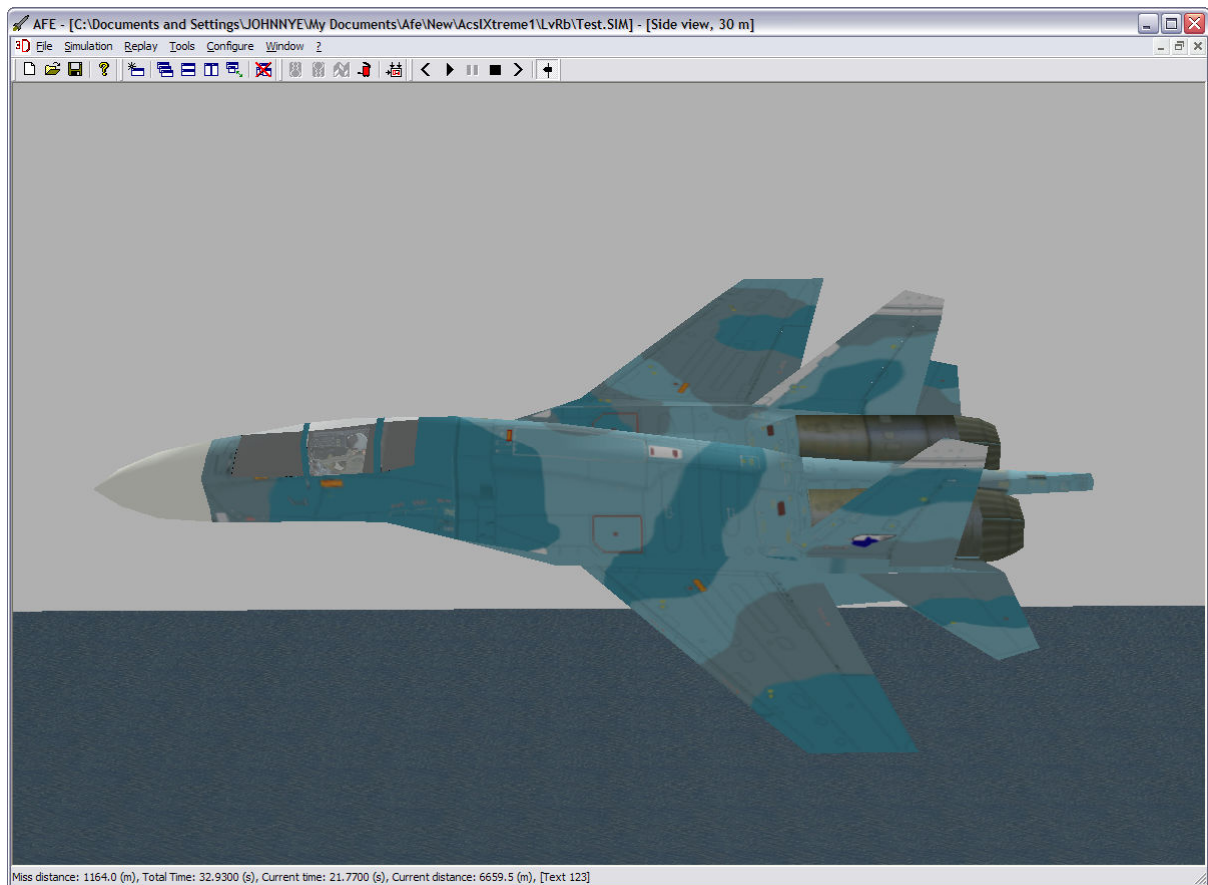
This is a single image frame from an animation sequence of a 3D object. It is made up of triangles and bitmap textures. 3D objects can be positioned, oriented, scaled etc. through variables. The object can be moved and rotated in all three directions with data from variables.

2.5 A 3D scene with textured background
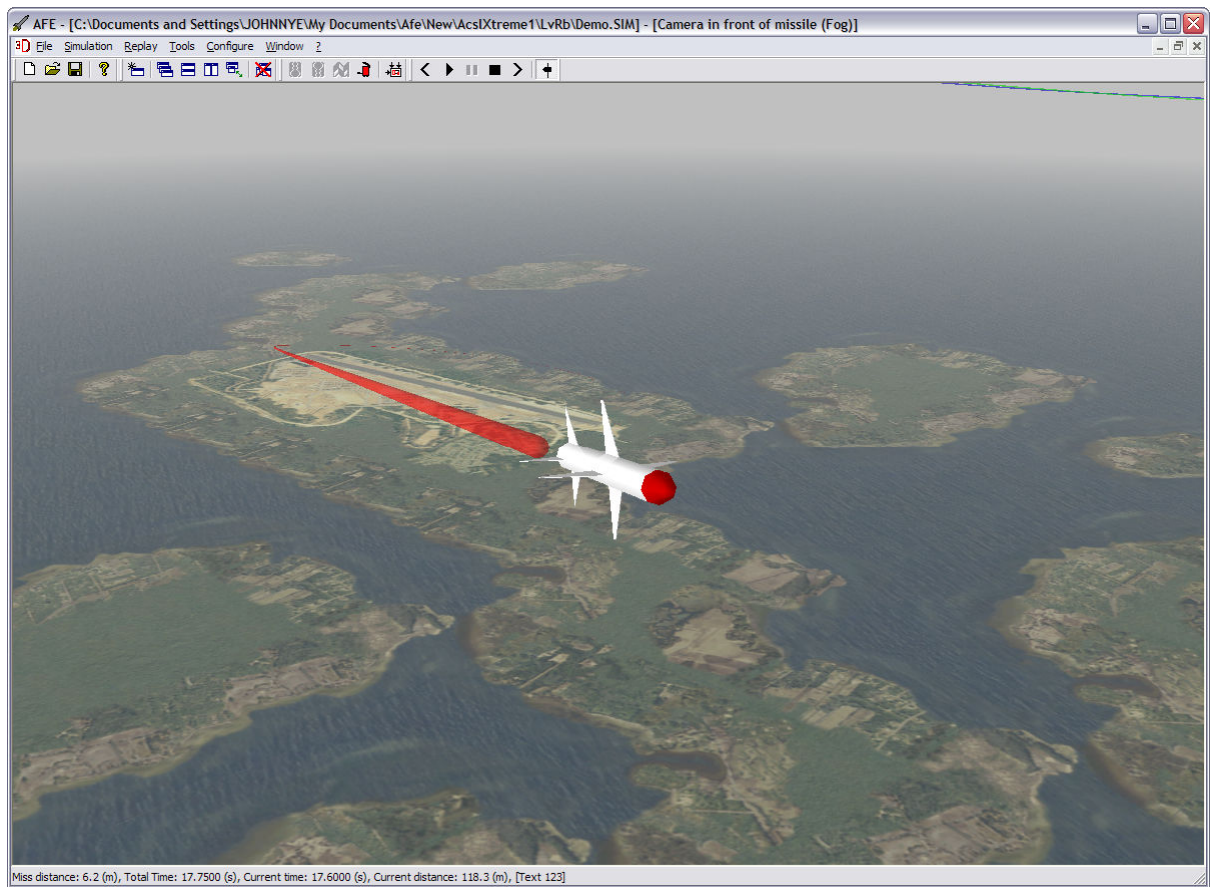
This example shows one frame from an animation sequence with a textured background and with fog added. The camera through which the scene is viewed is kept at a constant distance in front of the object (the missile) facing the object. This gives the viewer an animation sequence from the ground and upward. An object can also be made to leave a trail to visualize its history.

2.6 Multiple 3D scenes
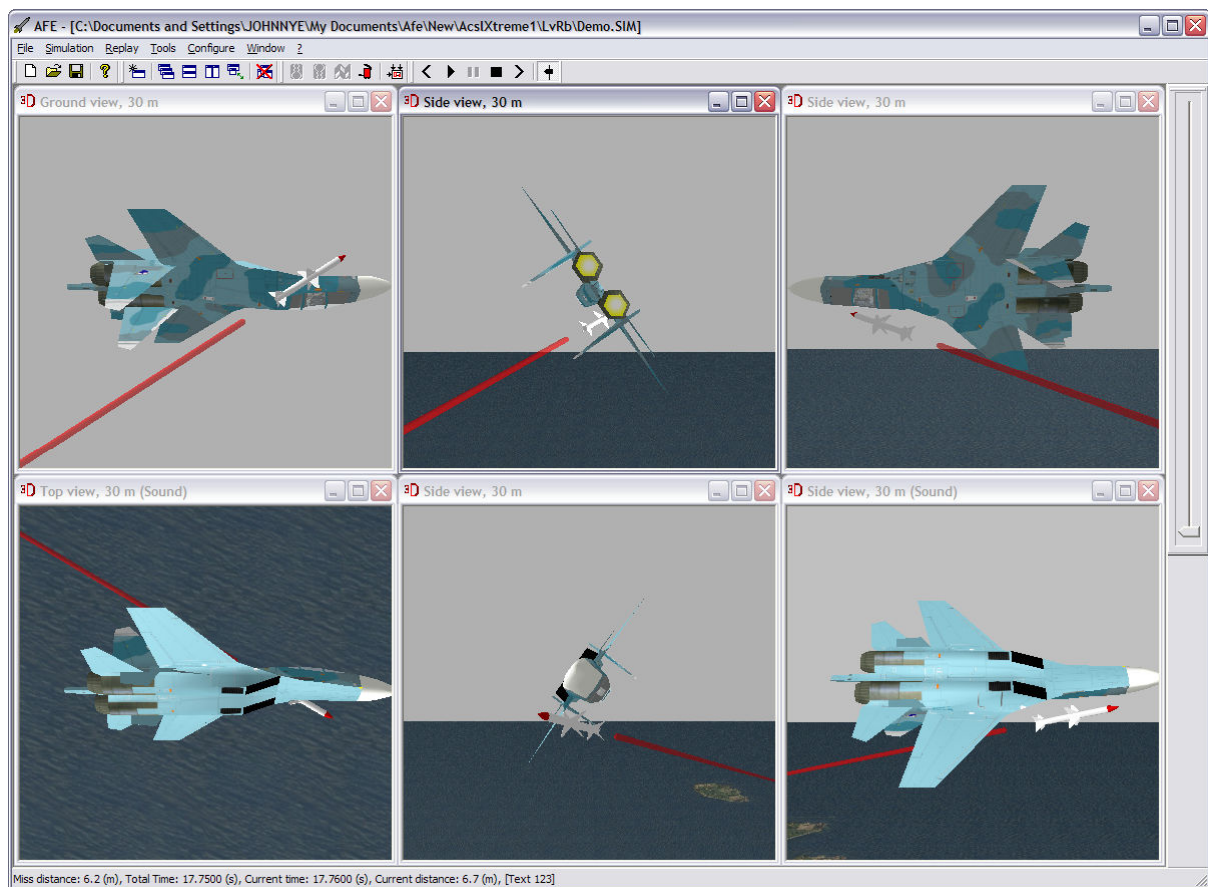
This multiple 3D scene gives an overview of the two objects (the plane and the missile) in which their relative position to each other can be visually assessed. In the side views the cameras are positioned around the plane and in all four directions parallel to the horizon. Also in the ground and top view the cameras are positioned below looking upwards and above looking downwards. The slider to the right can be moved to view individual timeframes.

2.7 Scene overview
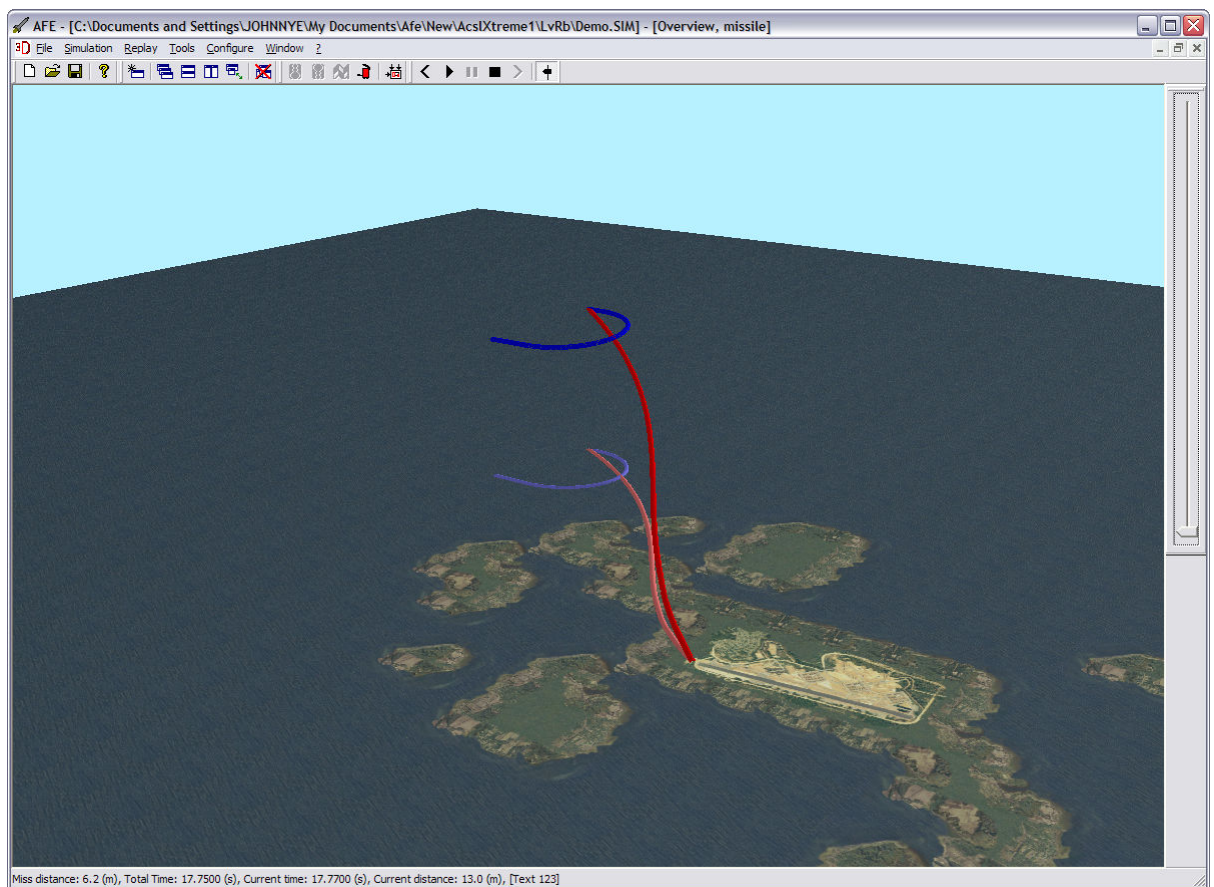
By using the ability to generate a trail from an object this view shows the trajectories of two moving objects. The lighter colored trails are the projection of the trails on the ground plane.

3 INSTALLATION

AFE is installed by running the setup program on the distribution CD. Follow the instructions on the screen. Do not move or modify files in the installation directory.

3.1 System requirements

AFE is designed to run on a standard PC with Windows XP SR2 Professional edition or Windows Vista, with the following extra software components installed:

DirectX 9. Installed from separate package.

.NET Framework 3.5. Installed from separate package.

Windows Message Queuing. Included in Windows XP Professional edition, but not installed by default. To install select "Start", "Control Panel", "Add or Remove Programs", "Add/Remove Windows Components", check "Message Queuing" in the list and select "Next" and "Finish".

4 USER GUIDE

4.1 The main menu
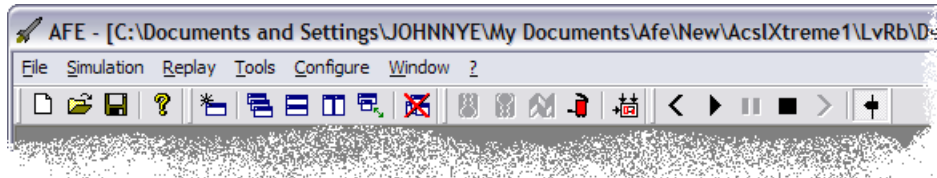
This chapter describes all commands available from the main menu. Several of these commands can also be given through the toolbar buttons or through keyboard shortcuts.

4.1.1 File

This submenu contains commands for administration of files, and for ending the program.

New   Creates a new empty simulation. Start parameters and window layout is maintained from any previous simulation or from a loaded simulation model.

Open   Opens a simulation previously saved on a file. The Windows standard dialog box for filename selection is used. Missing start parameter values are taken from the simulation model if it is loaded.

Save   Saves a simulation to a file using the current filename. If no filename exists, the user is asked for one by the Windows standard dialog box for filename selection.

Save As Saves a simulation to a file. The Windows standard dialog box for filename selection always asks for the filename used.

Export   Opens the dialog "Export data", where simulation data can be exported to a text file in a tabular format.

1..5   Recently loaded or saved simulation files. The filename follows the number. Selection of one of these menu items opens the file.

Exit   Exits the program. All open windows maintained by the program are closed. If necessary, the user is given an opportunity to save modified configuration and data to disk before the program is finally closed.

4.1.2 Simulation

This submenu contains commands for controlling a simulation.

Start   Starts a new simulation, or continue one that was previously paused.

Pause   Pauses a running simulation.

Stop   Aborts a running or paused simulation permanently.

Clear   Prepares the program for a new simulation. Data collected from the last simulation run are discarded. Start parameters are not affected.

Properties   Opens the "Simulation Properties" dialog window.

Parameters   Opens the "Start parameters" dialog box.

4.1.3 Replay

This submenu contains commands for controlling a replay from an earlier simulation.

Start	Starts a replay from the current time. If the current time is the last possible time, the replay is started from the beginning.
Stop	Interrupts a replay.
Reset	Resets the current time to the beginning.
Step Forward	Moves the current time forward one step. If the shift key is held down, the move is 10 steps, and correspondingly for the ctrl key and the alt key the move is 100 and 1000 steps.
Step Backward	Moves the current time backward one step. If the shift key is held down, the move is 10 steps, and correspondingly for the ctrl key and the alt key the move is 100 and 1000 steps.

4.1.4   Tools

Commands for opening or closing the tool bar, time bar, status bar and the options dialog box.

Tool Bar	Shows or hides the tool bar at the top of the main window, just below the main menu.
Time Bar	Shows or hides the time slider to the right of the main window.
Status Bar	Shows or hides the status bar at the bottom of the main window.
Options	Opens the options dialog box.

4.1.5   Configure

Commands for configuring AFE to a particular simulation model.

New	Creates a new empty configuration.
Open	Opens a configuration previously saved on a file. The Windows standard dialog box for filename browsing is used.
Save	Saves a configuration to a file using the current filename. If no filename exists, the user is asked for one by the Windows standard dialog box for filename selection.
Save As	Saves a configuration to a file. The Windows standard dialog box for filename selection always asks for the filename used.
Model	Opens the "Configure simulation model" dialog box.
Variables	Opens the "Configure Variables" dialog box.
Start Parameters	Opens the "Configure start parameter pages" dialog box.
Status Line	Opens the "Configure the status line" dialog box.
Windows	Opens the "Configure Windows" dialog box.
Select Window(s)	Opens the "Configure Select Window(s)" dialog box.
Show Errors	Opens the "Configuration Errors" dialog box.
Load/Unload model	Loads or unloads the model.
Refresh	Reloads all X-files in use, and updates all open windows. If a model that uses a workspace is loaded, the model is unloaded, the workspace recreated and the model is reloaded.
1..5	Recently loaded or saved configuration files. The filename follows the number. Selection of one of these menu items opens the file. The first file #1 is always loaded when AFE is started.

4.1.6 Window

This submenu contains commands for administration of windows.

Output Window Selection Opens the "Select Window(s)" dialog box.

Model Output Window Opens the "Model Output" window.

Close All Closes all open windows.

Cascade Cascade all open windows.

Tile horizontally Tile all open windows horizontally side by side.

Tile vertically Tile all open windows vertically side by side.

Fit in window Resize and move all open windows so they fit inside the main window.

Arrange Icons Arrange all icon windows at the bottom of the main window.

Keep Layout Toggles the window locking for each invocation. If the window locking is on, the windows layout stays the same when simulation files are opened. The locking is on if the menu entry is checked.

Open Layout Opens a window layout from a simulation file without loading any simulation data. This command works even if the window locking is on.

1..n A list of currently open windows. If selected the window is activated and brought to the top. If the window is minimized, it is restored.

4.1.7 ? (Help)

The only command currently available is for opening the about box.

4.2 The tool bar

This chapter describes the tool bar, which is normally found below the main menu.

Creates a new empty simulation. Start parameters and window layout is maintained from the previous simulation.

Opens a simulation previously saved on a file. The Windows standard dialog box for filename selection is used.

Saves a simulation to a file using the current filename. If no filename exists, the user is asked for one by the Windows standard dialog box for filename selection.

Opens the "About" dialog box.

Opens the "Select Window(s)" dialog box.

Cascade all open windows.

Tile all open windows horizontally side by side.

Tile all open windows vertically side by side.

Resize all open windows so they fit inside the main window.

Closes all open windows.

Starts a new simulation, or continue one that was previously paused.

Pauses a running simulation.

Aborts a running or paused simulation permanently.

Prepares the program for a new simulation. Data collected from the last simulation run are discarded. Start parameters are not affected.

Opens the "Start parameters" dialog box.

Moves the current time backward one step. If the shift key is held down, the move is 10 steps, and correspondingly for the ctrl key and the alt key the move is 100 and 1000 steps. If you have a wheel mouse, turning the wheel forward will activate this function.

Starts a replay from the current time. If the current time is the last possible time, the replay is started from the beginning.

Interrupts a replay.

Resets the current time to the beginning.

Moves the current time forward one step. If the shift key is held down, the move is 10 steps, and correspondingly for the ctrl key and the alt key the move is 100 and 1000 steps. If you have a wheel mouse, turning the wheel backward will activate this function.

Opens or closes the time bar.

4.3 The time bar

The time bar is the slider to the right in the main window. By moving the slider, the current time can be moved forward or backward. The slider also supports a mouse with a wheel button. Rotating the wheel one notch forward or backward is the same as selecting the **Step Forward** or **Step Backward** command in the **Replay** menu. Also the shift and control keys can be used to increase the number of time step used for each notch.

4.4 Keyboard shortcuts

The following keyboard shortcuts can be used to trigger menu commands.

F1   Opens the "About" box.

F2   Opens the "Start parameters" dialog box.

F3   Opens the "Select Window(s)" dialog box.

F5   Starts a new simulation, or continue one that was previously paused.

F6   Pauses a running simulation.

F7   Aborts a running or paused simulation permanently.

F8   Prepares the program for a new simulation. Data collected from the last simulation run are discarded. Start parameters are not affected.

F11   Load or unloads the model.

F12   Reloads all X-files in use, and updates all open windows. If a model that uses a workspace is loaded, the workspace is recreated and the model is reloaded.

⬆   Starts a replay from the current time. If the current time is the last possible time, the replay is started from the beginning.

⬇   Interrupts a replay.

➡   Moves the current time forward one step. If the shift key is held down, the move is 10 steps, and correspondingly for the ctrl key and the alt key the move is 100 and 1000 steps.

⬅   Moves the current time backward one step. If the shift key is held down, the move is 10 steps, and correspondingly for the ctrl key and the alt key the move is 100 and 1000 steps.

Home Resets the current time to the beginning.

End   Sets the current time to the end of the simulation.

Also available are the usual Windows keyboard shortcuts and shell extensions.

4.5 Export data

The dialog "Export data" is be used for exporting simulation data to a text file in a tabular format.
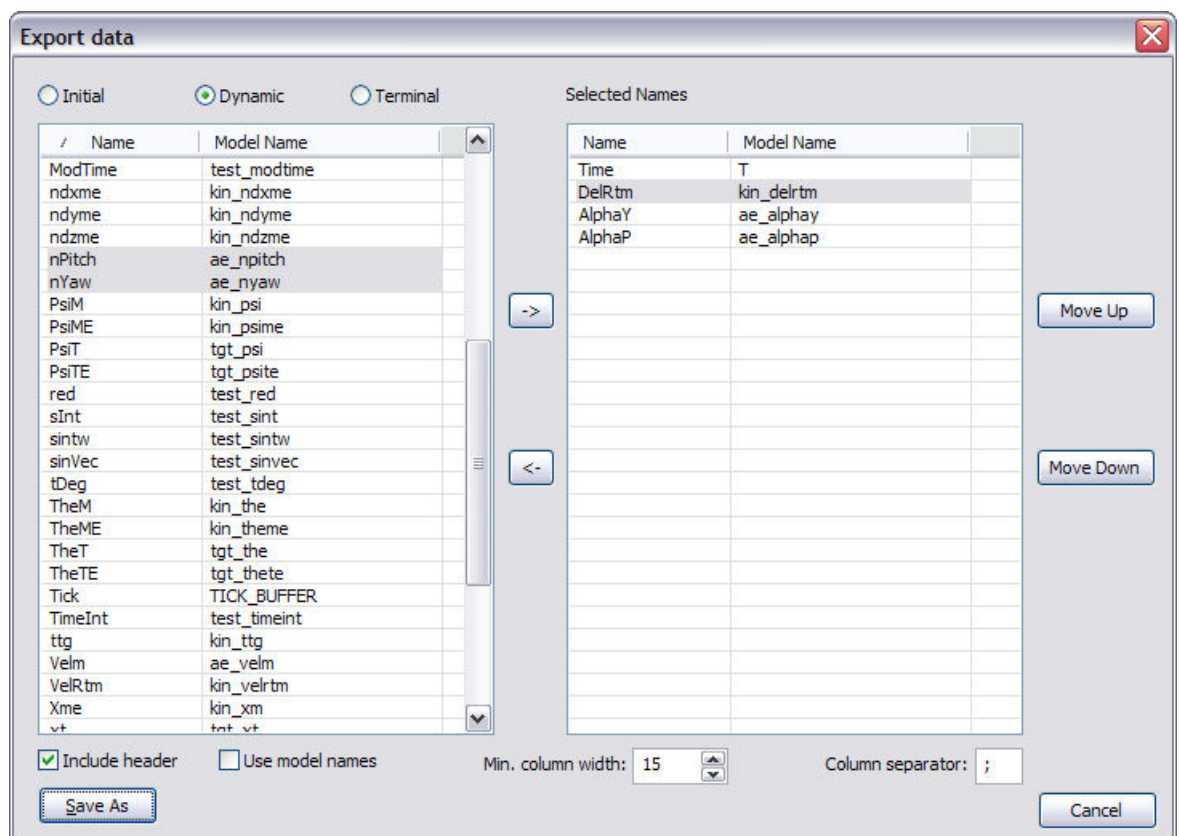
The list to the left shows the variable names available for export, and the list to the right shows the actual names selected for export. The selections made in this dialog are saved in the configuration file (.AFE).

Initial   Select initial variables.

Dynamic   Select dynamic variables.

Terminal   Select terminal variables.

Selected Names	The list shows the names of the variables to be exported. One column is written for each name in the order they are listed.
➔	Move names to the selected list.
←	Move names from the selected list.
Move Up	Move selected names up one position.
Move Down	Move selected names down one position.
Include header	Includes a header in the exported file. The header will be the names of the selected variables.
Use model names	Use the model name instead of the name in the header.
Min. column width	The minimum column width. Extra spaces are added only if the column is smaller then this value.
Column separator	The separator character for columns.
Save As	Selects a file and export data.

4.6 View and edit start parameters

The purpose of the dialog "Start parameters" is to view and edit the start parameters in a simulation.
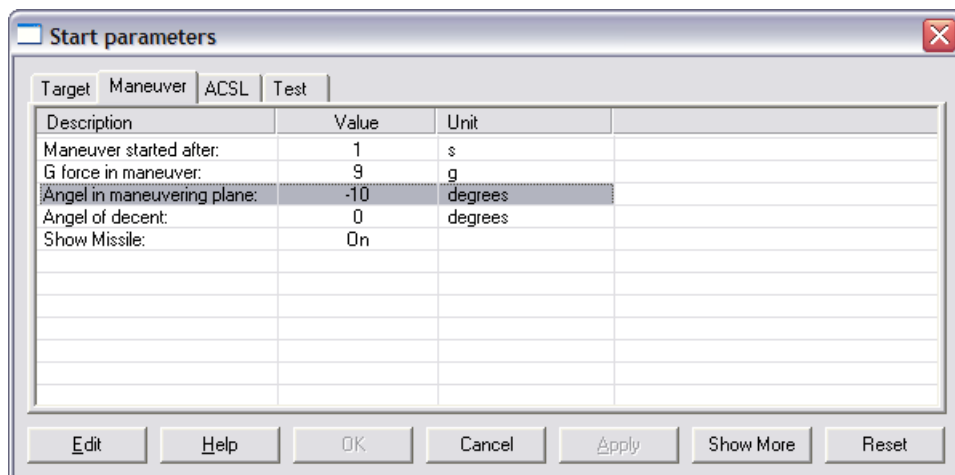
The tabs are used to select among available sets of start parameters, which are displayed in the list. The contents in the list, and the number and definition of tabs can be configured. The window can be resized, and the buttons have the following function:

Edit	Opens the dialog box "Edit *type* value", in which the user can edit the current start parameter marked in the list. *Type* indicates what kind of value is currently being edited. Double clicking on a row in the list can also activate this button, unless the value is of the type logical. If so the value is toggled instead. If the edited type is a vector, the size of the opened window can be changed.
Help	Opens a window with an explaining configurable text for the current start parameter.
OK	Closes the dialog box and makes changes available for a simulation. If a simulation had been run before this button was pressed, a new simulation is started immediately.
Cancel	Closes the dialog box and discards any changes made.

Apply   Makes changes available for a simulation. If a simulation had been run before this button was pressed, a new simulation is started immediately. The dialog box remains open.

Show More   Expands the **Value** column into four new columns. **Value** corresponds to the previous **Value** column. **Old Value** displays the last value applied. **File Value** displays the value in the last loaded or saved simulation, i.e. the .SIM file. **Model Value** displays the original value from the executable simulation model.

Reset   Opens the dialog "Start parameters reset". From this dialog it is possible to reset the **Value** column to one of **Old Value**, **File Value** or **Model Value**. It is also possible to choose between resetting all start parameter values or only the ones in the current page.

4.6.1 Support for Drag & Drop

The dialog "Start parameters" supports "Drag & Drop" to the program Batch Manager, see [BATCHMAN]. Batch Manager is used for configuring and running multiple simulations. By dragging from the "Start parameters" dialog on to the main interface window in Batch Manager the user can transfer the current start parameter values and configuration to Batch Manager for further processing.

4.7 Viewing simulation results

With the dialog "Select Window(s)" the user can open and close the windows that shows the result from a simulation run. The windows can be opened, closed and moved during both simulation and replay.
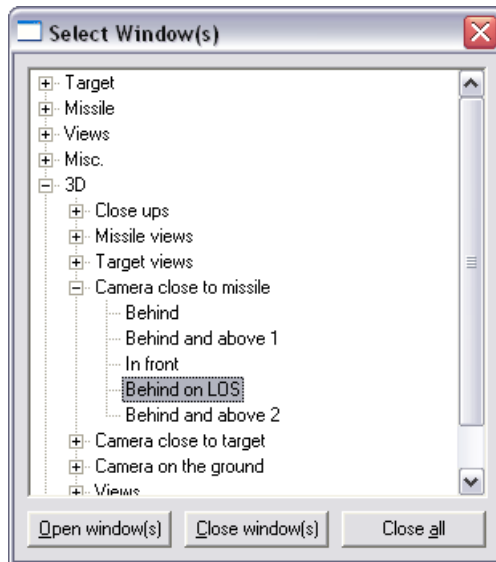
The list displayed is hierarchical. A level can be expanded or contracted by clicking on the "**+**" or "**–**". The lowest level corresponds to one output window, and a higher level corresponds to all output windows in the underlying levels up to the current, or top, level. The contents in the displayed list and its structure, as well as the contents of the windows, are configurable. The window can be resized, and the buttons have the following function:

Open window(s)   Opens the windows that correspond to the current item in the list. Already open windows are not affected.

Close window(s)   Closes the output windows that correspond to the current item in the list. Any other open window is not affected.

Close all   Closes all open output windows.

The "Model Output" window can only be opened from the main menu.

4.8 Context menus

A pop up context menu is available in some windows by clicking the right mouse button.

4.8.1 Start parameter dialog

Configure Opens the "Configure start parameter pages" dialog.

4.8.2 X-Y plot windows

Zoom Out   Restores the previous zoom state or the original axis if there is no previous zoom state. This command can also be executed by pushing the escape button. **Zoom In** is performed by pressing and holding the left mouse button at the top right corner and moving and releasing the same button at the lower right corner of the new axis positions.

Zoom Out All Restores the original axis as they are specified in the configuration from any zoom state.

Configure   Opens the X-Y plot configuration dialog.

4.8.3 Polar plot windows

Configure Opens the polar plot configuration dialog.

4.8.4 Text windows

Configure Opens the text window configuration dialog.

4.8.5 3D Scene windows

Camera Bias Opens the dialog "Camera Bias".

Configure   Opens the 3D scene configuration dialog.

Cameras   Opens the cameras configuration dialog.

3D Objects Opens the 3D objects configuration dialog.

Sounds   Opens the sounds configuration dialog.

4.8.5.1 The Camera Bias Dialog

The dialog below is used for giving the camera metaphor used in 3D Scene windows a temporary offset or bias from its position and orientation provided by the simulation data at the current time point.
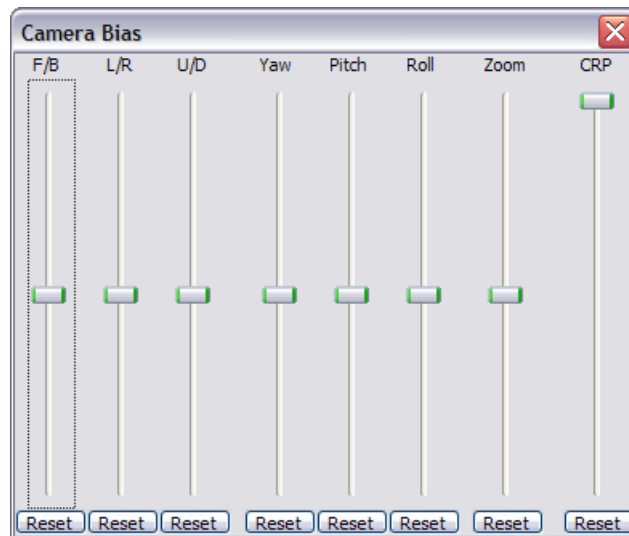
All offsets are computed in the cameras local coordinate frame and applied after the data from the simulation model have been used to position, rotate and/or zoom the camera. The settings are saved in the .SIM-file together with the window layout.

The first three slider controls the camera position. The maximum offset is ± 1000 units. The movement is non linear with a minimum step of approximately 1E-5 units near the center of a slider and a maximum step of approximately 3 units near the ends of a slider.

F/B   Move forward or backward.

L/R   Move left or right.

U/D   Move up or down.

The next three slider controls the camera orientation. The maximum rotation is ± 180º, and the step size is approximately 0.18º and linear.

Yaw   Rotate around the vertical axis.

Pitch   Rotate around the horizontal axis.

Roll   Rotate around the center axis.

The **Zoom** slider modifies the camera field of view. The maximum offset is ± 3 radians which are added to the field of view. The offset is non linear with a minimum step of approximately 3E-9 radians near the center of the slider and a maximum step of approximately 0.001 radians near the ends of the slider.

The **CRP** (**C**amera **R**otation **P**oint) slider moves the camera rotation point forward from the camera. By doing so it is possible to view an object from all directions. To make use of **CRP** try the following:

Use the **F/B**, **L/R** and **U/D** sliders to position the desired object in the center of the frame.

Use the **Zoom** so that the entire object is visible.

Move one of **Yaw** or **Pitch** until the object disappears completely.

Move **CRP** until the object is visible in the center of the frame again.

Use **Yaw** and **Pitch** to view the object from the desired direction.

The **Reset** buttons resets the corresponding slider control to its disabled or zero, position.

4.9 Error handling during a simulation

In case of an execution error in the simulation model during simulation, AFE tries to display the following message.
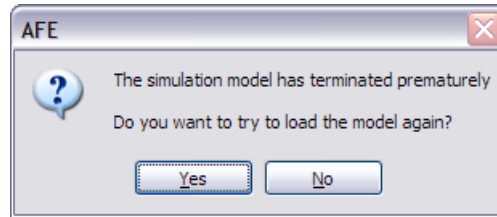
If the **Yes** button is selected, the model is reloaded as if AFE was shut down (closed) and restarted. The **No** button leaves the model in an unloaded state, even if the configuration specifies that it should be loaded.

This message box indicates a serious problem in the simulation model. It should never appear during normal operation of a model. It is purely for diagnostic purpose. AFE is not designed for handling or debugging of execution errors in the simulation model. All such work must be complete before the model is run from AFE.

4.10 Viewing simulation properties

The window "Simulation Properties" displays some properties concerning a simulation.
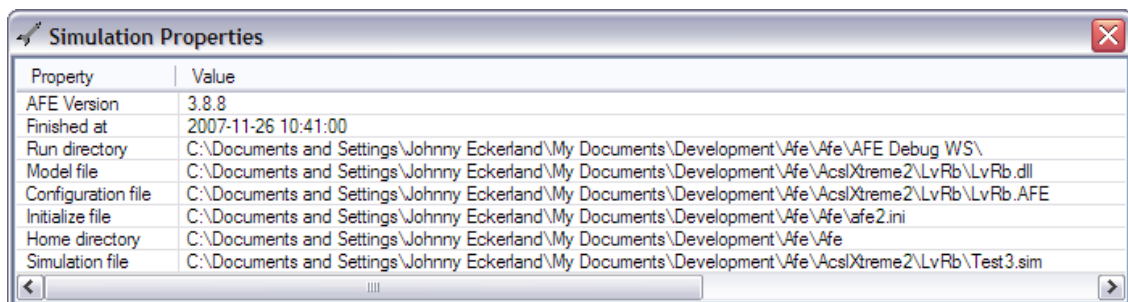
AFE Version	The AFE version used to produce the simulation.
Finished at	The date and time the simulation finished.
Run directory	The directory used for running the simulation.
Model file	The model file specified in the "Configure simulation model" dialog box.
Configuration file	The configuration file (.AFE) in use when the simulation was run.
Initialize file	The initialization file (.INI) in use when the simulation was run.
Home directory	The current directory when AFE was started.
Simulation file	The original file the simulation was saved to.

4.11 Program options

The "Options" dialog box is used for changing various general options in the program. All changes take effect immediately, so there is no need for an Apply-button. The options are grouped together in three tabs. The settings are saved in the INI-file between invocations of the program.

4.11.1 Replay

Replay options affect the speed and behavior of a replay.
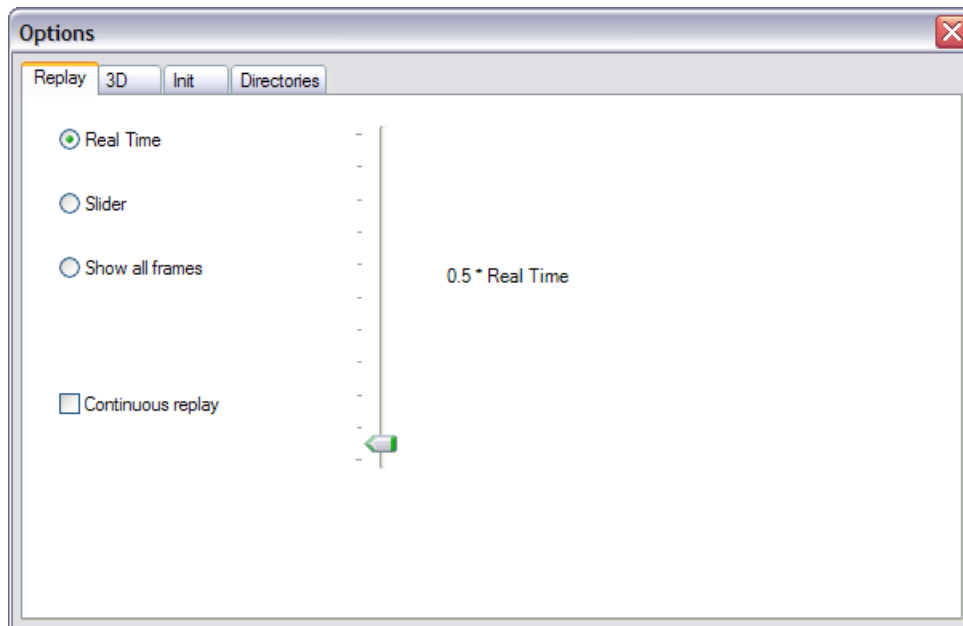
Real Time	The replay is always performed in real time (wall clock time). The frame rate is controlled to be as fast as possible with the available data and hardware performance.
Slider	The replay speed is selected by the slider. The selection is displayed to the right of the slider. The replay speed can be varied between 0.01 seconds and 10 seconds, in increments of 0.01 seconds.
Show all frames	The program displays all available frames in sequence as fast as possible. The actual replay speed compared to real time cannot be determined; it will vary with the current computer load and hardware performance.
Continuous replay	If this option is selected replay restart from the beginning rather then terminate when it reaches the final time.

4.11.2 3D

3D options affect only animation (3D) windows. Windows containing graphs or text are not affected.
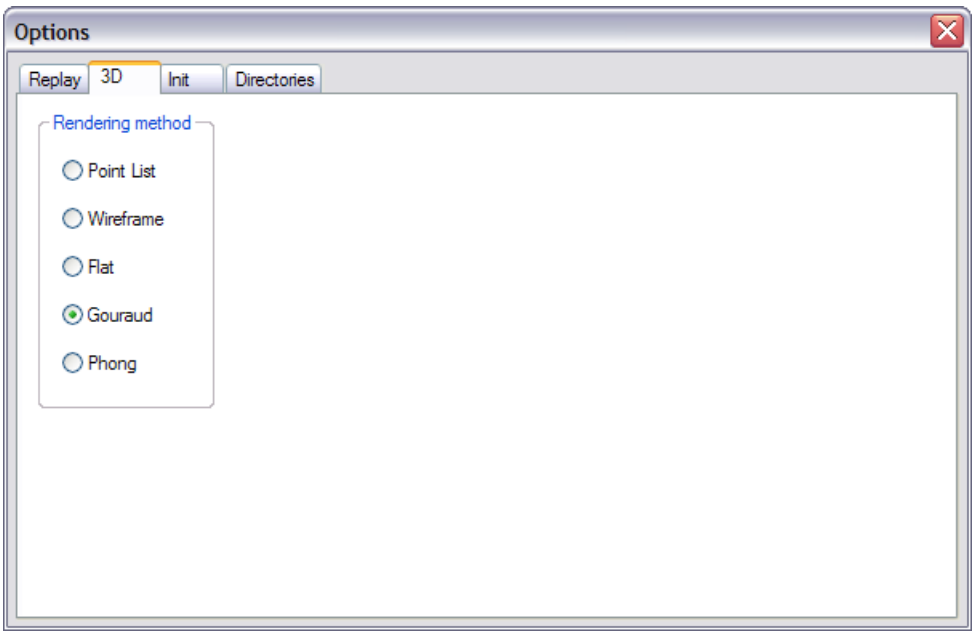
Rendering method	Selects the rendering method. Recommended setting is **Gouraud**. (**Phong** is currently the same as **Gouraud**).

4.11.3 Init

This page is used for some initial startup properties. In order to make changes to come into effect, AFE must be restarted.
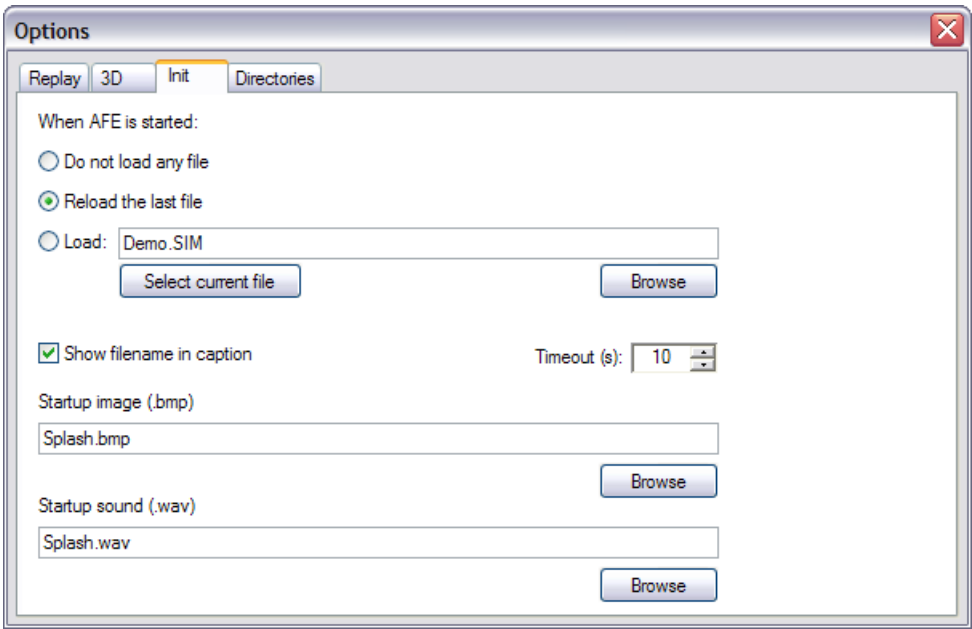
Do not load any file	Setup AFE to start with no initial simulation file loaded.
Reload the last file	Setup AFE to load the last simulation file in use when AFE was last run.
Load:	Setup AFE to load the specified simulation file when started.

Select current file	Selects the currently loaded simulation file as the initial file to be loaded.
Browse	Allows the user to select a file to be loaded with the **Select file** common dialog box.
Timeout (s)	Specifies a timeout value in seconds. During simulation, if no data have been received during the elapse of this time period, AFE will display a warning dialog.
Show filename in caption	Setup AFE to display the filename of the initially loaded file in the caption of the main window.
Startup image	Setup an initial image to be displayed during program startup. Clear this field to disable the startup image. The image must be in the bitmap (.BMP) format.
Startup sound	Setup an initial sound file to be played during program startup. Clear this field to disable the startup sound. The sound must be in the waveform (.WAV) format.

4.11.4 Directories

This page is used for specifying various directories the program may need, depending on the current configuration.

Workspace	This field must contain a valid directory name. The directory must not exist. AFE uses this directory as a temporary place to store model files during a session. The directory is created automatically when needed. Also, the directory is deleted, together with all its contents, when AFE is closed.
Search paths	This is a list of directory paths used for locating files that may be needed during a session. The search for a file is done in order from top to bottom of the list. The first file found is selected. No warning is given if more than one file matches. Only files referenced in the configuration is searched for in this list. Files used by the simulation model can not use this list. A search path can contain a relative path (i.e. '.' and '..'). If the checkbox is marked the search also includes any subdirectories.

4.12   About AFE

This is the "About box" for the program. The date on the first line is the system build date. The **System Information** button opens the "System Information" dialog.
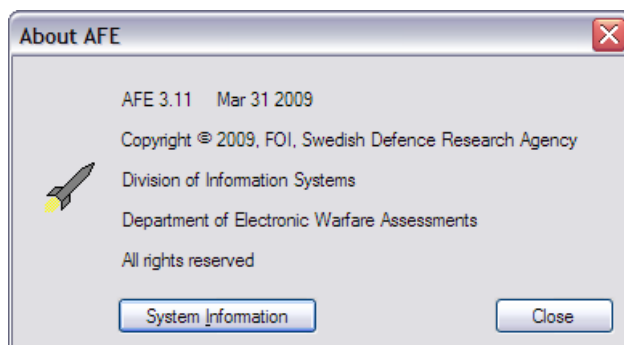
4.12.1 System information

The dialog shows some capabilities from the current computer system AFE is running on. This dialog is only intended for diagnostics.

Origin   Shows the name of a subsystem in the current computer system. Currently only **Direct3D** (the 3D graphics system) capabilities are displayed.

Capability These are some of the capabilities that AFE is dependent on.

Value   The current setting of a capability. This value can vary between different computers.

4.13   Format for simulation results.

The results from a simulation can be saved to a file in binary or text format. The syntax for the text format is described below. The binary format is not described in this document.

The file type (or file name extension) decides if binary or text format is used when a file is saved. The file type **TXT** selects text format, and **SIM** selects binary format. The correct file format is selected automatically when a file is opened.

The purpose of the text file format is for data exchange with other programs. A binary file should normally be selected for saving simulation results to a file. The text file format does not contain all information a binary file does.

4.13.1 Text file syntax for simulation data

```
<SYNTAX> -> ´AFE´ <string>
            ´INITIAL´  {+ <VARIABLE> } ´;´
            ´DATA´     {+ <VALUE> } ´;´
            ´DYNAMIC´  {+ <VARIABLE> } ´;´
            ´DATA´     {+ <VALUE> } {+ ´,´ <VALUE> } ´;´
            ´TERMINAL´ {+ <VARIABLE> } ´;´
            ´DATA´     {+ <VALUE> } ´;´
            {+ ´WINDOW´ <TYPE> <id> <STATE>
                <integer> <integer> <integer> <integer> ´;´ }
<VARIABLE> -> <id> { ´:´ <VARTYPE> { ´[´ <integer> { ´,´ <integer> } ´]´ } }
<VARTYPE> -> ´REAL´ | ´INTEGER´ | ´LOGICAL´ | ´CHARACTER´
<VALUE> -> <SIMPLE-VALUE> | ´[´ {+ <SIMPLE-VALUE> { ´;´ } } ´]´
<SIMPLE-VALUE> -> <number> | <string>
<TYPE> -> ´TEXT´ | ´XY´ | ´POLAR´ | ´SCENE´ | ´MODEL´
<STATE> -> ´NORMAL´ | ´MAXIMIZED´ | ´MINIMIZED´
```

The number of values supplied after a **DATA** keyword must be the same as the number of names supplied after the **INITIAL** and **TERMINAL** keywords preceding the **DATA** keyword. Also the number of columns after the **DATA** keyword following the **DYNAMIC** keyword must be the same as the number of names supplied after the **DYNAMIC** keyword. The values in a vector, surrounded by the […] syntax, are counted as one column. The number of values supplied between the brackets must match the length of the vector exactly. Any number of lines can be supplied in **DATA** after **DYNAMIC**. The first name after **DYNAMIC** must always be the time, and the corresponding columns in **DATA** must contain monotonically raising values. Note that the program does not check for this.

The character '!' (Exclamation) can be used to start a comment, valid to the end of line. Apart from this, the text can be freely formatted. All names supplied after **INITIAL**, **DYNAMIC**, and **TERMINAL** must be available in the current configuration.

At the end of the file there may be a specification for one or more windows to be opened when the file is loaded. Each window specification starts with the keyword **WINDOW** and ends with a ';'. After the **WINDOW** keyword the specification contains in order, the window type, the window configuration name, the window state, four digits specifying its normal state position, and optionally two digits specifying its minimized state position.

Example:

```
AFE 1.2

INITIAL tsm:Real acc:Real vtgt:Real ;

DATA 0.6 70 300 ;

DYNAMIC t:Real tgt2_xte:Real tgt2_yte:Real tgt2_zte:Real kin_xm:Real
kin_ym:Real kin_zm:Real ;

DATA 0.0 1.1 1.2 1.3 5.1 5.2 5.3 ,

1.2 1.3 1.4 5.2 5.3 5.4 6.8,

…

5.5 9.1 9.2 9.3 11.1 11.2 11.3 ;

TERMINAL miss1_bomt:Real miss1_bomd:Real ;

DATA 5.5 4.6 ;


WINDOW GRAPH PlotAcc NORMAL 123 23 456 789 ;

WINDOW SCENE WiewTgt MINIMIZED 23 456 789 567 ;
```

5 CONFIGURING AFE FOR A SIMULATION MODEL

This chapter describes how AFE is configured to a particular simulation model. The configuration information is saved in a special binary file, known as the AFE-file or configuration file, between invocations of AFE. The recommended file type for this file is `.AFE`, and AFE automatically tries to load the last saved or opened configuration file when it is started. The configuration file can also be saved and loaded in XML-format. There is also a so-called INI-file used for maintaining information between invocations of AFE. The INI-file contents are automatically created and maintained by AFE.

5.1 The model files

The dialog box "Configure simulation model" is used for specifying the files (if any) used in a simulation model.
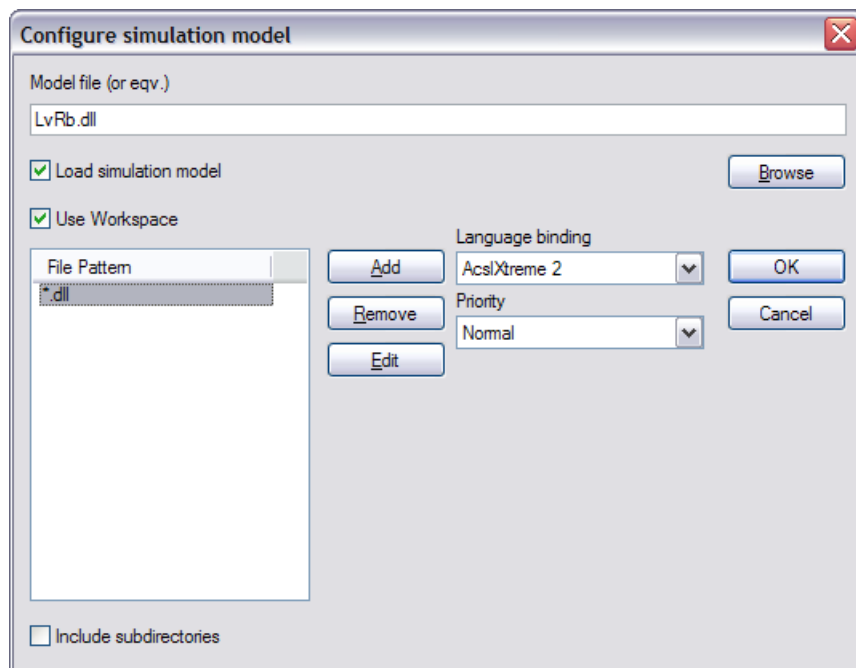
The file path **(Model file (or eqv.))** for the model main file is shown in the edit control. It can be edited manually or looked up by the **Browse** button. A relative directory using "." or ".." can be used but must be entered manually. The current directory (".") is always set to the same directory as the configuration file (.AFE) is located in before a path with a relative directory is expanded to a full path. The file path also defines the model directory, where the rest of the model files must be accessible. If a workspace directory is used, the list **File Pattern** holds the file patterns to be used for creating the workspace. Only files matching this pattern(s) are copied from the model files directory to the workspace directory.

Load…	This checkbox controls if the simulation model is loaded or not. To use AFE without a model, uncheck this box.
Browse	Opens the filename selection dialog window. The edit control is set to the file path selected.
Use Workspace	When this box is checked AFE creates a temporary directory, named the workspace directory, and copies all files matching any of the file patterns in the **File Pattern** list from the model files directory to the workspace directory. The files on the workspace

directory are then used when the model is loaded and executed instead of the original files on the model directory. The files on the model directory remain unchanged. The workspace directory is specified in the **Options Init** dialog page, see **4.11.3 Init**. The workspace directory and all its contents are deleted when AFE is closed.

File Pattern   The list contains the file patterns used when a workspace directory is created. The character "*" can be used to match zero or more occurrences of characters, and the character "?" can be uses to match any single character. To copy all files from the model files directory, specify the pattern "*.*" as the single entry in the list. Patterns that match the same files are removed from the list when the dialog is closed.

Include subdirectories   When this box is checked, subdirectories in the model files directory will also be copied to the workspace directory. Files in subdirectories are copied if they match any of the file patterns.

Language binding   This drop down selection box shows the current simulation language AFE is configured for. The model must be implemented in this language. Se appendix for more information on supported languages.

Priority   Defines the priority for the background process running the simulation model. The priority for the AFE main process is not affected. The main process controls the main window in AFE. The background process is normally not visible on the screen.

5.2 List controls and common buttons in dialog boxes

Many of the dialog boxes described in this chapter have one or more list controls as showed by this example.

The buttons to the right of the list control appears in most cases where a dialog box has a list control. Therefore, these buttons are described once here instead of in several other places. Each line in a list control, displays a few important properties of an object displayed in the dialog box. A list can be sorted or unsorted. Usually if the list is unsorted, the order in which the items in the list are ordered are significant. The column header buttons can in some dialog boxes, where the order is not significant, be used for sorting the lines in the list in ascending or descending order.

Add   Add a new line or item. If an item is selected this operation displays a dialog box with a copy of the selection. If no item is selected, an empty dialog box is

displayed. If the list is unsorted, the new item appears directly below the selected item, or last if no item is selected.

Remove　　Remove the selected item.

Edit　　Edit the selected item. Same function can be activated by a double click on a list item. In most cases opens the same dialog box as the **Add** button, but for editing an existing item.

The following two buttons are only displayed for unsorted lists where the list order is significant.

Move Up　　Move the selected item up one line.

Move Down　Move the selected item down one line.

5.3　Shortcut commands

The dialog boxes described in this chapter are sometimes deeply nested. Therefore a shortcut command has been implemented to facilitate enter and exit of nested dialog boxes. To exit an open dialog box, hold down **shift** while pressing **OK** or **Cancel**. This closes the current dialog box and all the dialog boxes that were opened in order to get to the current dialog box. To reenter the same dialog box closed in this way, hold down **shift** and select the same configuration command again.

5.4　Interface to the simulation model

The interface to the simulation model is made up of a set of variables communicated back and forth between AFE and the simulation model. The dialog box "Configure Variables" manages the variables.
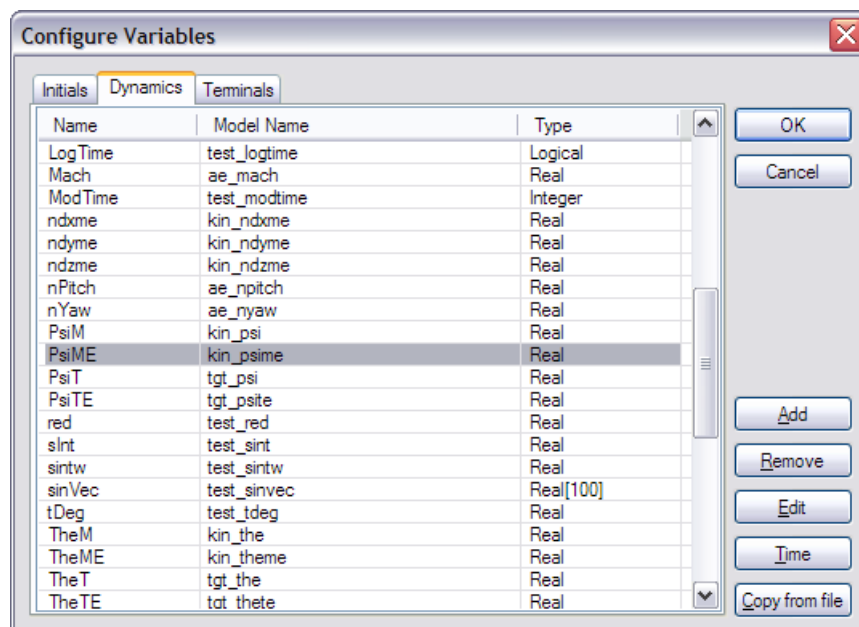
A selected variable always belongs to one of three subsets. These subsets are named **Initial**, **Dynamic** or **Terminal**. The name of a variable must be unique in the total set of all variable names, including both the **Name** and **Model Name.**

Initial　　These are the start parameter variables. AFE sends their current values to the model before a new simulation is started. Variables in this category with an empty **Model Name** are considered local variables in AFE. They are not sent to the model.

Dynamic	This set of variables represents the set of data collected by AFE each time data is collected from the model during a simulation. Data in this set are also collected once after the simulation has terminated.
Terminal	This set of variable values is collected by AFE once after a simulation has terminated. They are expected to be final values.
Name	A short and more convenient name to be used as a nickname for the real name the variable has in the model. This name is later used to refer to the variable in the rest of the configuration.
Model Name	The real name of the variable used in the simulation model. This field can be left blank for **Initial** variables to create a local value.
Type	The type of the variable. AFE currently supports **Real**, **Integer**, **Logical**, and **Character**. A **Logical** value is represented in AFE by the numeric value one (1) for a true value and zero (0) for a false value. If the variable represents a vector, the length of the vector is displayed in brackets after the type name. Also, if the variable represents a matrix, the row and column count are displayed in brackets after the type name. The **Character** type is always a vector.
Time	Modify the variable representing the model time. It is always defined and can not be removed. The time variable belongs to the **Dynamic** subset of variables.
Copy from file	Copy variables from another configuration file.

5.4.1 Modify variable properties

To add or modify an existing variable in the set of model interface variables the following dialog box is used.

Name	A short and more convenient name to be used as a nickname for the name the variable has in the model. This name is later used to refer to the value of the variable in the rest of the configuration.
Model Name	The name of the variable used in the model. This field can be left empty when AFE is used without a model and data is loaded from a text file. If it is left empty when a model is loaded the variable is considered local to AFE.
Type	The type of the variable. AFE currently supports **Real**, **Integer**, **Logical**, and **Character**. A **Logical** value is represented in AFE by the numeric value one (1) for a true value and zero (0) for a false value. If the variable represents a vector, the length of the vector is displayed in brackets after the type name. Also, if the variable represents a matrix, the row and column count are displayed in brackets after the type name. The **Character** type is always a vector. The button opens the "Edit type and dimension" dialog.
Select from model	Opens the dialog box "Select model variable" used for selecting existing model variables. This button is only available when a model is loaded.

The variable properties **Model Name** and **Type** must match an existing variable in the model exactly. If this is not the case a configuration error is generated. For a variable with a configuration error the following happens if a simulation is run. For a variable in the **Initial** subset no value is sent to the model, and for a variable in the **Dynamic** or **Terminal** subset it will always appear to have the numeric value zero (0), or empty for a **Character**.

5.4.1.1 Modify type and dimension

This dialog is used for modifying a type and/or dimension of a variable in AFE.
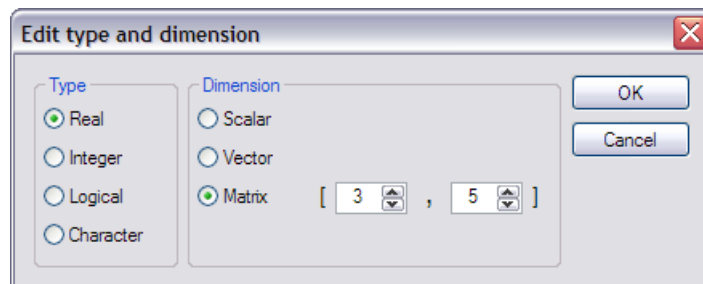
Type	The basic type of the variable. AFE currently supports **Real**, **Integer**, **Logical**, and **Character**.
Dimension	**Scalar** is a single valued variable. **Vector** is a one dimensional valued variable, **Matrix** a two dimensional valued variable. If **Vector** is selected, the length of the vector is displayed in brackets, and if **Matrix** is selected the dimensions are displayed as above.

The **Type** and **Dimension** must match the actual variable in the model exactly. If this is not the case a configuration error is generated, and the variable will not be altered or logged by AFE.

5.4.2 Selecting a new variable from the model

The dialog box "Select model variable" is used for browsing and selection of a a new variable name from the simulation model. This dialog box is only available if a model is loaded.

Select model variable		
Filter pattern: *psi*		
Model Name	**Type**	
dpsitg	Logical	OK
init_dpsite0	Real	Cancel
init_psi	Real	
init_psidel	Real	
init_psite0	Real	
kin_dpsi	Real	
kin_psi_0	Real	

The table shows the variables present in the current context, i.e. **Initial**, **Dynamic** or **Terminal**. A variable can simultaneously belong to more then one of these context, possibly all three. The edit control with the label **Filter pattern:** can be used for filtering out a subset of available variable names in the list. The special character '*' can be used for matching a sequence of any characters, including zero. Also the special character '?' can be used for matching any single character. The column header buttons can be used to sort the corresponding column in ascending or descending order.

5.4.3 Copy variables from an other configuration file

This dialog box is used for copying variables from a configuration file to the current configuration.
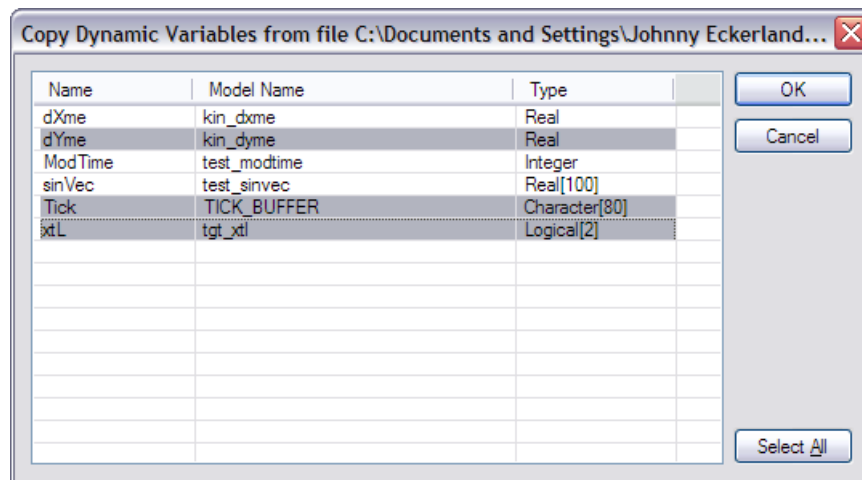
The list shows variables from the selected configuration file that is not already in use in the current configuration. To copy variables already in use these must first be removed from the current configuration. The button **Select All** selects all items in the list.

5.5 Start parameters

The dialog box "Configure start parameter pages" is used for configuring pages of start parameters. These pages are displayed and used in the dialog box "Start parameters", described in section 4.5. In the text below "displayed value" and "displayed text" means a value or text presented to the user of the "Start parameters" dialog box. In addition, a reference made to the user means the user of the "Start parameters" dialog box.
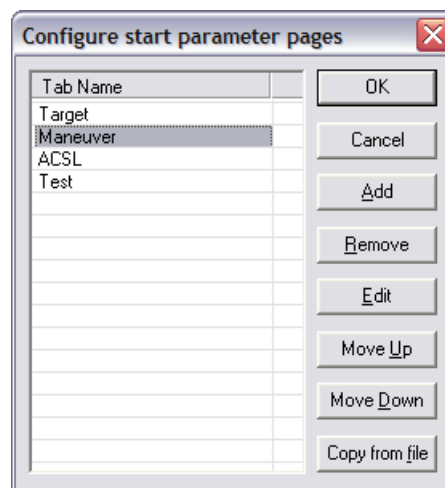
Each page is displayed in the "Start parameters" dialog box with a separate tab in the order they are listed. The list shows the tab names used for each page. This dialog box can also be opened from the "Start parameters" dialog by selecting **Configure** in the right mouse button menu.

5.5.1 Modify start parameter pages

This dialog box is used for managing the start parameters on a single tab in the "Start parameters" dialog.

Each line in the list represents a single **Initial** variable in the model to be assigned a start value before a simulation is started.

Tab Text   The text displayed on the tab used for selecting the page.

Visible   Controls if the page is visible as a tab in the "Start parameters" dialog. The start values on the page are sent to the model regardless of this setting.

Description   The text displayed before a start parameter value.

Unit   The text displayed after a start parameter value.

Type   The type of the value displayed. This value affects how the user is allowed to modify a value. In the current version of AFE, it must match the type of the variable.

Variable Name The name of the variable to be assigned the displayed start value. This variable must be from the **Initial** set of variables. This field can be left empty to introduce an empty line on the page.

Min Value   The minimum displayed value allowed for this variable.

Max Value   The maximum displayed value allowed for this variable.

Scale By   A value used to scale the variable value before it is displayed.

Offset By   A value used to offset the scaled variable value before it is displayed.

The following relation holds (in both directions) between the displayed value (**D**) and the variable value (**V**):

D = ScaleBy*V + OffsetBy

5.5.2 Modify start parameter properties

This dialog box is used for editing the properties of a single start parameter.

Description	The text displayed before a start parameter value. It can be used to give the user some idea of what the start parameter is intended for in the model.
Unit	The text displayed after a start parameter value. It can be used to specify the unit of the displayed value.
Type	The type of the value displayed. This value affects how the user is allowed to modify a value. In the current version of AFE it must match the type of the variable.
Filename	If **Type** is set to **CHARACTER** and this checkbox is selected the value is regarded as a filename. Windows standard dialog box for selecting files are used for modifying the value.
File must exist	When this checkbox is selected only filenames corresponding to an existing file can be selected. A simulation cannot be started if the actual file does not exist.
Variable Name	The name of the variable to be assigned the displayed start value. This variable must be from the **Initial** set of variables. This field can be left empty to introduce an empty line on the page. The name can be edited directly, or selected from the drop down list. Names already in use, on some page, are not displayed in this list. If the variable name is not available a configuration error is generated. Each **Initial** variable can only be used once; it cannot appear on several pages. If the variable is not properly configured here, the value will not be transferred to the model when a simulation is initiated.
Min Value	The minimum displayed value allowed for this variable. If the user tries to enter a smaller value an error message is displayed.
Max Value	The maximum displayed value allowed for this variable. If the user tries to enter a greater value an error massage is displayed.
Scale By	A value used to scale the variable value before it is displayed.

Offset By	A value used to offset the scaled variable value before it is displayed.
Visible	Controls if the line is visible in the "Start parameters" dialog. The start value on the line is sent to the model regardless of this setting.
Help Text	A short text intended to give a further explanation of the text entered as **Description**. This text is only displayed when the user presses the **Help** button.

The displayed value (**D**) the user sees can be different from the actual value (**V**) of the variable. When a variable value is displayed to the user the following calculation is performed:

D = ScaleBy*V + OffsetBy

The user can then change the displayed value and when it is moved back to the variable the following calculation is performed:

V = (D – OffsetBy)/ScaleBy

For example, this can be used to perform a simple translation back and forth of the unit radians in the model to the unit degrees displayed and edited by the user.

5.5.3   Copy start parameter pages from a file

The dialog box is used for selecting and copying start parameter pages from another configuration file to the current configuration.
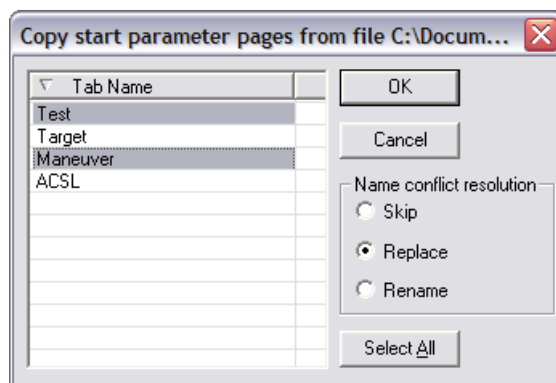
Tab Name	The text on the tab used for referring to the start parameter pages in the configuration in the file.
Select All	All lines in the list are selected.

Name conflict resolution controls what happens if a tab name selected is already used in the current configuration.

Skip	The selected page is not copied to the current configuration.
Replace	The selected page is copied and replaces the window with the same name in the current configuration.
Rename	The selected page is copied to a new tab name not used in the current configuration.

If a page copied contains start parameter variable names already in use in the current configuration, these names are not copied from the file.

5.6 Status line

The status line is the single line of text displayed in the bottom frame of the main window (i.e. the status bar). This dialog box is used for configuring the status text depending on the current program mode. The status line is also used for displaying short help messages, when the user is

about to make a menu selection or hovers the cursor for a short period of time over a button in the control bar. These help messages are not configurable.
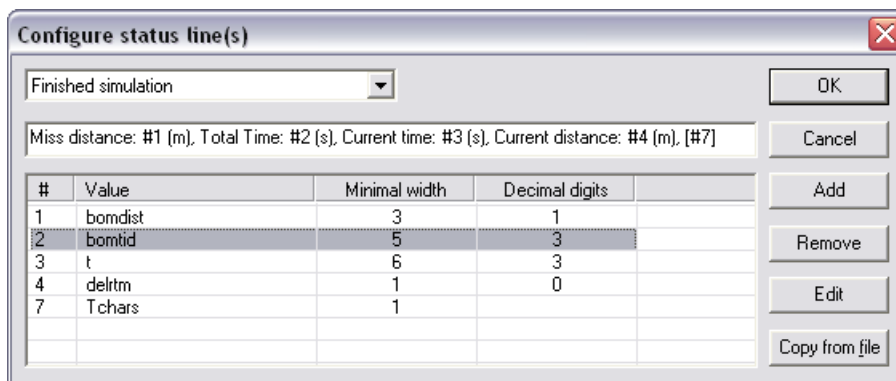
The combo box at the top of the dialog box selects one of the possible program modes. Each mode has its own status line definition. The corresponding status line is displayed in the edit control below the combo box. The following modes are possible.

Ready for a new simulation Displayed when the program is ready to start a new simulation. Start parameters may have been modified.

Running simulation Displayed when a simulation is running.

Paused simulation Displayed when a simulation is temporarily paused.

Finished simulation Displayed when a simulation has terminated normally.

Interrupted simulation Displayed when the user has interrupted a simulation.

Replaying Displayed during a replay of recorded data from a previous simulation.

If the status line contains the character # followed by a single letter, this sequence is replaced by the corresponding value identified in list below the status line.

The letter identifying the value in the status line.

Value The value to be displayed. The available variables to choose from, depends on the program mode.

Minimal width The minimal number of character positions in the field. Extra positions are added if more characters are needed to show the whole value.

Decimal digits Number of digit positions after the "." in the number displayed. This option is only available for numeric values.

The **Copy from file** button can be used for copying status lines from another configuration file.

5.6.1 Formatting a value on a text line

This dialog box is used for configuring a single value in a line of text. A text line can appear in a text window, overlaid on a 3D-scene, or on the status line.
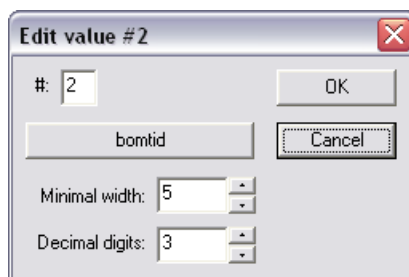
The button is used for selecting a value. The button text displays the source of this value by showing the variable name, possibly in a formula describing the calculations made on the value.

The identification of the value in the text line. It can be any printable letter.

Minimal width The minimal number of character positions in the field. Extra positions are added if more characters are needed to show the whole value.

Decimal digits Number of digit positions after the "." in the number displayed. This option is only available for numeric values.

5.6.2   Selecting a single value

The dialog box "Select constant or single value from…" can be opened from several other dialog boxes when a single value is to be selected. The caption shows the appropriate subset of variables available depending on from where the dialog box was opened.

Type   Selects the base type of the value. Controls the variable names displayed in the drop down lists.

Simple variable   Selects a value from a variable that is not a vector.

Element from a vector Selects an element in a vector.

Element from a matrix Selects an element in a matrix.

Constant   Selects a constant value. Selecting this option also disables the **Scale Value By** and **Offset Value By** fields.

Variable Name   A name of a variable that is not a vector or matrix. The drop list shows the available variable names depending on the **Type** and the current available subset of variables. If the variable name does not exist an error message is displayed.

Vector Name	A name of a variable that is a vector. The drop list shows the available vector variable names depending on the **Type** and the current available subset of variables. If the variable name does not exist an error message is displayed.
Matrix Name	A name of a variable that is a matrix. The drop list shows the available matrix variable names depending on the **Type** and the current available subset of variables. If the variable name does not exist an error message is displayed.
Index	One or two positive integer used as index for an element in a vector or matrix. If the index is out of range an error message is displayed.
Constant Value	The constant value, possibly with a sign.
Scale Value By	A single numeric constant used for scaling the value. Default value is 1 (one). This option is only available for numeric values.
Offset Value By	A single numeric constant used for offsetting the value. Default value is 0 (zero). This option is only available for numeric values.

The fields **Scale Value By (= K)** and **Offset Value By (= L)** are used in the formula **Y = K*X+L**, where **Y** is the resulting value and **X** is the value from the simulation. It is used for implementing a linear adjustment of the value before it is used.

5.6.3   Selecting a vector value

The dialog box "Select vector value from…" can be opened from several other dialog boxes when a vector value is to be selected. The caption shows the appropriate subset of vector variables available depending on from where the dialog box was opened.
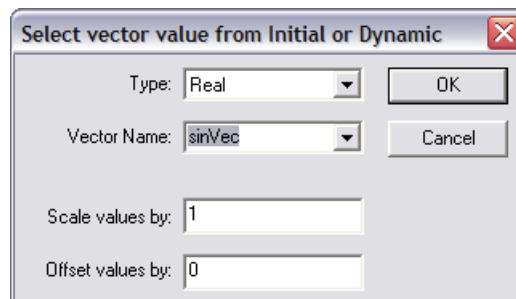
Type	Selects the element type of the vector.
Vector Name	A name of a vector variable. The drop list shows the available vector variables depending on the selected element **Type** and the current available subset of variables. If the variable name does not exist an error message is displayed.
Scale values by	A single numeric constant value used for scaling all values in the vector. Default value is 1 (one).
Offset values by	A single numeric constant value used for offsetting all values in the vector. Default value is 0 (zero).

5.6.4 Copy status lines from a file

The dialog box is used for selecting and copying status lines from another configuration file to the current configuration.
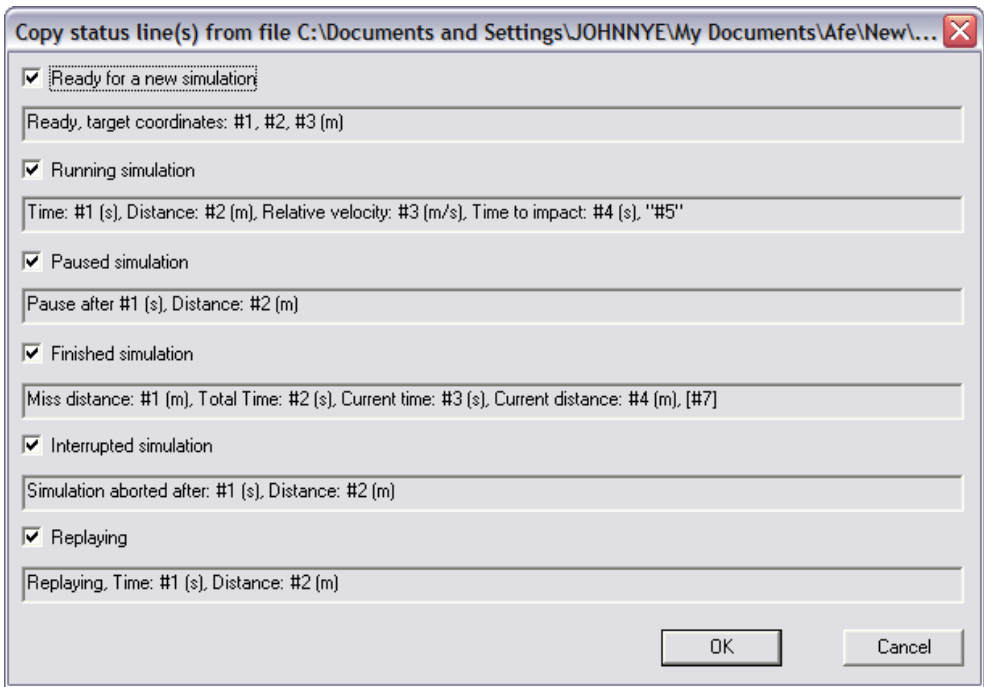
The check boxes are used for selecting the status lines that are to be copied to the current configuration.

5.7 Simulation result windows

The "Configure Windows" dialog box is used for configuring of the available types of windows used for displaying simulation results.
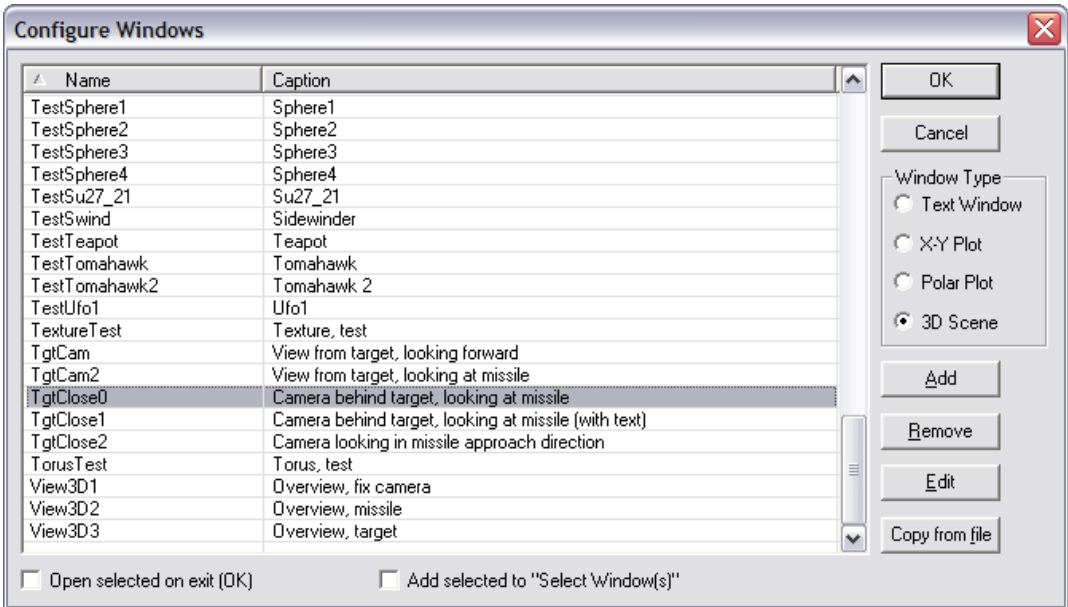
The contents of the list show the available windows depending on the selected **Window Type**. If the check box **Open selected on exit (OK)** is checked the selected window in the list is opened when the user pushes the **OK** button. If the check box **Add selected to "Select**

Window(s)" is checked the selected window is added to the "Select Window(s)" dialog box when the user pushes the **OK** button.

Name   The name of the window.

Caption   The window caption.

Copy from file Used for copying windows of the selected type from another configuration file.

5.7.1 Copy a window from a file

This dialog box is used for copying windows to the current configuration from another configuration saved in a file.
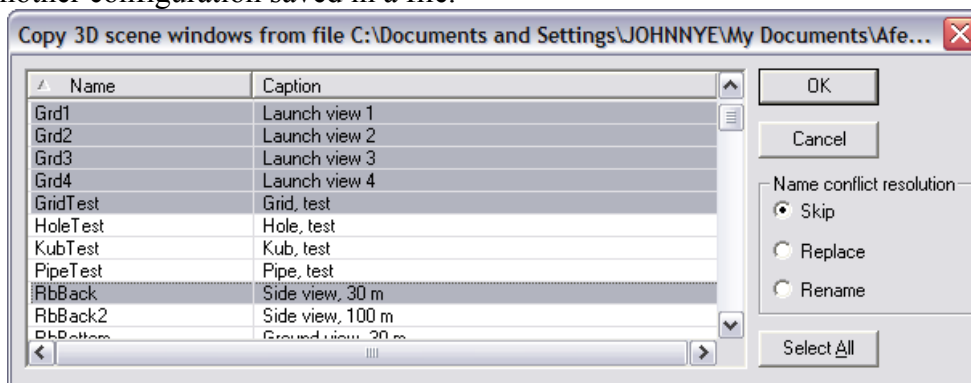
Name   The name of the window in the configuration file that is to be copied from.

Select All   All lines in the list are selected.

Name conflict resolution Controls what happens if a selected name is already in use in the current configuration.

Skip   The selected window is not copied to the current configuration.

Replace   The selected window is copied and replaces the window with the same name in the current configuration.

Rename   The selected window is copied to a new name not used in the current configuration.

5.8 Text windows

Text windows are used for displaying a few lines of text in a window.
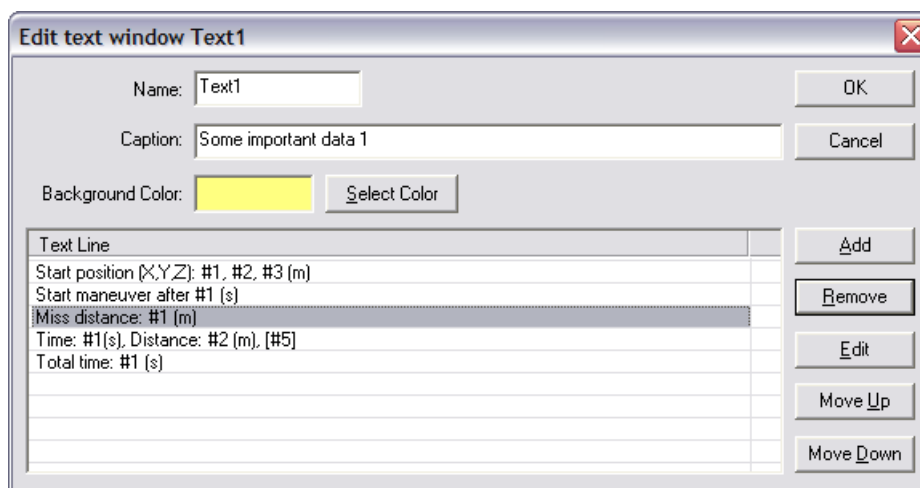
Name	The window name. The name must be unique for the window type.
Caption	The window caption. The caption is the single text line displayed in the top frame of the window.
Background Color	Shows the selected background color in the window. The button **Select Color** can be used to change background color.
Text Line	The text lines as they are displayed in the text window. The #n is replaced with a value.

This dialog box can also be opened from an active text window by selecting **Configure** in the right mouse button menu.

5.8.1 Modify a single line of text

To modify a single line of text in a text window, the following dialog box is used.
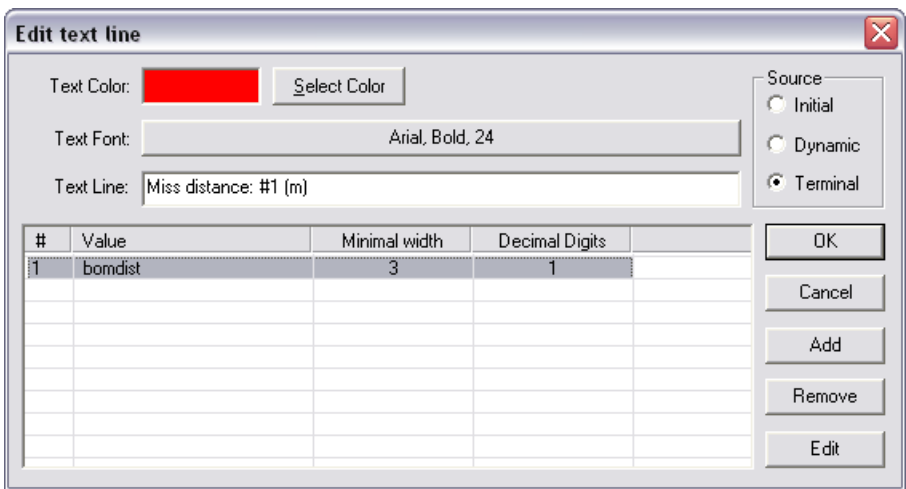
Text Color	Shows the selected text color for the line. The button **Select Color** can be used to change color.
Text Font	A button where the button text shows the selected font for the line. If the button is pressed the user can choose another font.
Text Line	The text line as it is displayed in the text window. The #n sequence is replaced with the corresponding value specified in the list control. The n can be any printable character.
#	The letter identifying the value in the status line.
Source	Selects the category of variables. A variable referred to in a text line must belong to this category. Also controls if lines are displayed or not, depending on the program mode. **Initial** variables are always available and therefore the text line is always displayed. **Dynamic** variables are only available after or during a simulation and therefore the text line is only displayed during a simulation, after a simulation has terminated or during a replay. **Terminal** variables are only available after a simulation has terminated and therefore the text line is only displayed after a simulation or during a replay.

The columns in the list control have the following meaning.

#n	A single letter for identification of the list item in the text line. The value specified in each list item is used in the **Text Line** by referring to it with the #n syntax. Each list item represents a value and how it is displayed. List items not refereed to in the **Text Line** are ignored. To modify values see **5.6.1 Formatting a value on a text line**.

Value Shows the source of the value, usually a variable name possibly with a sign or an index.

Minimal width The minimal number of character positions in the field. Extra positions are added if more characters are needed to show the whole value.

Decimal Digits Number of digit positions after the "." in the displayed number.

5.9 X-Y plot windows

An X-Y plot window contains one or more Cartesian X-Y –plots and is configured by this dialog box. It can also be opened from an active X-Y plot window by selecting **Configure** in the right mouse button menu.


Name The window name. The name must be unique for the window type.

Caption The window caption. The caption is the single text line displayed in the top frame of the window.

Background Color Shows the selected background color in the window. The button **Select Background Color** can be used to change the background color.

Grid Color Shows the selected color for the grid. The Button **Select Grid Color** can be used to change this color.

Axis Color Shows the selected color for the axis. The Button **Select Axis Color** can be used to change this color.

Text Color Shows the selected color for all text. The Button **Select Text Color** can be used to change this color.

Text Font A button displaying the font information used for the text on the axis. By pressing the button new font information can be selected.

Axis These two buttons are used for modifying the scale on each axis.

Copy Make multiple copies of the selected plot. Any indexed vector in the plot can have its index automatically incremented.

The drop list just above the list control is used for selecting between different graphical objects that can be displayed in an X-Y plot window. The selection can be made between **Plots**, **Start parameter marks**, and **Background circles**. If the selection is **Plots** the list control shows the plots drawn in the window.

X The X-value used when drawing the curve.

Y The Y-value used when drawing the curve.

Color The color value as an RGB-code used when drawing the curve.

Width The width value in pixels of the curve.

Vector Plot **Yes** or **No** depending on if the plot is a vector plot or not.

If the selection in the drop list is **Start parameter marks**, the list control shows marks for selected start parameter values. A mark is a circle where the following properties can be modified.

X The start parameter value for the X-position.

Y The start parameter value for the Y-position.

Size The size in pixels.

Thickness The edge width in pixels.

Edge Color The edge color as an RGB-code.

Interior Color The fill color as an RGB-code.

If the selection in the drop list is **Background circles**, the list control shows data for ellipses that can be used for a background in the plot. If at least one background ellipse is specified, the plot axis will be drawn with equal length regardless of their scaling. If the axes have the same scaling the ellipse will be drawn as a circle. The ellipse is always centered on the origin.

Radius The radius in axis units.

Color The fill color of the ellipse as an RGB-code.

The graphical objects are drawn in the order they are listed. This means that an object below another object may hide that object more or less.

5.9.1 Modify a single plot in a window

A single curve in an X-Y –plot or polar plot is configured with this dialog box.
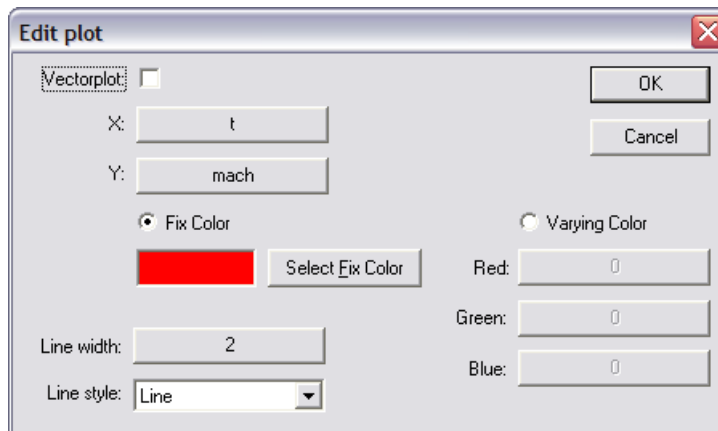
Vectorplot	Controls if the plot show a vector plot or not. If it is a vector plot then **X** and **Y** must both be vector values of the same length.
X, Y	The button text shows the values used in the plot. Values can be selected by pushing these buttons. If the dialog box is opened from a polar plot these buttons selects angle and radius values.
Fix Color	Selects a fix color for the whole plot. The button **Select Fix Color** can be used to change the fix color.
Varying Color	Selects varying plot color.
Red, Green, Blue	The button text shows the values used for controlling the color of the plot as RGB-codes. The buttons can be used to select new values. These values are automatically limited to the interval **0..255** when the plot is drawn.
Line width	The button text shows the value used for controlling the line width when the plot is drawn. If the button is pushed, a new value can be selected.
Line style	The plot curve can be drawn either as a continuous line or as a doted line. When doted is selected a dot is drawn for every available data point. If the data points are very dense, the plot may appear continuous.

How plot values are selected is described in **5.6.1 Selecting a single value**.

5.9.2 Modify an axis in a plot window

The axis of an X-Y – plot, and the radius of a polar plot are configured with this dialog box.
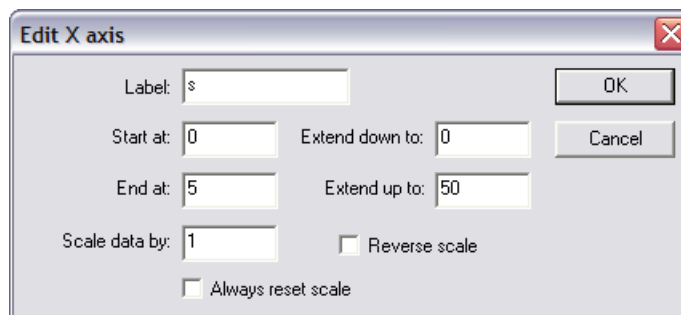
Label	The axis label.
Start at	The start point of the axis scale.

End at	The end point of the axis scale.
Scale data by	A scaling factor for the displayed values. All values drawn are multiplied by this value.
Extend down to	The extended start point. The axis scale is allowed to automatically extend down to this value.
Extend up to	The extended end point. The axis scale is allowed to automatically extend up to this value.
Reverse scale	If checked, the axis scale is drawn in reverse order.
Always reset…	If checked the axis scale is reset to **Start at** and **End at** during both simulation a replay, if not checked the scale is only reset before a simulation, not during replay. This option is also available for the radial scale in a polar plot.

5.9.3 Modify a start parameter mark

A start parameter mark in an X-Y –plot is configured with this dialog box. A start parameter mark is a circle used for displaying a start parameter value. They are always displayed and do not move during a simulation or replay.
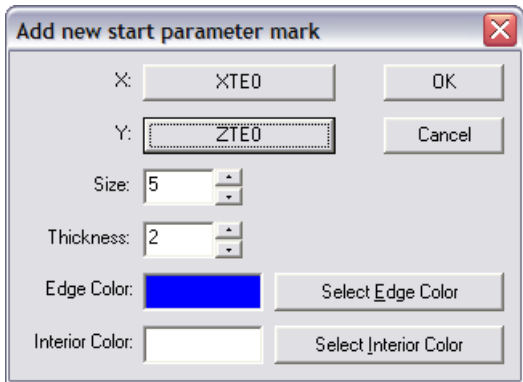
X, Y	The start parameter values used for the X, and Y-position. The buttons can be used to select new values. If variables are used, they must belong to the **Initial** subset of variables.
Size	The total size in pixels.
Thickness	The edge width in pixels.
Edge Color	The edge color. The button **Select Edge Color** selects a new color.
Interior Color	The fill color. The button **Select Interior Color** selects a new color.

5.9.4 Modify a background circle

A background circle, or ellipse, in an X-Y –plot is configured with this dialog box.
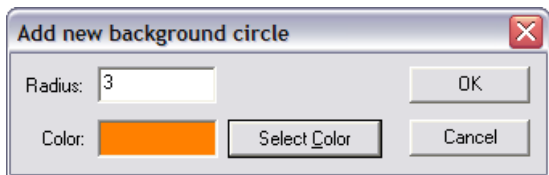
Radius	The radius in axis units.
Color	The fill color. The button **Select Color** can be used to change the color.

5.10 Polar plot windows

A polar plot window contains a circular plot, and is configured by this dialog box. It can be opened from the **Configure** menu or by selecting **Configure** from the right mouse button menu.

Name	The window name. The name must be unique for the window type.		

Name   The window name. The name must be unique for the window type.

Caption   The window caption. The caption is the single text line displayed in the top frame of the window.

Background Color Shows the selected background color in the window. The button **Select Background Color** can be used to change the background color.

Grid Color   Shows the selected color for the grid in the plot. The Button **Select Grid Color** can be used to change this color.

Axis Color   Shows the selected color for the axis in the plot. The Button **Select Axis Color** can be used to change this color.

Text Color   Shows the selected color for the text in the plot. The Button **Select Text Color** can be used to change this color.

Text Font   A button displaying information about the font used for the text on the scales. By pressing the button a new font can be selected.

Radial scale   The button is used for modifying the radial scale.

Angle scale   Properties for modifying the angle scale.

Use degrees   If checked the input angle is expected to be in degrees rather than in radians. The numbers on the angle scale are always in degrees.

54

Reverse scale   If checked the angle scale is drawn in reverse.

Offset scale   An offset for rotating the angle scale. It must be a value in the range 0..360 degrees.

The list shows the plots drawn in the window.

Angle   The value used for the angle.

Radius   The value used for the radius.

Color   The color value as an RGB-code used when drawing the plot.

Width   The width value in pixels of the plot.

Vector Plot   **Yes** or **No** depending on if the plot is a vector plot or not.

How to select values to be plotted is described in **5.6.2 Selecting a single value**.

5.11   3D Scene windows

A 3D scene window can contain 3D objects, overlaid text and sounds. Its purpose is to show simulation results in the form of an animation. This dialog box is used for configuration of a 3D scene window. It can also be opened from an active 3D scene window by selecting **Configure** in the right mouse button menu.

Name   The name of the window. The name uniquely identifies this particular window.

Caption   The window caption. The caption is the single text line displayed in the frame above the window.

Background Color   Shows the background color in the window. The button **Select Background Color** is used for changing the background color. If fog is enabled in the scene, this color is also the color of the fog.

Fog   Opens the fog configuration dialog.

Camera   The selected camera through which the scene is viewed. The drop list is used for selecting and viewing available cameras.

Cameras	This button allows the user to configure available cameras.
3D Objects	Configures available 3D objects.
Sounds	Configures available sounds.
Ambient light	Opens the color configuration dialog. Ambient light is the overall light coming from no specific direction in a scene.

The first tab **3D Objects** shows the selected 3D objects in the scene. Multiple selections can be made in this tab.

3D Object	The name of a 3D object.
Filename	The filename of the 3D object. All 3D objects must be located in the X-Files directory specified in the **Directories** tab in the **Options** dialog.

The second tab **Text** shows any overlaid text lines in the scene.

|	
Text Position	The position in the window where the text appears.
First line	The fist line of the text.

The third tab **Sounds** shows the selected sounds in the scene. Multiple selections can be made in this tab.

Sound	The name of a sound.
Filename	The filename of the sound. All sounds must be located in the sound directory specified in the **Directories** tab in the **Options** dialog.

5.11.1 Fog

The fog configuration dialog is used for enabling of fog and selection among available fog modes in a 3D scene window.
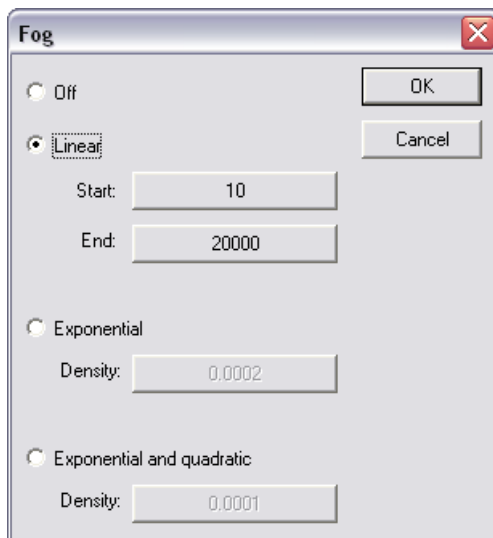
Off	No fog is added to the scene.
Linear	Fog is added to the scene and interpolated linearly from 100% visibility to 0% visibility between **Start** and **End**, which are distances from the camera. **Start** and **End** must both be positive, and **Start** must be less or equal to **End**.
Exponential	Fog is added to the scene according to the formula $1/e^{(d * density)}$, where d is the distance between the object and the camera. **Density** must be in the range 0..1.

Exponential and quadratic Fog is added to the scene according to the formula $1/e^{(d\,*}$ $^{\text{density})2}$, where d is the distance between the object and the camera. **Density** must be in the range 0..1.

5.11.2 Text lines in 3D Scenes

Overlaid text in a 3D scene window is configured with this dialog box.
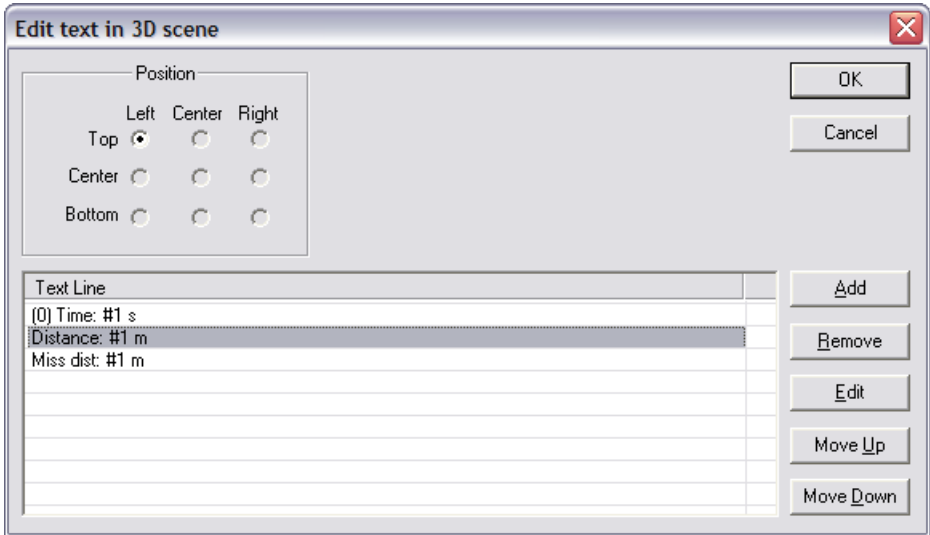
The **Position** field allows selection of a position for the overlaid text. Positions already in use are dimmed. The list control shows the text lines. The dialog box used when editing a line is described in **5.6.1 Formatting a value on a text line**.

5.12   Cameras

This dialog box is used for managing cameras. It can also be opened from an active 3D scene window by selecting **Cameras** in the right mouse button menu.
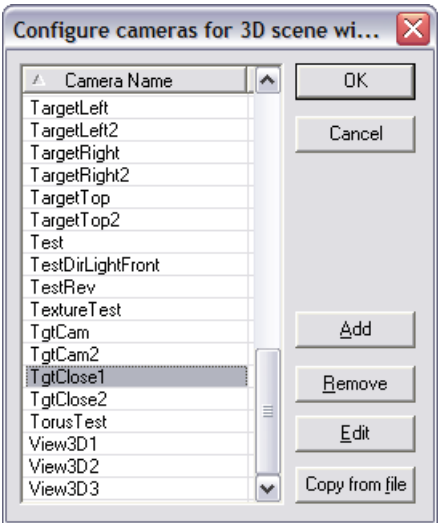
Camera Name The name used when referring to a camera in a 3D scene. It must be unique.

Copy from file Used for copying cameras from another configuration file.

5.12.1 A single camera

A camera is configured with this dialog box.

Name	The unique name of the camera. Used for selecting the camera in a 3D scene window.
Field of view	The value used for controlling the field of view of the camera. A new value can be selected by pushing the button. If the value supplied is negative or to small, a very small positive value is used instead. The value must be given in radians.
Front clipping plane	Objects closer to the camera than this value are not visible. A new value can be selected by pushing the button. If the value supplied is negative or to small, a default value is used instead.
Back clipping plane	Objects further away from the camera than this value are not visible. A new value can be selected by pushing the button. If the value supplied is negative or to small, a default value is used instead.

The list shows the 3D operations that control the camera during a simulation or replay. They are executed in the order they are listed. Before the first operation is executed the camera is located in the center of the world coordinate frame, oriented in the opposite direction of the Y-axis.
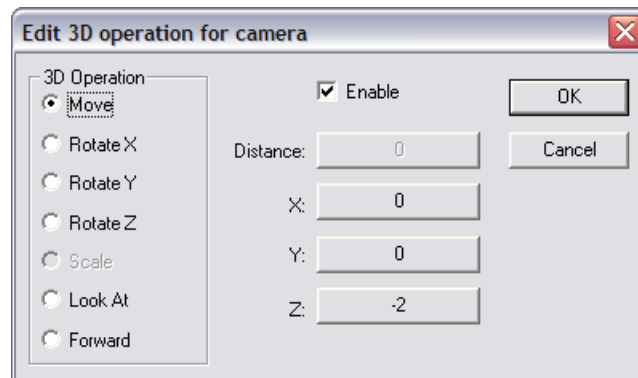
3D Operation	The name of the 3D operation.
Arguments	The value, or values, used for argument to the operation.
Enabled	Yes or No depending on if the operation is enabled or not.

5.12.2 A single 3D Operation

This dialog box is used for configuring a single 3D operation for a camera or a 3D object.

The radio buttons in the **3D Operation** frame selects among available 3D operations. The **Distance, X, Y,** and **Z** buttons are used for selecting argument values to the operation.

Move Move the object or camera from its current location in the world coordinate frame a relative distance given by the **X, Y,** and **Z** arguments.

Rotate X, Y, Z Rotate the object or camera from its current orientation around one of the axis X, Y, or Z. The amount is given by the corresponding arguments **X, Y,** and **Z**. The rotation center is always the center of the world coordinate frame. When a rotation is applied to an object, its local coordinate frame is also rotated relative to the world coordinate frame. The values must be in radians.

Scale Scale the object along its main axis directions X, Y, and Z using the values of the arguments **X, Y,** and **Z**. This operation can only be applied to 3D objects.

Look At This operation is only available for a camera. It orients the camera to view the point given by the arguments **X, Y,** and **Z**. The camera is oriented so that its roll angle always is zero. Note that this operation supersedes previous **Rotate** operations.

Forward This operation is only available for a camera. It moves the camera the distance given by the argument **Distance** from its current location towards the point given by the arguments **X, Y,** and **Z**. If **Distance** has a negative value the camera is moved away from the point. The movement is relative to the world coordinate frame.

Enabled This checkbox can be used for disabling the operation temporarily. This can be very useful when testing out a new object or camera.

The dialog box used for selecting values is described in **5.6.2 Selecting a single value**.

5.12.3 Copying cameras from a file

The dialog box is used for copying cameras to the current configuration from another configuration saved in a file.
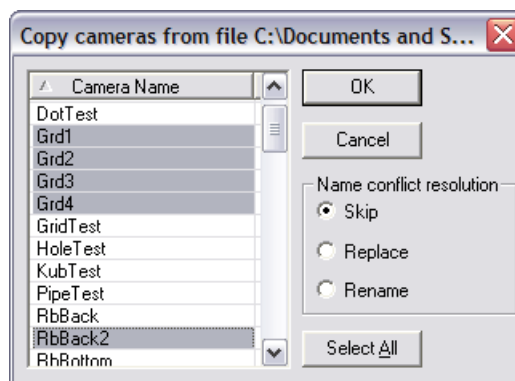
Camera Name The name used for referring to a camera in the configuration file that is to be copied from.

Select All All cameras in the list are selected.

Name conflict resolution Controls what happens if a name that is selected is already used in the current configuration.

Skip The selected camera is not copied to the current configuration.

Replace The selected camera is copied and replaces the camera with the same name in the current configuration.

Rename The selected camera is copied to a new name not used in the current configuration.

5.13 3D Objects

This dialog box is used for managing 3D objects. It can also be opened from an active 3D scene window by selecting **3D Objects** in the right mouse button menu.
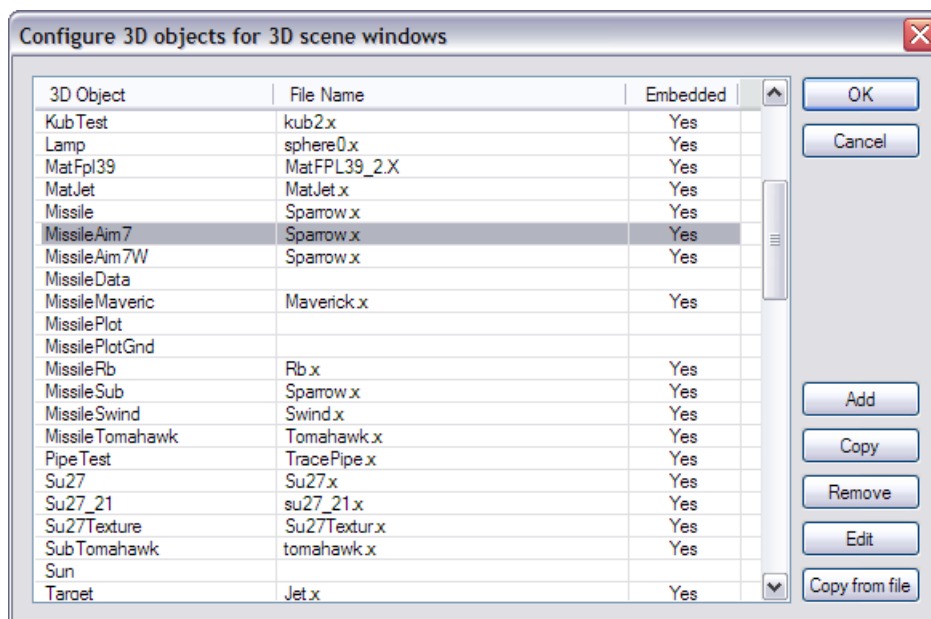
3D Object The name used for referring to an object in a 3D scene. It must be unique.

Filename The DirectX file used for storing the object. The file location must be specified in the **Directories** tab in the **Options** dialog. The object can be stored either as a "mesh" or a "frame". If the file internally refers to any texture files, there locations must also be accessible.

Embedded Indicates whether the X-file is embedded or not.

Copy Make multiple copies of the selected object.

Copy from file Copies 3D objects from another configuration file. Any files used by the object are not copied.

5.13.1 A single 3D Object

This dialog box is used for the configuration of a 3D object.

Name The name used for referring to an object in a 3D scene. It must be unique. The name is also used for referring to an object that is part of another object, a "sub-object".
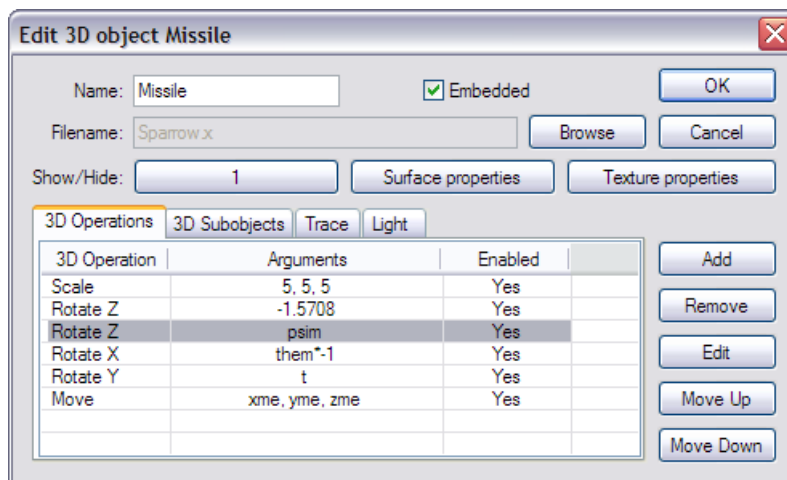
Embedded If checked, the content of the X-file is embedded in the configuration file (.AFE). If the X-file has references to image (texture) files, these are also embedded.

Filename The name of the DirectX file where the object is stored. The common location for all DirectX files must be specified in the **Directories** tab in the **Options** dialog. The object must be stored either as a DirectX "mesh" or "frame". If the file contains more than one object, only the first is loaded. If the file internally refers to any texture files, there locations must also be accessible. Pathnames in texture filenames (inside an .X-file) are ignored. Textures can be stored as .BMP, .JPG, .GIF, .TIF and .PNG files. No error message is produced if a texture file fails to load correctly. The filename of the .X-file must only contain the name and the type (extension), the directory path and device unit must be left out. The **Browse** button can be used for changing the filename. If the file is embedded this field is dimmed.

Show/Hide The object is not visible if this value is zero. Any other value different from zero makes the object visible in a scene. By pressing the button the user can select a new value.

Surface properties The button opens the "Surface properties" dialog, where the user can specify such properties as color, transparency, reflectance, emission, etc, for the object.

Texture properties   The button opens the "Texture properties" dialog, where the user can specify a transparent color for a textured object.

3D Operations

This tab shows the 3D operations that control the objects motion during a simulation or replay. They are executed in the order they are listed. Before the first operation is executed, the object is located in the center of the world coordinate frame. Its local coordinate frame is oriented so that forward is in the positive x-axis direction, and upwards is in the negative z-axis direction. A single 3D operation is managed with the same dialog box that is used for managing of a 3D operation for a camera, is described in **5.6.2 Selecting a single value**

3D Operation   The name of the 3D operation.

Arguments   The value, or values, used for argument to the operation.

Enabled   **Yes** or **No** depending on if the operation is enabled or not.

3D Subobjects

A "sub-object" is an object that is a moving part of another object. The 3D operations for this type of object controls the motion of the object relative to its "parent" object, regardless of how that object moves. When this tab is selected the list shows:

3D Subobject The name of the sub-object.

Filename   The filename of the DirectX-file where the object is stored.

Trace

This tab shows a list with the traces enabled for the object. A trace is a "trail" which a moving object leaves behind. The ordering of the traces is not significant.

Color   Shows the color as an RGB-code used for displaying the trace.

Width   The width of the trace.

Position   The starting position relative the center of the object of the trace.

Enabled   Yes or No depending on if the trace is enabled or not.

Light

An object may have one or more lights associated with it. The tab shows some properties of the lights.
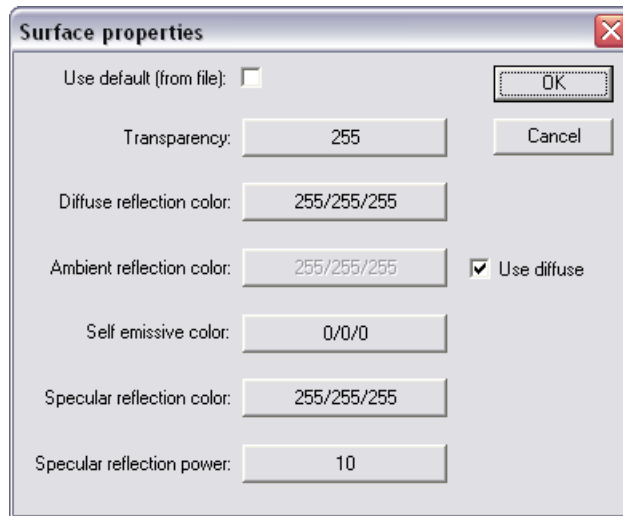
Type   The type of the light. It can be directional, point, or spot.

Enabled   Shows if the light is on or off.

Color   Shows the diffuse color property as an RGB-code of the light.

5.13.2 Surface properties

This dialog is used for controlling the surface appearance of an object. It has no effect on a textured object.

| **Use default (from file)**	When this box is checked, all surface properties are taken from the file in which the object resides.
Transparency	Controls the transparency. It must be a value in the range 0..255, where a higher value means less transparence. A value outside the range 0..255 is clamped to this range.
Diffuse reflection color	This is the diffuse surface colors originating from directional lights.
Ambient reflection color	This is the surface color originating from ambient light.
Use diffuse	When this box is checked, the ambient reflection color is the same as the diffuse reflection color. This is the recommended setting.
Self emissive color	This is the color of a surface that appears to emit light. It is not dependent on any lighting.
Specular reflection color	This is the color of the specular highlights on a shiny surface.
Specular reflection power	This value controls the sharpness of specular highlights. It should be a positive value. The value zero disables specular highlights.

5.13.3 Texture properties

This dialog controls the transparent color for a textured object. It has no effect on non textured objects.
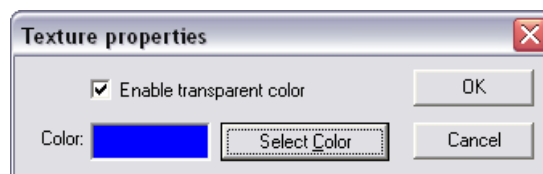
Enable transparent color	If checked, the transparent color is in use.
Color	This color will appear transparent in a texture. The color can be changed by pressing the **Select Color** button.

63

5.13.4 Configure color

The dialog "Configure color" can be opened from various other dialogs to configure a color (as an RGB-code). Both fix and varying colors can be selected.
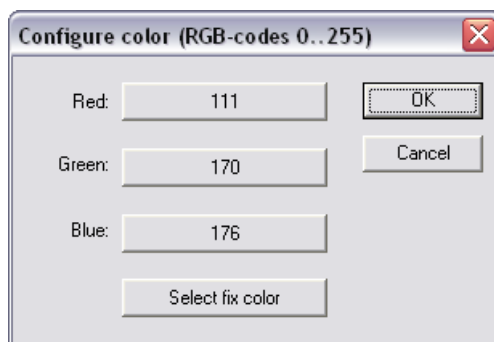
Red, Green, Blue	The buttons opens the dialog for selecting a constant or variable value for each color channel. The value must be in the range 0..255, where higher values means more saturation. A value outside the range 0..255 is clamped to this range.
Select fix color	Opens the select fix color dialog.

5.13.5 Trace on a 3D Object

Trace from a 3D object used in a scene is configured by this dialog box.
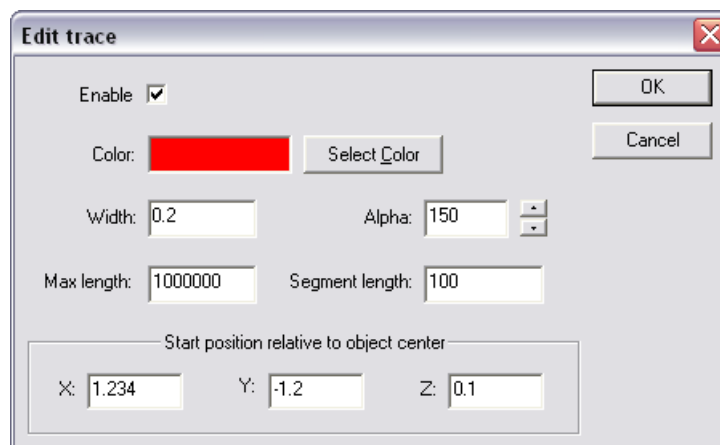
Trace is used for generating a "trail" usually from behind a moving object. It can be used to visualize smoke from an engine or creating a 3D plot of some moving objects. The trace is built automatically from a number of segments. Each such segment is a straight and hollow pipe.

Enable	If checked the trace is visible.
Color	Shows the color of the trace. A new color can be selected with the **Select Color** button.
Width	The width of the trace.
Alpha	This value controls the transparency of the trace. It is the "alpha blend factor" and must be a value in the range 0..255. A value of 255 makes the trace opaque. A smaller value makes the trace transparent.
Max length	The trace can be shorter but not longer than this value.
Segment length	The length of each segment used to build the trace.

X, Y, Z   The starting position relative the center of the object from which the trace emanates.

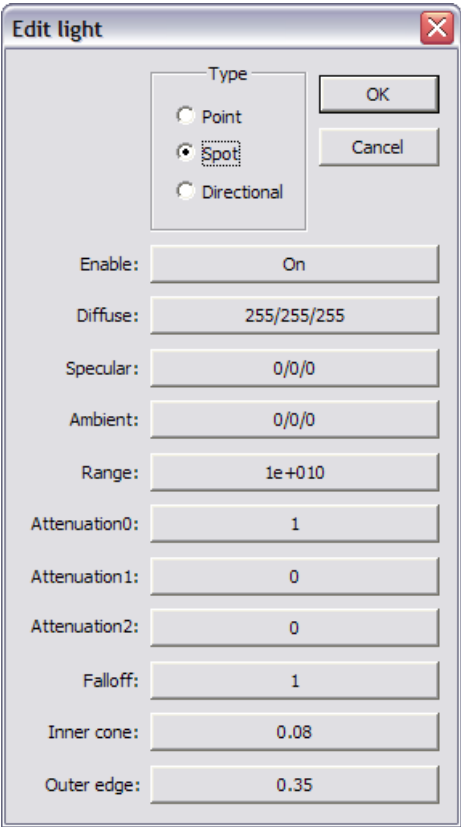### 5.13.6 Light from a 3D Object

This dialog is used for configuring light properties. All lights are attached to an object, which gives the position and direction for the light. The light direction is always the current local X-axis direction of the object (1, 0, 0).

Type   There are tree types of light available. **Point** light radiates evenly in all directions from the position of the object. The direction of the object has no effect. **Spot** light radiates in a cone from the position and in the direction (X-axis) of the object. **Directional** light appears to radiate from a position infinitely far away and in (not from) the direction of the object. The position of the object has no effect.

Enable   Controls if the light is on or off. When this property is set to off, the light does not consume any hardware resources. Use this method to conserve resources rather than setting the colors to black (0, 0, 0) or range to zero.

Diffuse   Sets the diffuse color property of the light.

Specular   Sets the specular color property of the light.

Ambient   Sets the ambient color property of the light.

Range   Distance beyond which the light has no effect. The value is clamped to a positive value. This property is only available for the **Point** and **Spot** light types. Do not set this value to zero to turn of the light, use the **Enable** property instead. Setting this value to zero will still consume hardware resources.

Attenuation Values specifying how the light intensity changes over distance. The values are clamped to positive values. The total attenuation is calculated according to the following formula **1/(attenuation0 + attenuation1*d + attenuation2*d^2)**

where **d** is the distance between the light and the lit object. If **d** is larger than **Range** the total attenuation is zero. This property is only available for the **Point** and **Spot** light types.

Falloff   Decrease in illumination between the inner cone and the outer edge of a **Spot** light source.

Inner cone   Angle, in radians, of a **Spot** lights inner cone — that is, the fully illuminated part of the whole cone. The value is clamped in the range **[0..Outer edge]**.

Outer edge   Angle, in radians, defining the outer edge of a Spot lights cone. Objects outside this cone are not lit by the light. The value is clamped in the range **[0..PI]**.

The available lights in a 3D scene are dependent on the display adapter in the machine AFE is running on. Some lights will not show up in the scene if more lights then available are specified. AFE does not check for this limitation. To manually check how many lights are available on the current hardware, se the capability "Max Active Lights" in the "System Information" dialog.

5.13.7 Copying of 3D Objects

This dialog box is used when making multiple copies of a 3D object.
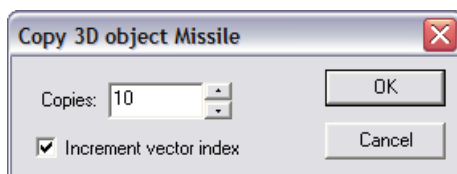
The **Copies** control specifies the number of copies to produce. If the **Increment vector index** check box is checked all vector values used by the object will have their index automatically incremented for each copy made.

5.13.8 Copy 3D Objects from a file

This dialog box is used for selecting and copying 3D objects in the current configuration from another configuration saved in a file.
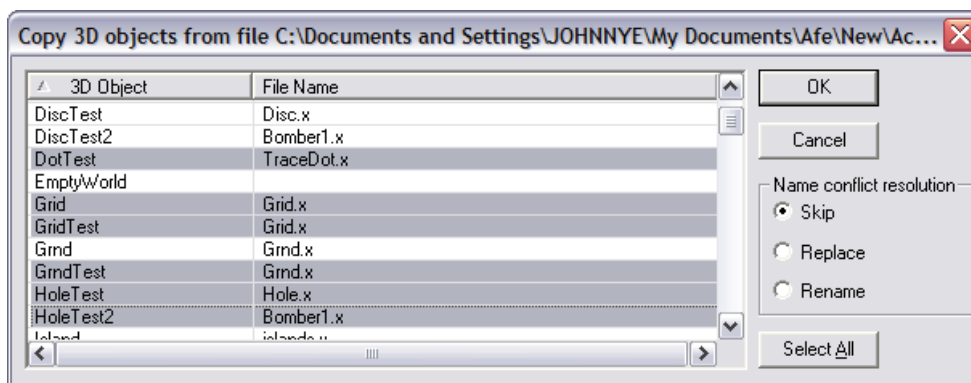
3D Object   The name used for referring to a 3D object in the configuration file that is to be copied from.

Filename   The DirectX file used for storing the object. The content of the file is not copied.

Select All   All 3D-objects in the list are selected.

Name conflict resolution   Controls what happens if a name that is selected is already used in the current configuration.

Skip   The selected 3D object is not copied to the current configuration.

Replace The selected 3D object is copied and replaces the 3D object with the same name in the current configuration.

Rename The selected 3D object is copied to a new name not used in the current configuration.

5.14 Sounds

This dialog box is used for managing sounds used in 3D scenes. It can also be opened from an active 3D scene window by selecting **Sounds** in the right mouse button menu.

Sound The name used for referring to a sound in a 3D scene. It must be unique.

Filename The file used for storing the sound. The file location must be specified in the **Directories** tab in the **Options** dialog. The sound must be stored as a WAV-file.

Embedded Indicates whether the sound is embedded or not.

Copy Make multiple copies of the selected object.

Copy from file Copies sounds from another configuration file.

5.14.1 A single sound

This dialog box is used for configuration of a sound.

Name The name used for referring to a sound in a 3D scene. It must be unique.

Embedded If checked, the content of the sound file is embedded in the configuration file (.AFE).

Filename The name of the file where the sound is stored. The common location for all sound files must be specified in the **Directories** tab in the **Options** dialog. The sound must be stored as a WAV-file (waveform audio). The

filename must only contain the name and the type (extension), the directory path and device unit must be left out. The **Browse** button can be used for changing the filename. If the file is embedded this field is dimmed.

On/Off   This is the value used for control of the sound. The sound is started when the value turns **true** or becomes different from zero, and the sound it stopped when the value turns **false** or becomes equal to zero. By pressing the button the user can select a new value.

Play continuously   When this box is checked the sound plays continuously if **On/Off** turns **true**. If the box is not checked the sound plays to the end or stops when **On/Off** turns **false**, whichever comes first.

5.14.2 Copy a sound from a file

This dialog box is used for selecting and copying sounds from another configuration file into the current loaded configuration.
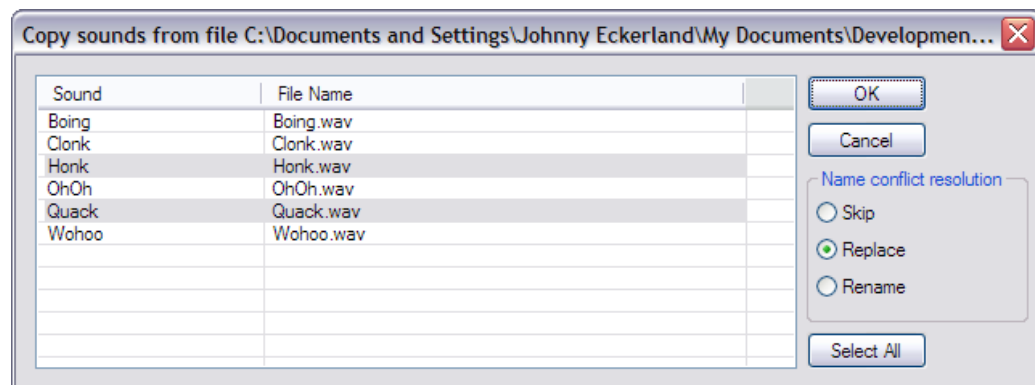
Sound   The name used for referring to a sound in the source configuration file.

Filename   The file used for storing the sound. The content of the file is not copied.

Select All   All sounds in the list are selected.

Name conflict resolution   Controls what happens if a name that is selected is already used in the current configuration.

Skip   The selected sound is not copied to the current configuration.

Replace   The selected sound is copied and replaces the sound with the same name in the current configuration.

Rename   The selected sound is copied to a new name not used in the current configuration.

5.15   Management of result windows

This dialog box is used for configuring what is displayed in the dialog box "Select Window(s)".
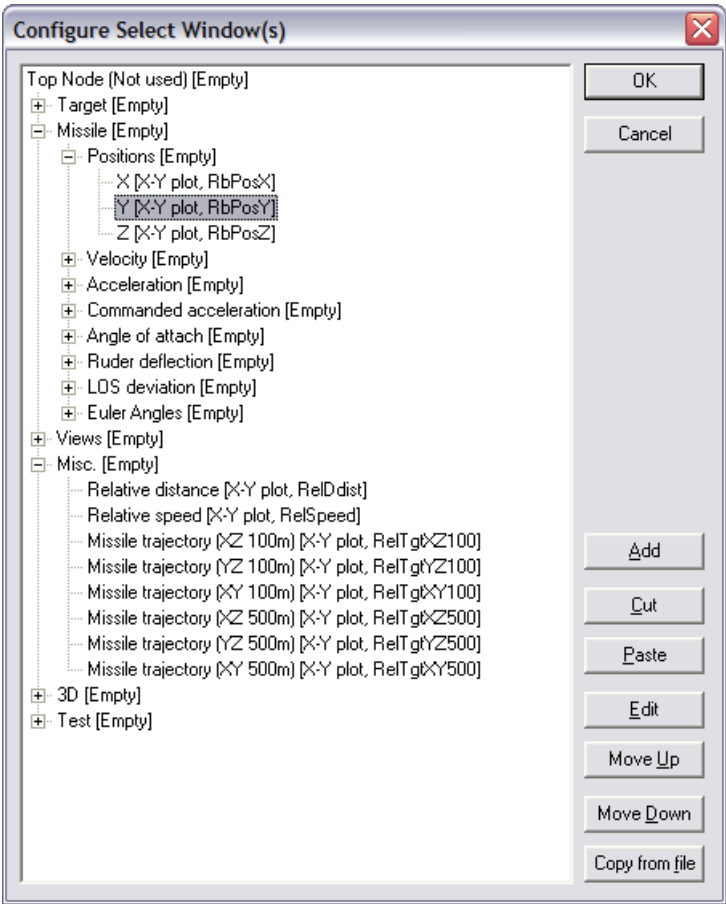
Each node in the tree control represents a result window that can be opened with the dialog box "Select Window(s)".

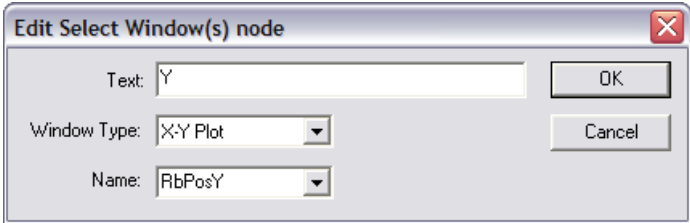**Cut**   Remove the selected node. The last removed node is saved for possible use by **Paste**.

Paste   Insert the last removed node as the first child of the selected node.

Copy from file   Copies "Select Window(s)" information from another configuration file.

5.15.1 Managing a single result window

This dialog box is used for editing a single node in the "Select Window(s)" dialog box.

Text   The node label to be displayed to the user.

Window Type   The type of result window associated with this node.

Name   The name of the result window.

### 5.15.2 Copying management information from a file

This dialog box is used for copying "Select Windows(s)" information to the current configuration from another configuration file.
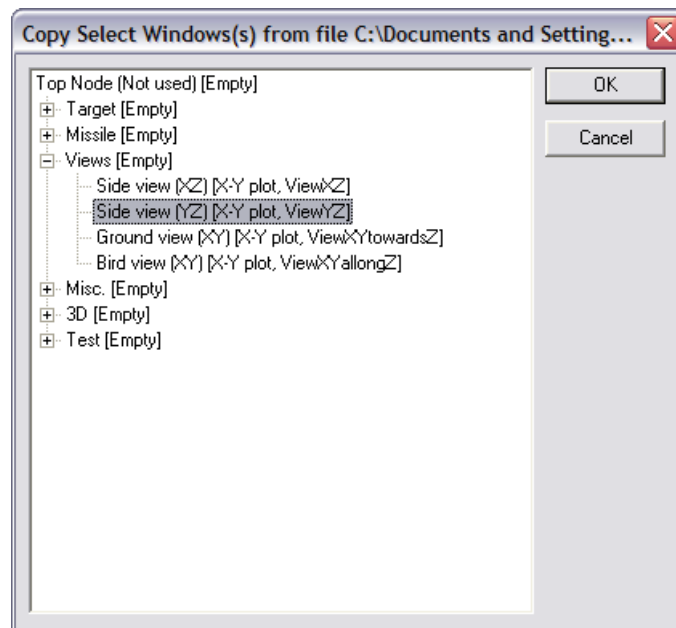
The selected node, or tree, is inserted as a child node to the node selected in the "Configure Select Windows(s)" dialog box when the **OK** button is selected.
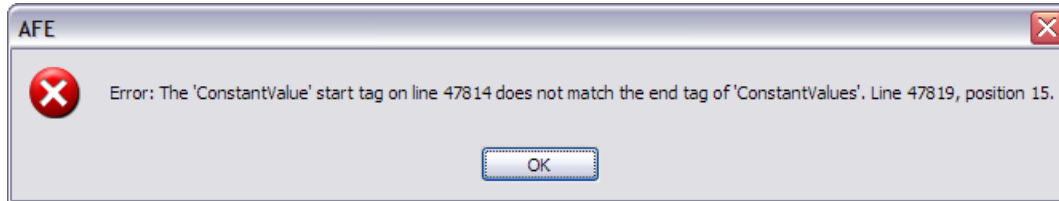
5.16 Configuration errors

This window shows a list of configuration errors, if any.
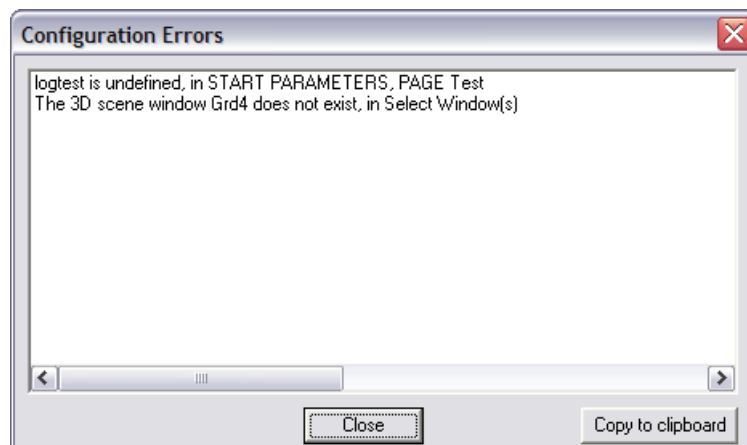
The configuration errors describe the discrepancies between how AFE is configured and which data (variable names) are available in the simulation model. It also shows if any names of result windows are used but not defined. The window is automatically displayed when AFE is reconfigured if there are any errors present. If a value is used but not defined its value is zero. If a name of a result window is used but not defined, nothing happens if the window is opened. The button **Copy to clipboard** copies the list of configuration errors to the clipboard.

If the configuration file is in XML-format, there may be parsing errors.

If a parsing error occurs the loading is aborted.

There may also be "Load Warnings" if the configuration file is in XML-format.
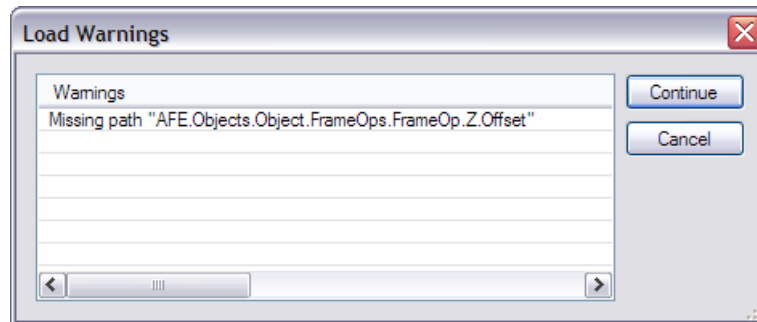
If the loading is continued the missing data will be filled with a default value.

5.17 Demands on the simulation model

For AFE to be able to run a simulation model, it must at least conform to the following demands:

- Simple run time errors such as; divide by zero, indexing outside of arrays, trying to open non-existing files, etc. must not occur. AFE is not designed to handle such severe errors.

- The model internal time must not be reset; i.e. the model must not run more than one simulation for every start command.

- It must be possible to run the model several times without restarting or reloading the model.

- If the model opens and read internal files the file names must not be hard coded, i.e. the model must not be dependent on from which directory it is run. (Relative path names are OK).

- The model should not have any accumulating result files that are not automatically removed after a simulation.

5.18 The INI file

The INI file can be supplied through a single command line argument. If no command line argument is given, AFE searches for the file AFE.INI on the current directory. If AFE.INI is not found on the current directory, a default AFE.INI on the installation directory is used.

The format used in the INI file follows the normal Windows standard with section names between brackets followed by a number of entries. The following definitions are defined:

Section **[DIRECTORIES]**

The entries contain paths to various directories that AFE may need. They are maintained and updated automatically by the program. They should not be altered directly by the user.

Section **[INIT]**

This section stores information that affects how AFE behaves when started. Entries are maintained and updated automatically by the program. They should not be altered directly by the user.

Section **[OPTIONS]**

This section may contain a number of entries used to save the contents of the "Options" dialog box. Values should not be altered directly by the user. To restore the default settings, exit AFE and remove these entries from the INI file and then restart AFE.

6 APPENDIX A: ACSL 11

This appendix provides additional information on how to use an ACSL 11 simulation model from AFE.

6.1 General information

AFE uses the "ACSL Open Api" interface to run the model. This means that ACSL 11 do not need to be installed on the target machine. ACSL 11 is not used by AFE.

6.2 Model files

The model files that must be made available to AFE are:

The **.AFE** file used by AFE.

The **.PRJ** file maintained by ACSL 11.

The **.PRX** file generated by ACSL 11.

The **.CMD** file if the model is dependent on it. This file must not contain any **START** command.

Any other files the **.PRX** and **.CMD** file is dependent on.

In the "Configure simulation model" dialog the **.PRJ** file must be specified as the "Model file" and, the "Language binding" selection set to "Acsl 11", see **5.1 The model files**.

7 APPENDX B: AcslXtreme 2

This appendix provides additional information on how to use an AcslXtreme 2 simulation model from AFE.

7.1 General information

AFE uses the "C-language callable native API" interface to run the model. This means that AcslXtreme 2 does not need to be installed on the target machine. AcslXtreme 2 is not used by AFE, only the generated simulation model is used (i.e. the .DLL –file).

7.2 Model files

The model files that must be made available to AFE are:

The **.AFE** file used by AFE.

The **.DLL** file generated by AcslXtreme 2.

Any other files the **.DLL** file is dependent on.

In the "Configure simulation model" dialog the **.DLL** file must be specified as the "Model file" and, the "Language binding" selection set to "AcslXtreme 2", see **5.1 The model files**.

8 APPENDIX C: MATLAB 7

This appendix provides additional information on how to use MATLAB 7 from AFE.

8.1 General information

MATLAB 7 must be installed on the machine. The communication between MATLAB 7 and AFE is all done through MATLAB 7 workspace variables. Some of these variables are predefined, and some are specified in MATLAB 7 **.M** files. A simple example running a Simulink simulation is provided as a starting point.

8.2 Model files

The files that must be made available to AFE are:

The **.AFE** file used by AFE.

The **.M** files **AFE_LOAD_SIMULATION.M**, **AFE_UNLOAD_SIMULATION.M**, **AFE_BEGIN_SIMULATION.M**, **AFE_STEP_SIMULATION.M** and **AFE_END_SIMULATION.M**. These files are used by AFE to control the simulation.

All other files needed to run the simulation from MATLAB 7.

In the "Configure simulation model" dialog, one of the model files must be specified as the "Model file" and, the "Language binding" selection set to "Matlab 7", see **5.1 The model files**.

8.2.1 The AFE_LOAD_SIMULATION.M file.

This file is executed once when MATLAB 7 is started from AFE. It must do the following:

Prepare the simulation model for operation.

Assign default values of correct type for all variables AFE is intended to have knowledge of.

Assign the variable **afe_time_variable** to the name (a string) of the time variable. This variable tells AFE which workspace variable represent the time in the simulation model.

Before **AFE_LOAD_SIMULATION.M** is executed AFE does the following:

The workspace variable **afe_model_file_name** is assigned the "Model file" set in the "Configure simulation model" dialog.

The current directory in MATLAB 7 is set to the directory in the "Model file".

After **AFE_LOAD_SIMULATION.M** has executed AFE does:

Information of available workspace variables is collected. This information can be viewed in the "Select model variable" dialog, see **5.4.2 Selecting a new variable form the model**.

All values of variables defined in AFE as start parameters are collected. These values can be viewed in the column "Model Value" in the "Start parameters" dialog when the "Show More" button is pressed, see **4.6 View and edit start parameters**.

8.2.2 The AFE_UNLOAD_SIMULATION.M file.

This file is executed once before MATLAB 7 is shut down from AFE. Its intended use is for cleaning up operations, such as deleting any temporary files which may have been generated during simulation.

8.2.3 The AFE_BEGIN_SIMULATION.M file.

This file is executed once before every started simulation. It must do the following:

Prepare the simulation model for execution.

Calculate and assign any extra initial values to variables.

Assign the variable defined by **afe_time_variable** to the start time.

Assign all variables intended to be collected by AFE values corresponding to the start time of the simulation. This may include calculating output values from the model at the start time.

Before **AFE_BEGIN_SIMULATION.M** is executed AFE does the following:

All start parameter values in use in the "Start parameters" dialog is assigned to the corresponding MATLAB 7 workspace variables. This may be subset of the available variables.

After **AFE_BEGIN_SIMULATION.M** has executed AFE does:

The value of the variable described by **afe_time_variable** is collected.

All variable values intended to be collected by AFE are collected. This is the simulation output corresponding to the start time of the simulation.

8.2.4 The AFE_STEP_SIMULATION.M file.

This file is executed repeatedly during a simulation. It must do the following:

Execute the simulation to the next time output data is to be collected. This may include more than one simulation time step.

Update the variable defined by **afe_time_variable** to the current simulation time.

Assign all variables intended to be collected by AFE to values corresponding to the current simulation time.

Assign the workspace variable **afe_continue** to the logical value **true** (1) if the simulation should continue, and to **false** (0) otherwise.

Before **AFE_STEP_SIMULATION.M** is executed AFE does the following:

The workspace variable **afe_step_no** is assign to the current step number.

After **AFE_STEP_SIMULATION.M** has executed AFE does:

The value of the variable described by **afe_time_variable** is collected.

All variable values intended to be collected by AFE are collected. This is the simulation output corresponding to the current time of the simulation.

The value of the workspace variable **afe_continue** is collected. If this value is **false** (0), the simulation is considered to be finished.

8.2.5 The AFE_END_SIMULATION.M file.

This file is executed ones when a simulation has finished. It must do the following:

Calculate and assign all variables intended to be collected by AFE after a simulation.

Perform any necessary cleanup operations after the simulation has finished.

After **AFE_END_SIMULATION.M** has executed AFE does:

All variable values intended to be collected by AFE after a simulation is collected. This is the final simulation result.

9 REFERENCES

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[ACSLXTREME] acslXtreme for Windows, Version 2.4, 2007, Xcellon – The Aegis Technologies Group, Inc., USA.

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[DIRECTX] DirectX SDK 9.0, 2008, Microsoft Corporation USA.

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[AFE 1.1] AFE 1.1 - Ett generellt grafiskt användargränssnitt för simuleringsmodeller, FOA-R--97-00424-616--SE, ISSN 1104-9154, 1997, in Swedish.

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