



HOOD User's Guide

A Manual for End Users of HOOD Applications

Roderick Affleck

Eric Thornhill

David C. Heath

Defence R&D Canada – Atlantic

Technical Memorandum

DRDC Atlantic TM 2005-177

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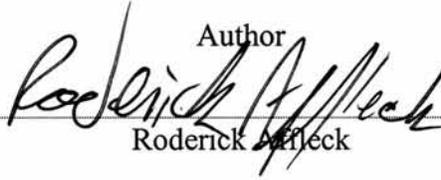
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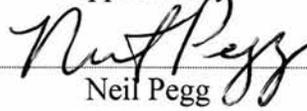
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Author

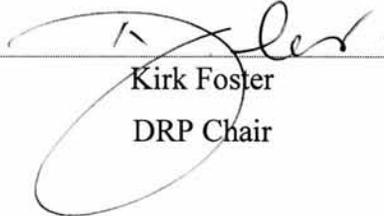

Roderick Affleck

Approved by


Neil Pegg

Section Head (Warship Performance)

Approved for release by


Kirk Foster
DRP Chair

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Abstract

The Hierarchical Object Oriented Developer's Toolkit (HOODTK or simply HOOD) is a large database of C++ code created by the Virtual Naval Platforms group at Defence Research and Development Canada – Atlantic for use in developing engineering software applications. This manual addresses many of the features common to all HOOD applications. The intended audience is first time users, as well as those who may have only limited experience with HOOD applications. It explains the basic functions common to all applications developed with HOOD and provides step by step instructions for some of the more complicated operations.

Résumé

La trousse du développeur utilisant la méthode de spécification orientée objet (Hierarchical Object Oriented Developer (HOODTK ou simplement HOOD) consiste en une base de données importante de code C++ créée par le groupe Plateformes navales virtuelles de Recherche et développement pour la défense Canada – Atlantique pour le développement d'applications d'ingénierie. Ce manuel aborde un grand nombre des fonctions communes à toutes les applications HOOD. Il s'adresse d'abord aux nouveaux utilisateurs ainsi qu'à ceux qui ne possèdent qu'une expérience limitée des applications HOOD; il contient des détails sur les fonctions de base communes à toutes les applications développées avec HOOD ainsi que des instructions détaillées concernant l'exécution d'opérations plus complexes.

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Executive summary

Introduction

The Hood User's Guide is a reference document for end users of HOOD-based applications. The intended audience includes DRDC staff, members of the Canadian Department of National Defence, and a wide range of collaborators and clients in Canada and worldwide.

Results

The features and instructions outlined in this users guide reflect the current functionality of HOOD applications. Topics discussed include basic application layout, common toolbar and menu options, model viewport manipulations, creating AVI video captures, scene graph layout and setting look-at points.

Significance

HOOD has become sufficiently capable and complex that a user's manual for applications is necessary. This document will help users in navigating some of the common features and operations of HOOD-based applications. It will be included with all installation packages for both internal use and for external clients.

Future plans

The HOODTK is a constantly evolving code database; enhancements are continually made as required. As a result future revisions will be provided in order that the manual stays up to date and is an accurate reference for future HOOD applications.

Affleck, R.A., Thornhill, E., Heath, D.C. 2005. HOOD User's Guide: A Manual For End users of HOOD Applications. DRDC Atlantic TM 2005-177. Defence R&D Canada – Atlantic.

Sommaire

Introduction

Le Guide de l'utilisateur de HOOD est un document de référence destiné aux utilisateurs finals des applications HOOD. Il est destiné au personnel de RDDC, au personnel du ministère de la Défense nationale du Canada et à une gamme variée de collaborateurs et de clients, tant au Canada qu'à l'étranger.

Résultats

Les caractéristiques et les instructions qui figurent dans ce guide de l'utilisateur prennent en compte les fonctionnalités courantes des applications HOOD. Les sujets qui y sont traités comprennent la documentation de base sur les applications, les options de menu et les barres d'outils communes, la manipulation de fenêtres modèles, la création de saisies d'image AVI, la présentation graphique de lieux et la définition de points de visée.

Portée

En raison du potentiel atteint par HOOD et de son niveau de complexité, il est aujourd'hui nécessaire de rédiger un guide de l'utilisateur pour les applications. Ce document permettra aux utilisateurs de naviguer plus facilement parmi certaines des fonctions et opérations les plus courantes des applications HOOD. Ce guide sera intégré à toutes les troussees d'installation, tant pour les utilisateurs à l'interne que pour les clients de l'extérieur.

Recherches futures

HOODTK constitue une base de données de code en constante évolution, faisant l'objet d'améliorations régulières, selon les besoins. En conséquence, le guide sera révisé de façon à être maintenu à jour et à constituer une référence exacte en ce qui concerne les applications futures de HOOD.

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1. Introduction

This document provides a basic introduction to using applications written with the HOOD architecture. It discusses features and options that are common to all HOOD applications.

The Hierarchical Object Oriented Developers Toolkit (HOOD TK, also known simply as HOOD) was designed to be a software library for creating modeling and simulation applications containing graphical, interactive, and analytical components. The library is built upon the sound principles of object oriented programming and design, with its main goals being to accelerate software prototyping and development, promote code reuse and promote consistent end-user interfaces across developed applications.

One of the results of this approach is that applications written using HOOD all have a common look and feel. Many options are automatically available in every application. Among other things, this is beneficial to the end user because it makes learning to use new applications easy once they have an understanding of the basic parts of a HOOD application and how to perform certain actions.

The intent of this document is to explain many of the features of HOOD for first time users. Although specific applications are mentioned in some examples, it is not geared toward a particular HOOD application, but applies to any program written in HOOD.

2. Layout

There are several main areas in a HOOD application. The window can be roughly divided into the menu and toolbars, the scene graph tree, and the main view space (also known as a viewport). An example of this can be seen in Figure 1, where the top and left-most rows and columns contain the menus and toolbars; the scenegraph tree shows the “Object Browser” with object “Precal Hull Stations”; and the viewport shows a window labelled “Dop.pcv”.

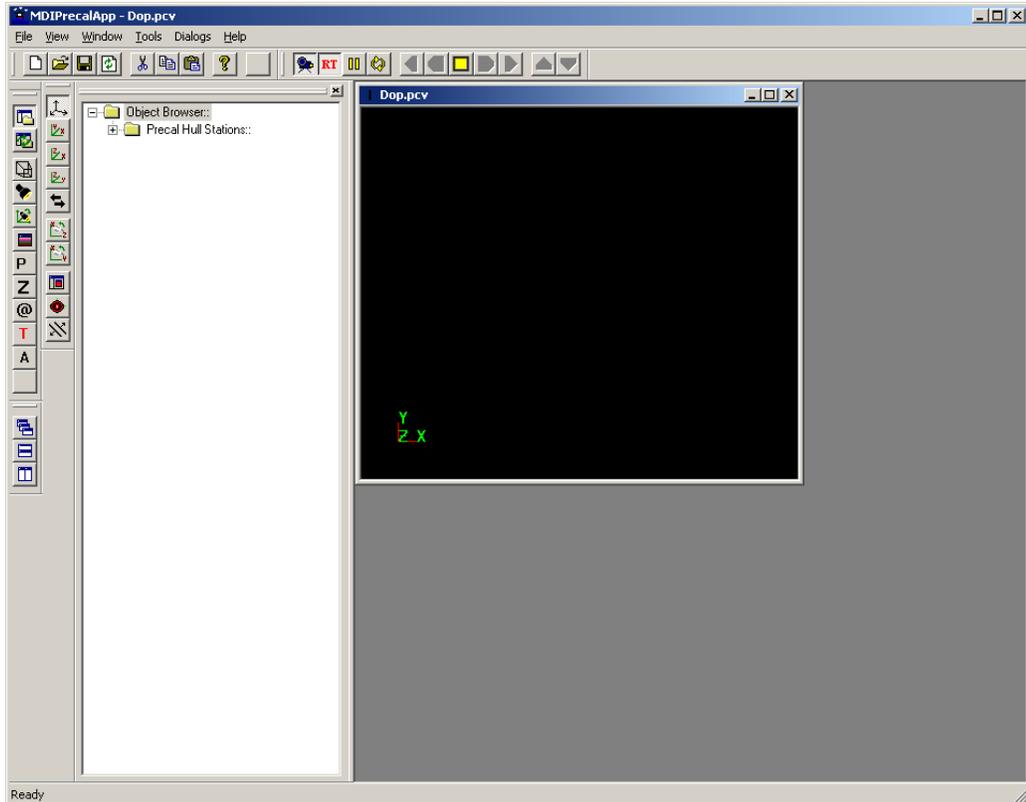


Figure 1: An example of a HOOD Application

The HOOD architecture allows for multidocument interfaces, or MDIs. These are applications in which several “documents” (such as models, datasets, etc.) can be opened up and viewed simultaneously, as shown in Figure 2. Any given document can have multiple view windows opened up at the same time as well, as shown in Figure 3. In addition, a MDI application can be designed so that it can open up multiple types of documents; thus it is feasible that an application could be written that contains both the

VShip visualizer [1] and PROVIDE [2] applications. Alternatively, a single document interface (SDI) does not allow for subwindows of this nature.

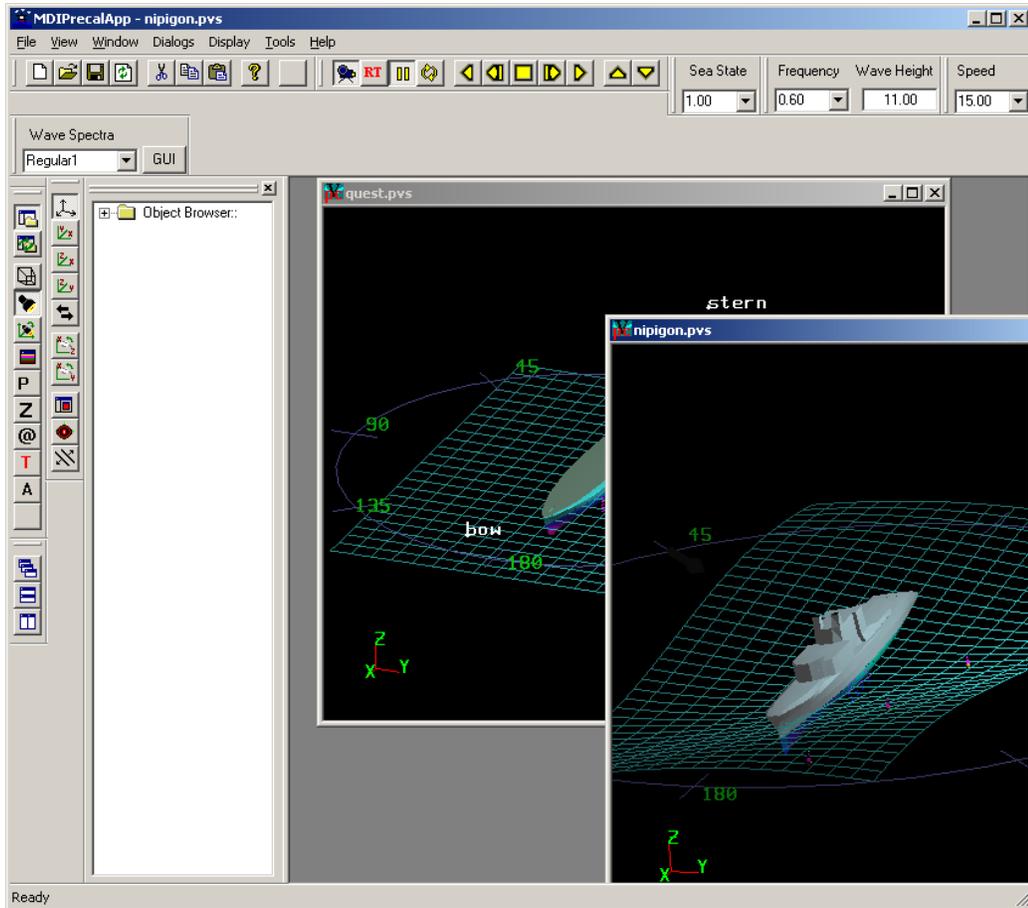


Figure 2: MDI application with two open documents

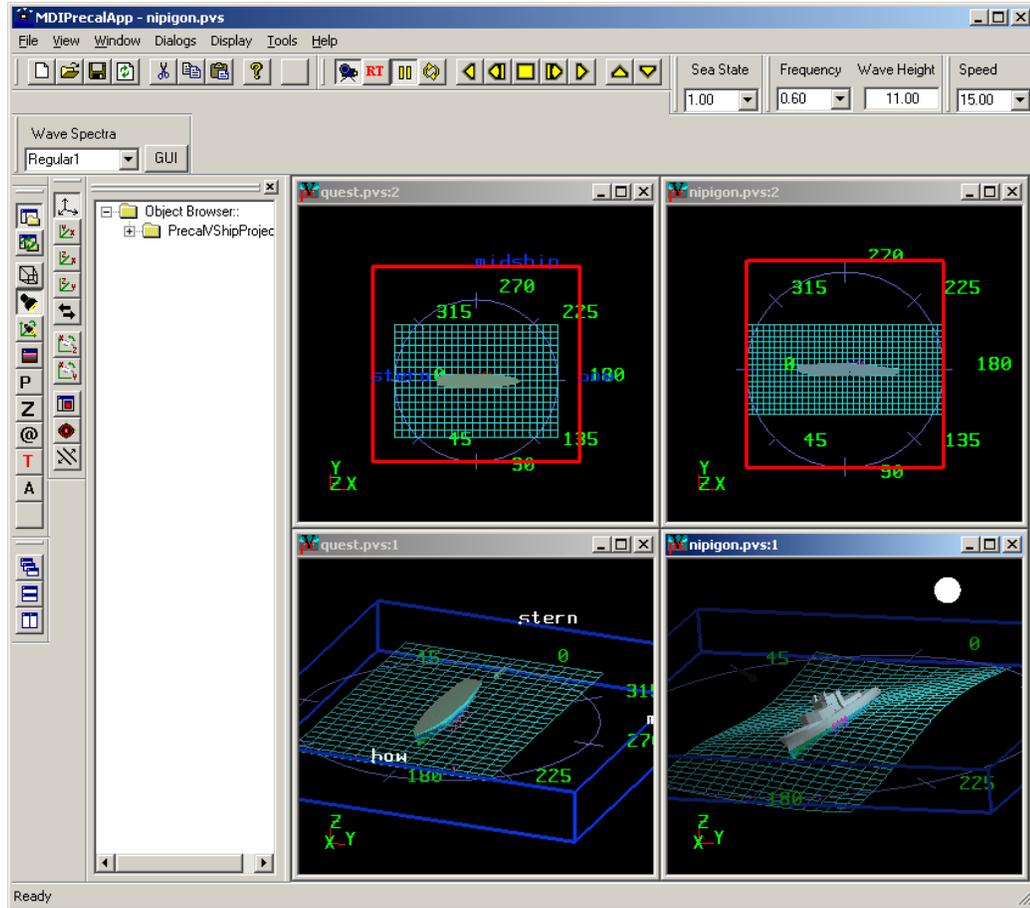


Figure 3: MDI application showing several views of the same document.

3. Initial Setup

Before beginning to use a HOOD program, the user may wish to set some of the application options by using the dialog found in Tools → Application Options..., as shown in Figure 4. Once these options are set, they are saved in an initialization (.ini) file in the Windows system32 directory. This initialization file and the options stored in it will be used each time the program is run.

Under Start Up Options, the following options can be set:

File Start Up Mode	None - application starts with no files loaded
	StartFile - application starts with file listed in 'Start Up File Name'
	LastFile - application starts with last file viewed in VShip
Calling App	shows if the application was launched by another program
Standalone	resets the 'Calling App' to 'none'

Under View Settings, and 'Mouse Response Factor' are settings for the increments in pixels that are needed to initiate a zoom, rotation, or translation operations with the mouse. How to actually perform these model manipulations is discussed in Section 4. The 'Mouse Pixel Increment' sets the sensitivity of the mouse scroll wheel (also used for zoom operations). The 'Mouse Pixel Move Tolerance' sets how far the mouse must move before an object moves. Under the 'Motion Draw Type' dropdown box are several options for how the display behaves during a zoom, move, or rotate operation. In many HOOD applications, only two options, 'Bounding Boxes' (objects are replaced by wire-frame boxes) and 'Same as Drawn' (no change to objects), are functional.

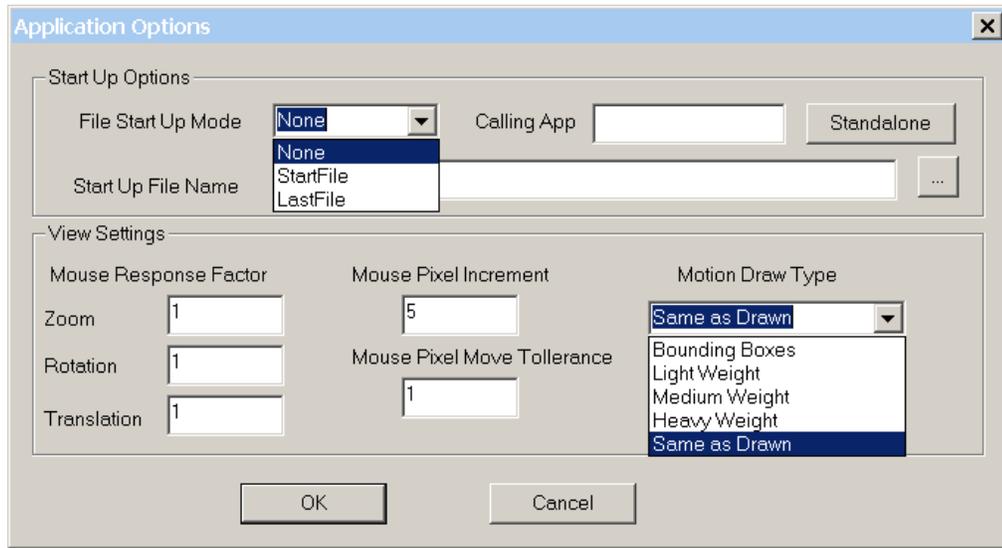


Figure 4: Application Options

4. Mouse Actions

The HOOD application environment enables the user to change the view and manipulate the model using mouse actions. The following is a list of available actions.

Change the angle of view	Move mouse so that pointer is on the model, hold the left mouse button down, and move the mouse.
Centre the view on a specific point on the model	Double right-click on the point of the model on which you wish to centre.
Zoom in	If using a mouse with a scroll wheel, move the mouse pointer to the view window and scroll down using the wheel. Alternatively, move mouse so that pointer is on the model, hold the right mouse button down and move mouse downward. Or, use the “Page Down” key on the keyboard.
Zoom out	Move the mouse pointer to the view window and scroll up using the scroll wheel. Alternatively, move mouse so that pointer is on the model, hold the right mouse button down and move mouse upward. Or, use the “Page Up” key on the keyboard.
Translate (Pan) view up/down/left/right	Move mouse so that pointer is on the model, simultaneously hold down the “Shift” key on the keyboard and the left mouse button, and move mouse.
Bring up the properties page for the object	Double-click on the object. If several objects overlap or it is otherwise unclear which object the user is selecting, a dialog box will appear with possible objects. Select the desired object from this list.

5. Menus and Toolbars

5.1 Menus

Individual HOOD applications will typically have special menus for application-dependent actions. This means that the menu options available will vary depending on what type of application is currently active. Switching between active applications in a MDI may also change the menu bar simultaneously. Figure 5 and Figure 6 show two different menus that occur in the application MDIPrecalApp[3].

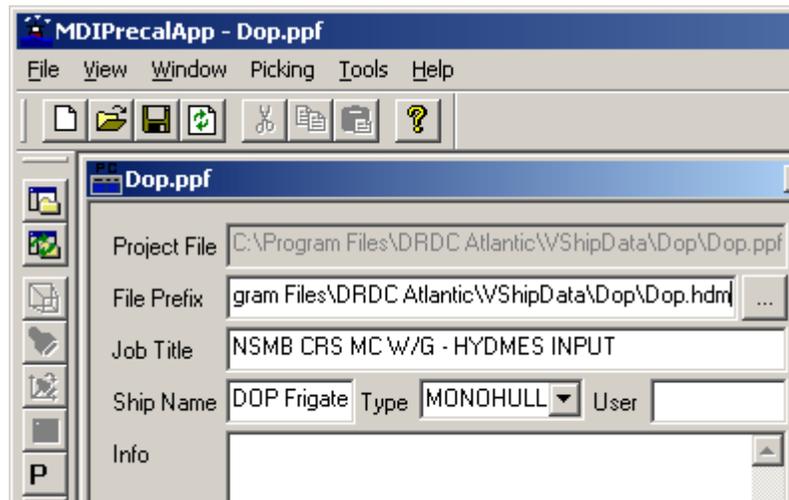


Figure 5: The PRECAL GUI default menu bar.

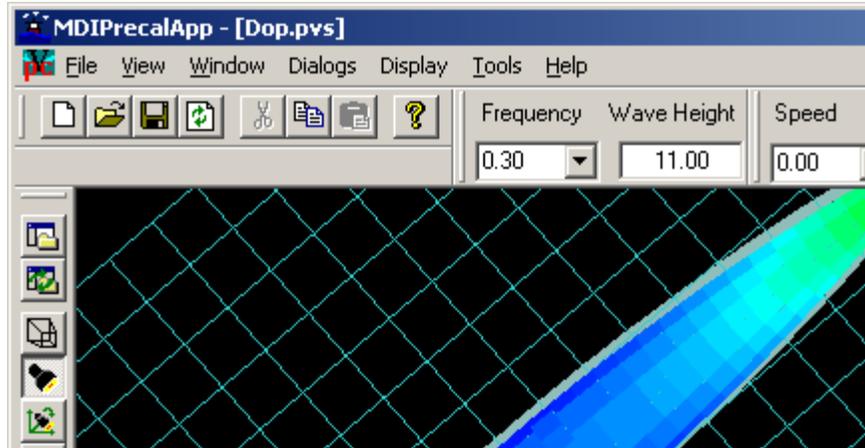


Figure 6: The VShip menu in the PRECAL GUI.

5.2 Common Menu Options

The File menu (see Figure 7) contains options for opening, closing and saving documents. It also lists the four files most recently opened by the application.

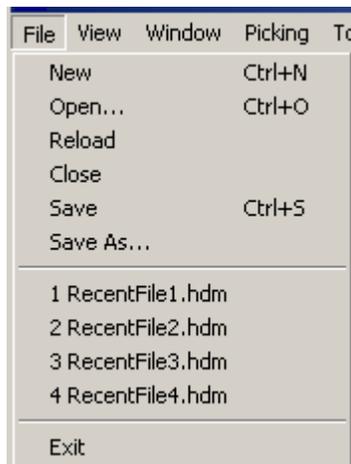


Figure 7: File Menu

The View menu (see Figure 8) enables the user to display or remove several viewing options.

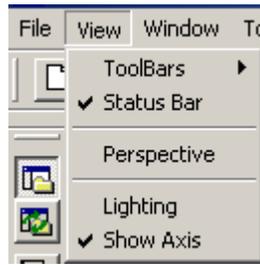


Figure 8: View Menu

ToolBars	Toolbars brings up a sub menu of the various tool bars that are available in the application. Selecting this has the same effect as right-clicking with the mouse in the toolbar area.
Status Bar	The status bar is the bar at the bottom of the main application window. It often provides messages of the state of the program, or displays additional information on some of the options (eg. when moving the mouse over some of the toolbar options.)
Perspective	Changes the model drawing perspective. Has the same effect as the Perspective button on the View toolbar described in Section 5.3.2.
Lighting	Turns lighting on and off. Has the same effect as the Toggle Lighting button on the View toolbar described in Section 5.3.2.
Show Axis	Displays or removes the axis legend in the view window. Has the same effect as the Toggle Axis button on the View Plane toolbar described in Section 5.3.3.

The Window menu (see Figure 9) gives various options for arranging the various windows in an MDI application.

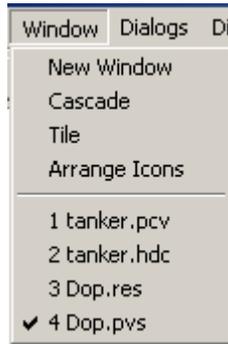


Figure 9: Window Menu

New Window	Creates a new view of the currently selected model.
Cascade	Arranges all windows in a cascaded order so that each window's title bar is visible.
Tile	Tiles all windows and resizes them so that they are all completely visible.
Arrange Icons	Arranges all minimized windows at the bottom of the main window.

The menu also has a list of all of the open documents, and allows the user to select one of them to bring it to the top. The document with the check mark beside it is the currently selected window.

The Tools menu (see Figure 10) contains one or more selections for tweaking the behaviour and appearance of the application. Often the only item in the menu is Application Options. This will bring up the dialog discussed in the “Initial Setup” section. Other applications may have other items available here.

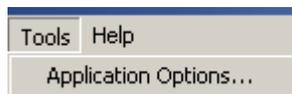


Figure 10: Tools Menu

5.3 Toolbars

Toolbars in HOOD applications can be toggled on/off by right-clicking the mouse over any grey toolbar area. This will bring up a list beside the mouse pointer of the available toolbars with checkmarks indicating which are active and which are hidden, as shown in Figure 11. Once this list is displayed, the checkmarks can be toggled with the left mouse button, causing toolbars to appear or disappear. Items on toolbars that cannot function because of current data or settings will automatically be 'greyed' out. Toolbars can also be undocked, moved and re-docked in different locations by clicking on the grey part of the toolbar and holding down the left mouse button while relocating. The layout of toolbars will be preserved the next time the HOOD application is run; however, each individual HOOD application will preserve its own settings. Thus for example, changing the layout of the application VShip will have no effect on the layout of the application Provide.

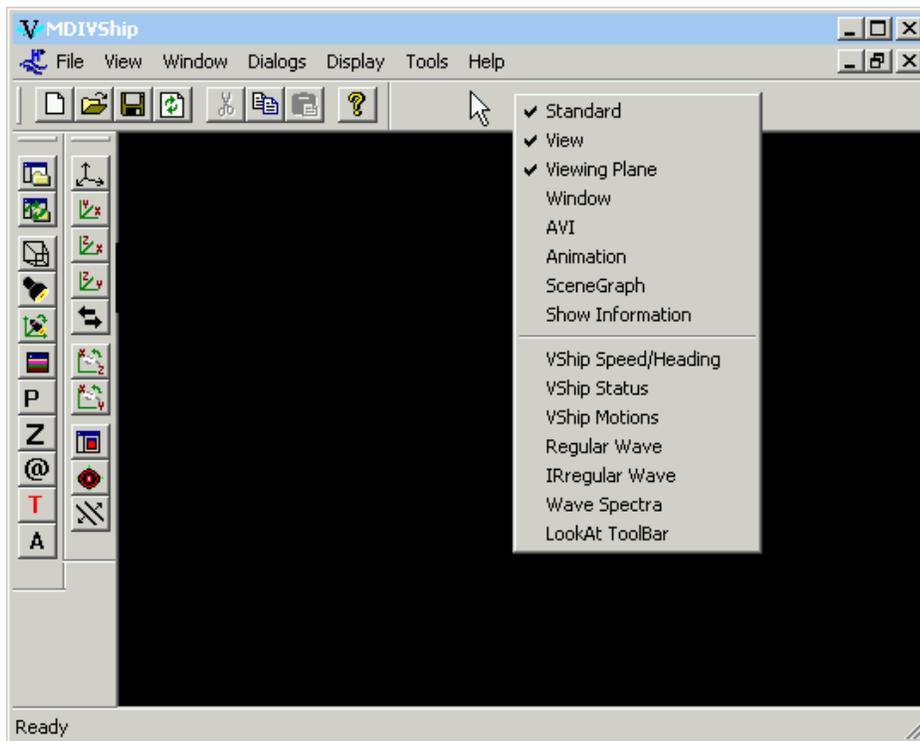


Figure 11: Toggling Toolbars

In some applications the toolbar list will be divided into two sections. The first section is the list of toolbars common to all HOOD applications. Those listed below the divider are toolbars specific to a particular application.

5.3.1 Common Toolbars

The standard toolbar (see Figure 12) provides a number of common file, edit and help functions.



Figure 12: The Standard Toolbar

New	Start a new document/project. If it's an MDI application, this will bring up a dialog with a list of possible document types that can be opened.
Open	Open an existing document/project.
Save	Saves the current project.
Reload	Reloads from file without saving (any changes to the project since last saving will be lost, although the current viewing position is maintained.)
Cut	Cuts a selected item (work in progress.)
Copy	Copies a selected item or the entire project (work in progress.)
Paste	Paste copied item (work in progress.)
Image Copy	Copies the image in the active view to the clipboard. This image can then be pasted into any external application that can accept images (eg Microsoft Word, Photoshop, etc.)
Help	Brings up a help page.

5.3.2 View

The View toolbar (see Figure 13) contains several of the application appearance controls.



Figure 13: The View Toolbar

Toggle SG Toolbar	Turns on the display of the Scene Graph toolbar/tree. The Scene Graph is described in Section 6.
Refresh SG Toolbar	Refreshes the appearance of the Scene Graph toolbar, in the event that a change was made to the model that is not yet reflected in the scene graph.
Perspective	Toggles the display of the model between “design” and “real world” perspective. In design perspective mode, all horizontal and vertical dimensions appear the same across the model regardless of how far away they are in the z-axis (the axis perpendicular to the computer monitor). In real world perspective mode, those parts of the model that are farther away appear smaller.
Toggle lighting	Turns lighting of the model on and off. When lighting is off, the model is still normally visible, but there is no shading or shadows on the model. If one doesn’t already exist, a “GlobalLight” object is created and added to the scene graph when lighting is turned on.
Display GlobalLight GUI	Brings up the dialog page for the lighting. This dialog allows the user to modify the source position and colour of the light.
Toggle Rotate lighting/model	Changes mouse action between rotating the model (default) and rotating the light source. This is useful for highlighting

	certain portions of the model.
Background Colour	Sets the background colour of the model view area (default is black).
Picking GUI	Brings up the Object Picking Interface. This dialog allows the user to select the various criteria and display options used for picking objects in the view area.
Zoom Window	Allows the user to select an area of the model and zoom in on that area.
Window/Node Event Mode	Changes the default behavior for certain viewable objects (nodes). Some nodes have the ability to accept mouse actions and respond to them in a special way. In such cases, this button is used to tell the window to ignore the messages from the mouse (thereby rotating/zooming/etc. the model) and passing the messages directly to the node. This feature is node specific, and not every node has this capability.
Turbo Window	Increase the frame rate for drawing animation/movements in order to take advantage of idle CPU cycles (if any). Results in smoother/faster movements.
Create Arena Object	Creates background “arena” for seascape/skyscape/ other. This is essentially a means of creating a realistic looking environment for the model. Currently available environments include a half-globe and a full globe with offset centre to avoid gaps at the sky-water interface.

5.3.2.1 Changing Background Colour

Clicking the ‘Background Color’ button on the ‘View’ toolbar will bring up a dialog (shown in Figure 14) which can be used to set the background colour for the visualization. Three options are available: Solid background, blended colours from corners, and image from file. The colour buttons adjacent to the first two options can be clicked to produce a colour menu for selecting new colours. A jpeg image can also be used in the background by specifying its location.

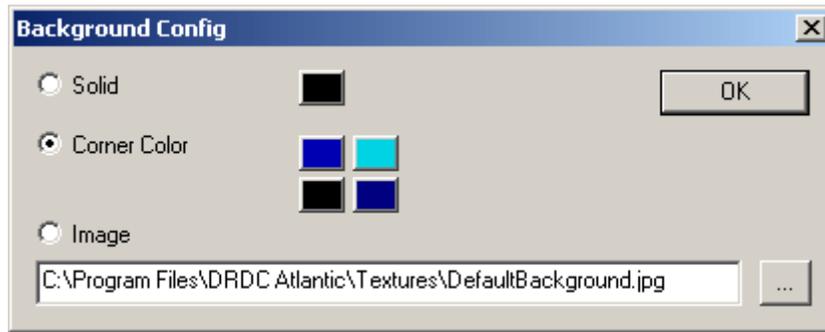


Figure 14: Background Colour Dialog

5.3.3 View Plane

The View Plane toolbar (see Figure 15) contains several tools for viewing and controlling the manipulation of the model



Figure 15: View Plane Toolbar

Toggle Axis	Display or remove the axis orientation icon in the bottom left corner of the view area.
XY Plane	Align the model so that the XY plane is parallel to the monitor screen.
ZX Plane	Align the model so that the ZX plane is parallel to the monitor screen.
ZY Plane	Align the model so that the ZY plane is parallel to the monitor screen.
Invert Plane	Used in conjunction with the plane buttons to give an additional three viewing axes.

XY -> ZX axis	Sets the mouse rotation mapping so that mouse movements in the screen's X-direction correspond to model rotations about the model's Z-axis, and movements in the screen's Y-direction correspond to model rotations about the model's Y-axis (default).
XY -> YX axis	Sets the mouse rotation mapping so that mouse movements in the screen's X-direction correspond to model rotations about the model's Y-axis, and movements in the screen's Y-direction correspond to model rotations about the model's X-axis.
Reset View	Resets the orientation of the model to the position it was in when first loaded or created.
Select New Centre Point	Allows the user to set the point in space about which the model is rotated.
Adjust Clip Planes	Allows the user to set the points in the screen's Z-direction at which the viewing area is clipped. Useful for blocking portions of a model in front of/obscuring the area of interest of a model.

5.3.4 Window

The Window toolbar (see Figure 16) contains buttons for arranging all windows in a multidocument interface.



Figure 16: Window Toolbar

Cascade Windows	Arrange windows in cascaded form, so that the windows overlap but each title bar is visible.
Tile Windows Vertically	Arrange so that all windows are completely visible, and are positioned one on top of the other.
Tile Windows Horizontally	Arrange so that all windows are completely visible, and are positioned adjacent to each other.

5.3.5 AVI

The AVI toolbar (see Figure 17) contains controls for creating Audio Video Interleave format video captures of the view window.

New	Creates a new AVI file
Record	Begins the recording of the animation
Stop	Stops the recording
Time Control	Advanced controls for the timing settings of the AVI movies.



Figure 17: AVI Toolbar

5.3.5.1 Making A Screen Capture Movie

There are several steps required to make an AVI movie capture inside a HOOD application.

Make sure the AVI toolbar is visible by right-clicking the mouse on the application border, and select “AVI” from the list of toolbars (Figure 18).

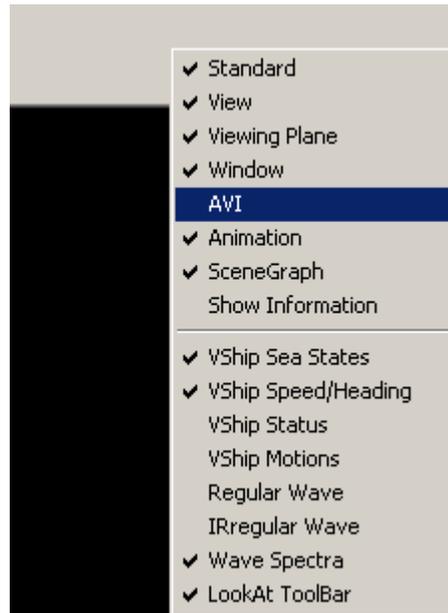


Figure 18: List of HOOD toolbars

Click the “New” button on the AVI toolbar (see Figure 17) to open up the file selection dialog (Figure 19) and select either an existing file, or type in the name of a new avi file.

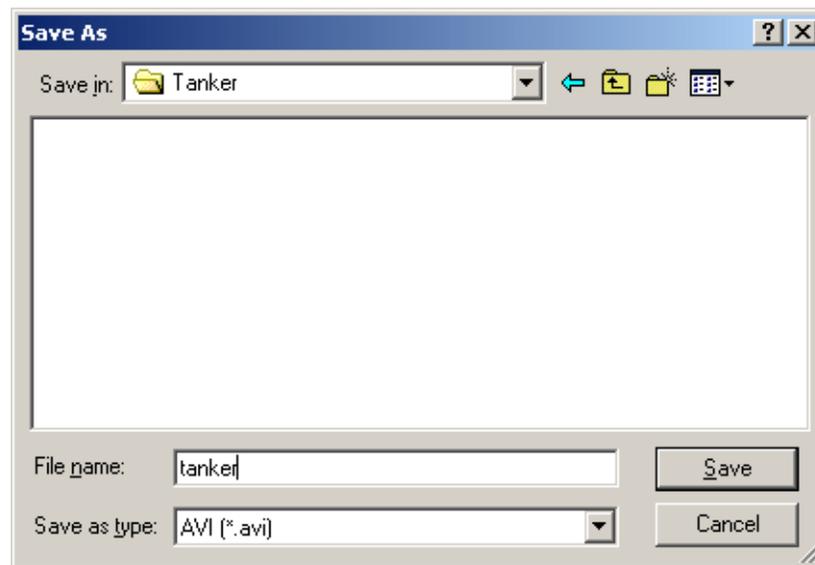


Figure 19: AVI file selection dialog

Click the “Record” button on the AVI toolbar (see Figure 17). A dialog will appear prompting you to select the video compression codec (see Figure 20). Select the Compression codec you wish to use (the default codec, Microsoft Video 1, is generally sufficient if you’re unsure which one to use. Other codecs are available to download from the internet (including several free ones). For many compression types, an option to specify the compression quality is also available. The lower the quality, the smaller the file; however, smaller files will also provide a poorer image quality. Conversely, high image quality can be achieved with a higher Compression quality, but at a cost of increased file size.

Click OK on the Video Compression window (see Figure 20) to start the video.

The model may now be manipulated in any way desired in the view window. The movements will be recorded and saved in the AVI file. To end the recording, click the Stop button on the AVI toolbar (see Figure 17).

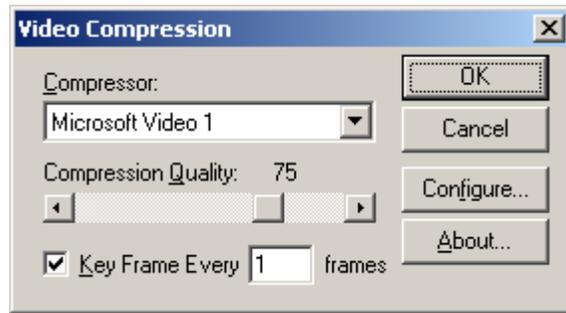


Figure 20: Video compression settings dialog

A number of options can be set for controlling the capture of the AVI videos. To view the AVI Time Control Dialog (see Figure 21), click the “Time Control” button on the AVI toolbar.

As in the “New” dialog for AVI files, the Time Control dialog also allows the user to specify the file name of the AVI file. Below the File Name, there is a data box that displays the current Capture Rate, which is the number of frames per second by which the model viewer is updating the animation. Clicking the grey button next to the Capture Rate causes this number to update in realtime. To the right is the “Frame Rate” which will be the recording rate in frames per second of the AVI video, and then the Step Period. If the animation is set to real-time, then the Step box is greyed out; the time step value will depend on the capture rate and frame rate. To ensure that the recorded AVI will also play in realtime, check the “Optimal Config” box.

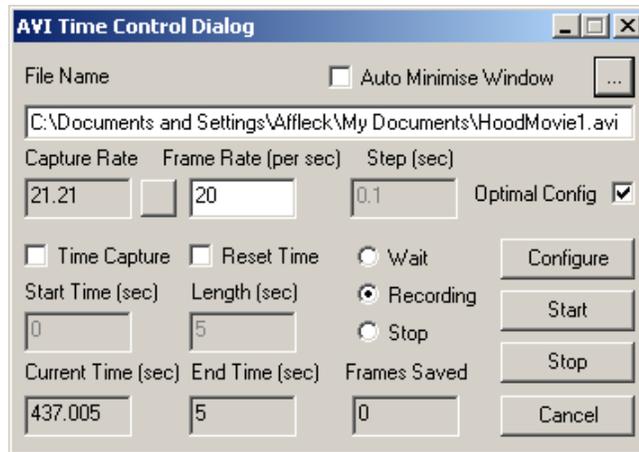


Figure 21: AVI Time Control Dialog, realtime updates

If the animation updates are not in realtime, the user can control the time step period, but the Frame Rate will be greyed out, as seen in Figure 22. The resulting frame is defined as the Capture rate divided by the time step period. In this way it is possible to create very smooth animated videos at high frame rates; the cost is that it may take much longer to create them.

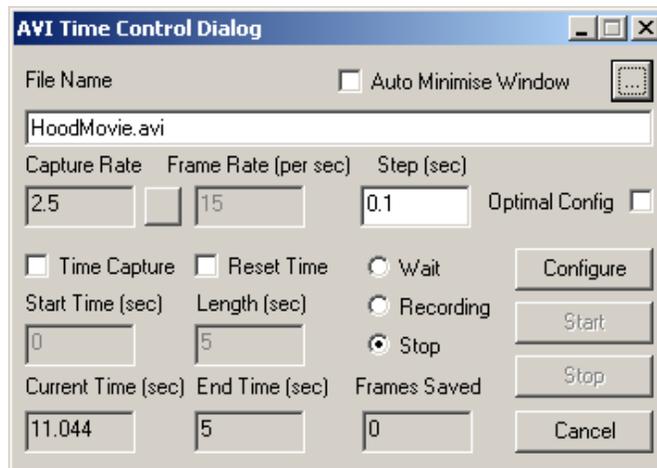


Figure 22: AVI Time Control Dialog, non realtime updates.

If the “Time Capture” checkbox is selected on the AVI Time Control Dialog (see Figure 22), the user can create videos that show the status of the model at a specific interval of its running time. The user must specify the start time and length of the desired video. On the bottom line is the “Current Time” text box. This shows the length of time for which the animation has been running. Note that the Start Time must occur after the Current Time, or no video will be saved. If the “Reset Time” box is

checked, this will reset the Current Time to zero when the Start button is clicked; in this case the Start Time can be any nonnegative number.

Before beginning a recording, click the “Configure” button. This will set up the file and the application so that it is ready to record at the correct speed and frame rate. If desired, check the “Auto Minimize Window” box. This will minimize the dialog when the video recording commences so that it doesn’t obscure the model view window. Once all of the options have been set, click “Start”. The application will now begin recording.

To stop the recording, either click the “Stop” button on the AVI Time Control Dialog, or the “Stop” button on the AVI toolbar. If a Time Capture video is being created, the application will notify the user when the current time has reached the end time, and it will automatically stop recording.

The Animation toolbar (see Figure 23) contains controls for animation settings. Note that not all objects/models respond to animation. In cases where there is no animation action associated with a model, this toolbar will have no effect.



Figure 23: Animation toolbar

Animation on/off	Turn on or off the animation mode.
Real Time	Set the time stepping mode. Real time means the time stepping corresponds to actual world time. User time means that the data rate can be increased or decreased by the user to change the play speed of the animation.
Pause	Pauses the animation at the current frame.
Reset Time	Resets the animation to its initial position
Play Backward	Plays the animation in reverse
Back One Frame	Pauses the animation and displays the previous frame. This can be used to step through each frame

	sequentially in reverse.
Stop	Stops animation and turns off the animation mode.
Forward One Frame	Pauses the animation and displays the next frame. This can be used to step forward one frame at a time.
Play Forward	Normal forward animation play mode.
Increase Speed	Increases the speed of animation.
Decrease Speed	Decreases the speed of animation.

6. The Scene Graph

The scene graph is a core concept of the HOOD toolkit. The scene graph is means of organizing models, methods and/or data in a hierarchical fashion. Essentially, it is a complex data structure made up of objects called nodes. HOOD nodes can do one or more of the following: store data (both graphical and nongraphical), act simply as a “parent” nodes for other nodes, and contain methods to perform calculations or otherwise manipulate data. In most HOOD applications, the scene graph contains the objects that combine to form an entire model (such as a ship, a bulkhead, propeller, etc.)

6.1 Scene Graph Browser

The Scene Graph Browser is a powerful feature of all HOOD applications. This is a graphical tree structure, similar to Windows Explorer directory tree. If the browser isn't currently visible, right-click on the application's window frame and select “Scene Graph” from the list of toolbars, as shown in Figure 24. Figure 25 shows an example of the Scene Graph Browser. Note that the Scene Graph Browser is a dockable toolbar, meaning it can be moved to any side of the window frame, or it can be a free floating dialog window. If there is no document (model) loaded or created, the browser will be empty. When a document is loaded or created, then the “Object Browser” folder will appear at the top of the Scene Graph Window. This corresponds to the root node in the scene graph. Each  level can be expanded/collapsed by clicking the  or  switches; these levels correspond to parent nodes. The children of these nodes may be other parents (folder icons) or graphical or data nodes, which are represented by a blue button icon . Note that graphical nodes can also be parents of other nodes; in this case they will still be represented by blue buttons, but there will also be the  or  switch next to the icon.

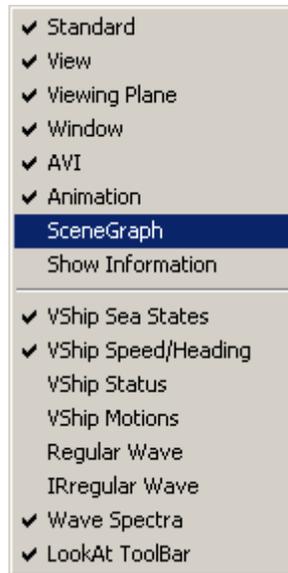


Figure 24: Selecting Scene Graph from the list of toolbars.

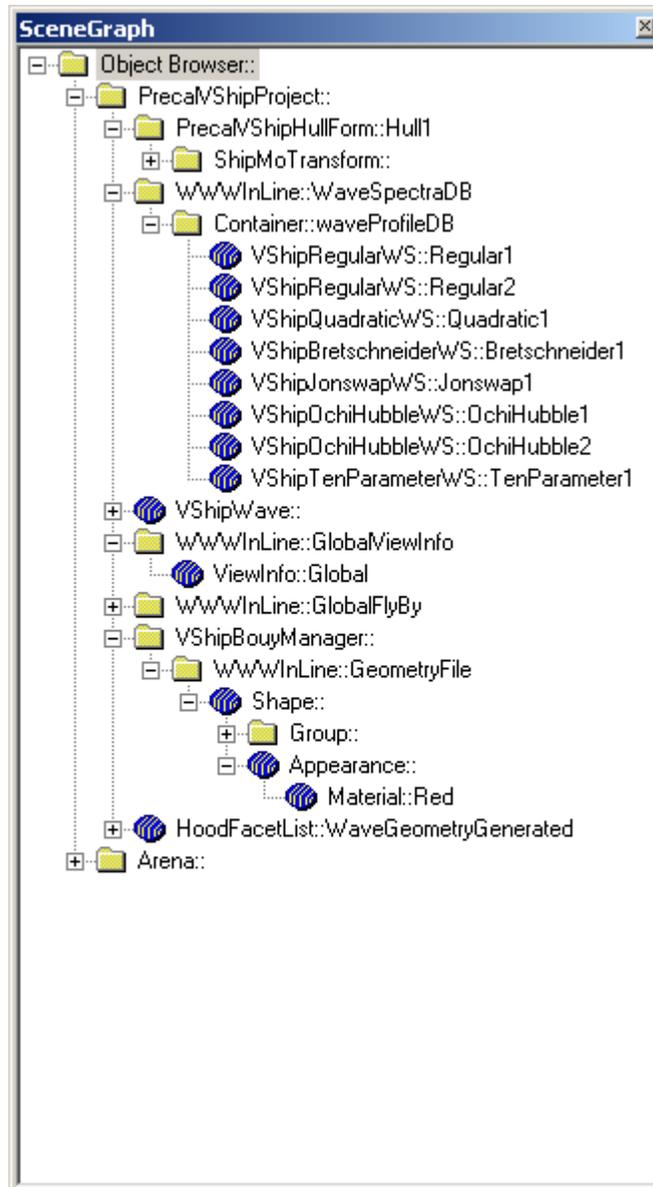


Figure 25: Scene Graph Browser example

Right-clicking on an object in the Scene Graph Browser will display a pop-up menu, as shown in Figure 26. The following is a list of options from which to choose on this menu.

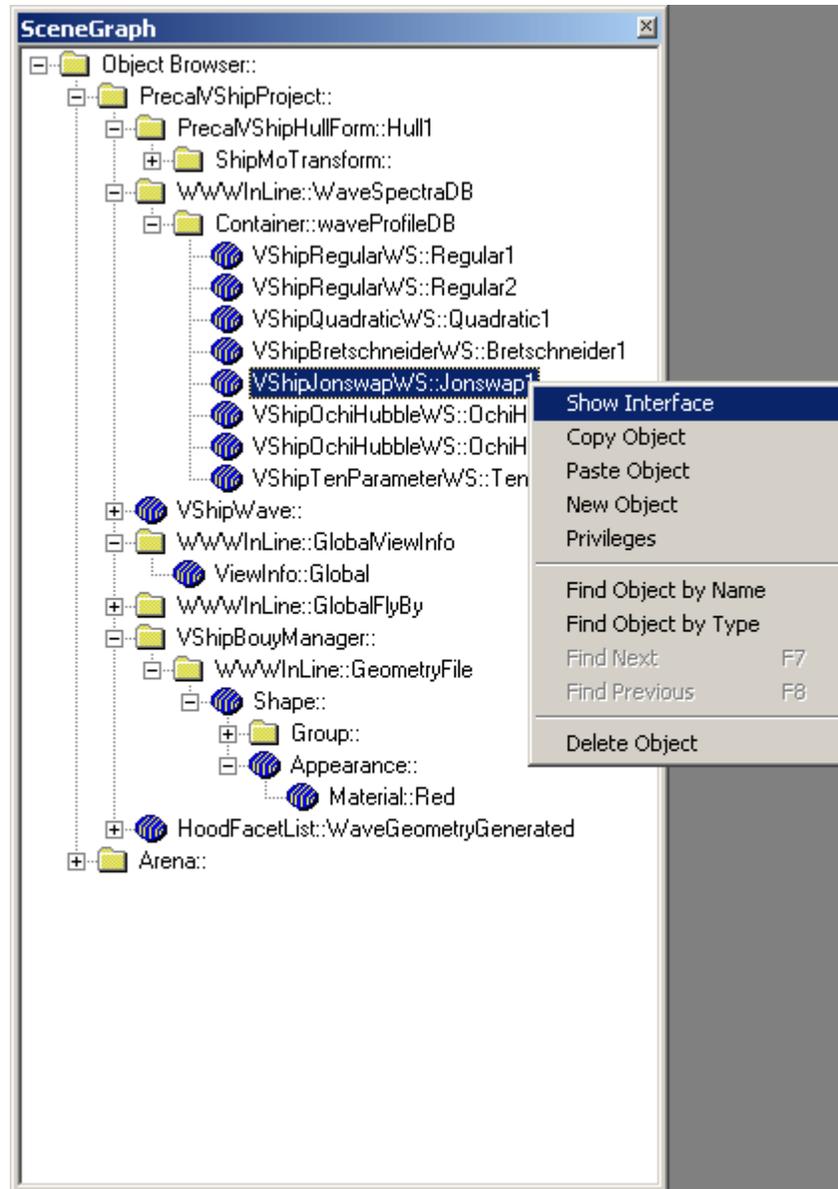


Figure 26: Scene Graph Browser with pop-up menu displayed

The actions available on the Scene Graph Browser pop-up menu are described below.

6.1.1 Show Interface

The Show Interface command (see Figure 26) displays the “interface” for the node in the scene graph that is currently highlighted. The interface is a dialog window that offers the user a means of manipulating certain characteristics of that node. Some nodes have very complicated interfaces that offer many controls, while others are

extremely basic and have very few options (if any at all beyond those that it inherits from a parent class). The interface for the class “Box” is shown in Figure 27. It allows the user to set the dimensions and location of where the box is to be drawn.

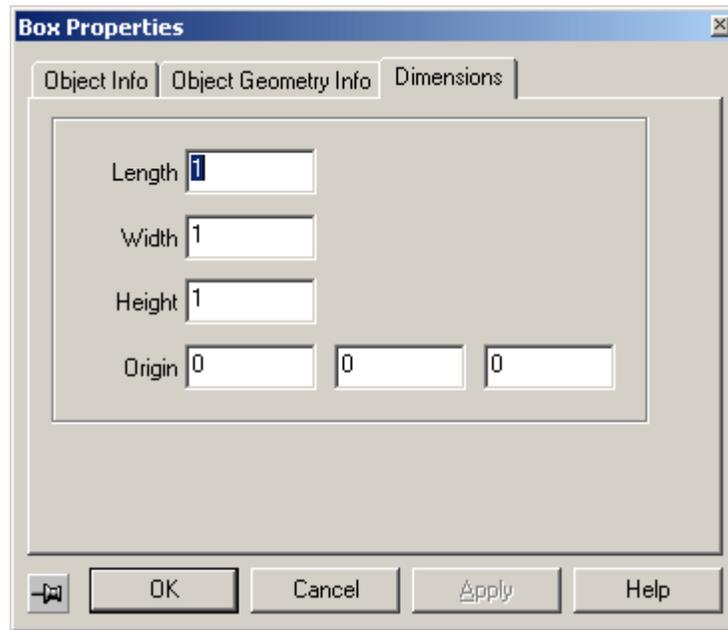


Figure 27: Interface dialog for the Box class.

6.1.2 Copy Object/Paste Object

The copy object option (see Figure 26) allows the user to make a copy of a selected object. Note that the object is placed on the application’s clipboard. A copy is not immediately placed into the scene graph. To add the object into the scene graph, select the location inside the scene graph at which the object should be placed. Right click at that location and select Paste Object. The object should now appear in the scene graph. If it is a graphical object it will also be visible in the model viewport as well, although that may not be immediately obvious since it is likely in the same position as the original object and hence the two will be exactly overlapping.

6.1.3 New Object

The New Object command on the Scene Graph Browser pop-up menu (see Figure 26) allows the user to create a new object and add it to the scene graph. When “new object” is selected, the dialog shown in Figure 28 appears. On the left of the dialog is the list of packages from which the user can select objects. This list will vary from application to application, but in general the packages “VRML”, “General” and “HOODSupportNodesNode” will always be available.

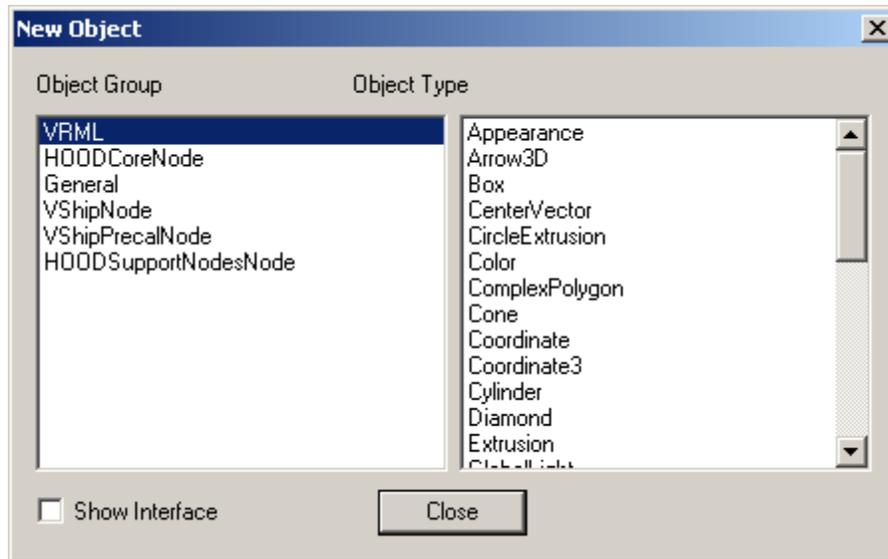


Figure 28: New Object Selection Dialog example

VRML	Consists of various geometric shapes such as Box, cone, Nurbs curve, etc. It also has special objects that control appearance such as several types of lighting, image textures, and transforms to control location and orientation.
General	Contains some commonly used objects including the Arena node, Container and Group, and the WWWInline, which allows the user to specify a file in which more nodes are written.
HOODSupportNodesNode	These are HOOD-specific nodes that are used to draw complicated shapes (such as HoodFacetList), draw “compass coordinate” rings, or create a walkthrough of a model.

6.1.4 Privileges

The Privileges command on the Scene Graph Browser pop-up menu (see Figure 26) brings up the Privileges dialog window, shown in Figure 29. This lets the user set a

number of settings for a specific object, such as whether it is pickable, visible, whether it is affected by lights, whether it can be modified, created or destroyed.



Figure 29: Privileges dialog

6.1.5 Find Options

At times a scene graph tree can become quite large. If one is looking for a specific node in the tree it can be somewhat cumbersome to do a brute force search by opening various branches of the tree to find it. The scene graph has various search capabilities to deal with this problem.

Each node will have either one or two identifiers associated with it, the “type” and the “name”. This information appears in the Scene Graph Browser in the form “Type::Name” as can be seen in Figure 25 and Figure 26. Every node will have a type associated with it, but it is not necessary for a node to have a name.

If one is looking for a node of a certain type (or “class” as they are known in computer programming), this information can be used to perform the search by selecting “Find Object By Type” from the popup menu shown in Figure 26. A dialog will appear that prompts for the node type (see Figure 30). Enter the node type and click OK. If a node of that type exists in the tree, the first one found will be highlighted and the tree structure leading to it will be expanded.

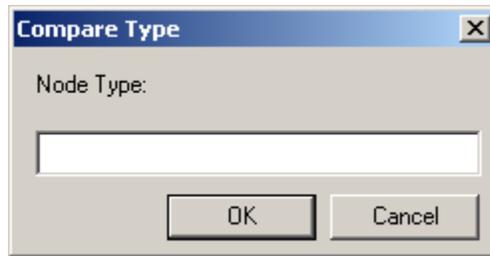


Figure 30: Compare Type Dialog for finding objects in the Scene Graph

A similar method is used to search for nodes by name. In this case, select “Find Object By Name” from the popup menu (see Figure 26), and enter the name of the node in the new dialog box.

Once a search string has been entered, the user can continue searching to see if there are more nodes with that name or type. To continue searching the currently selected branch of the scene graph tree, select “Find Next” from the popup menu. To search backwards through the tree, select “Find Previous”. Note that these two options are greyed out in the popup menu until the first search has been performed.

6.1.6 Delete Object

The Delete Object command (see Figure 26) will remove the selected node from the scene graph. The removal won't be permanent unless the model is saved after the deletion. Note that there is no “undo” option when deleting nodes; use this command with caution.

7. Setting LookAt Points

Several HOOD applications have the ability to set “LookAt” points. These are points that can be used to change the view to look from a specified point to another specified point in the visualization. The LookAt points can be either fixed in space, or can be relative to the moving ship (e.g. this can be used to visualize what the motions would look like from the bridge of a moving ship model). Several applications (such as VShip) have an additional “LookAt” toolbar from which the user can select predefined points. The following describes how to define LookAt points for a given model.

7.1.1 Setting Fixed Look Points

Setting LookAt points in HOOD applications requires using the Scene Graph which can be displayed in the same manner as the toolbars (see Section 6 for more information on the Scene Graph). In the example shown in Figure 31, ‘Object Browser’ is the top level, under which is the current project ‘VShipProject’.

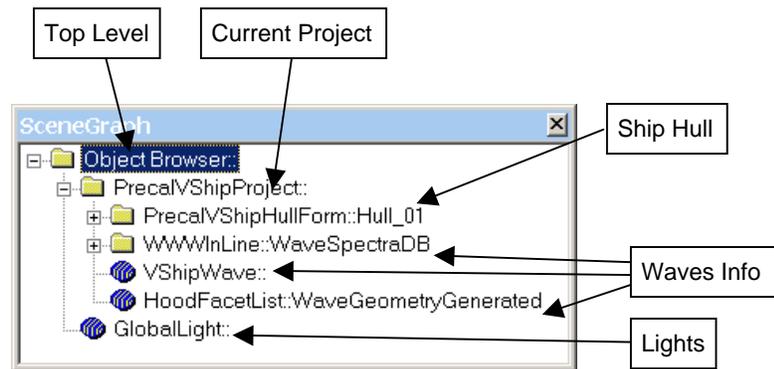


Figure 31: SceneGraph Display

Objects below the current project “VshipProject” in Figure 31 are for controlling the ship, the ocean waves, and lighting. To create fixed look points:

- Right-click on the highest level under ‘ObjectBrowser’ and select ‘New Object’ (see Figure 32).
- In the ‘New Object Dialog’ select ‘ViewInfo’ from the right side by double clicking. The right side is used to sub-divide between different object types; ViewInfo is a VRML type. Also make sure the ‘Show Interface’ box is checked (see Figure 33). This will bring up the ‘ViewInfo Properties Dialog’. Close ‘New Object Dialog’.

- Under the 'Object Info' tab in the 'ViewInfo Properties Dialog', give the object an appropriate name (see Figure 34).
- Under the 'View Info' tab, name and enter the X,Y,Z coordinates of the desired look points. The 'Use Pick Point' button is explained in the 'Setting Moving Look Points' section. Clicking checks beside the 'Show Look Points' and 'Label Look Points' will make them visible in the current display (see Figure 35). Click 'Apply' and then 'OK' to close the dialog.

The points can then be seen in the display as shown in Figure 36.

The points should now be listed in the 'LookAt' toolbar (Figure 37) for selection. Note that the left-hand dropdown box will also list the default locations; up, down, north, east, south, west.

If the coordinates of the look points need to be changed, the 'ViewInfo Properties Dialog' can be brought up by right-clicking on 'ViewInfo' in 'SceneGraph'.

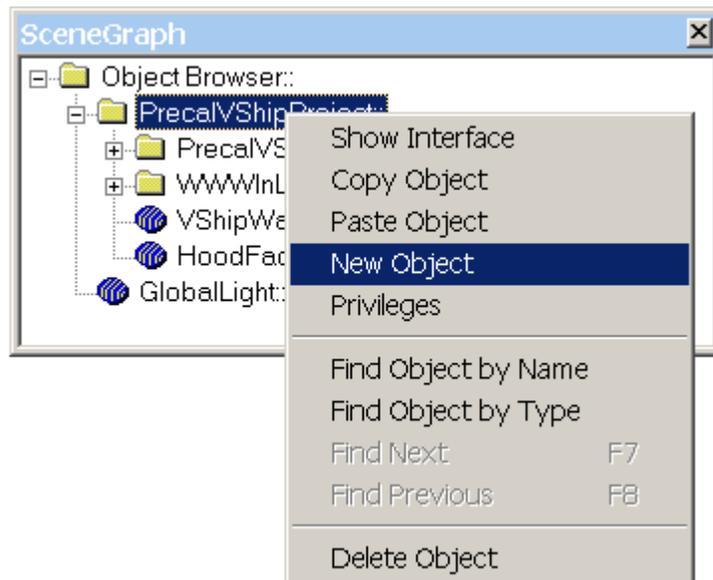


Figure 32: Picking New SceneGraph Object

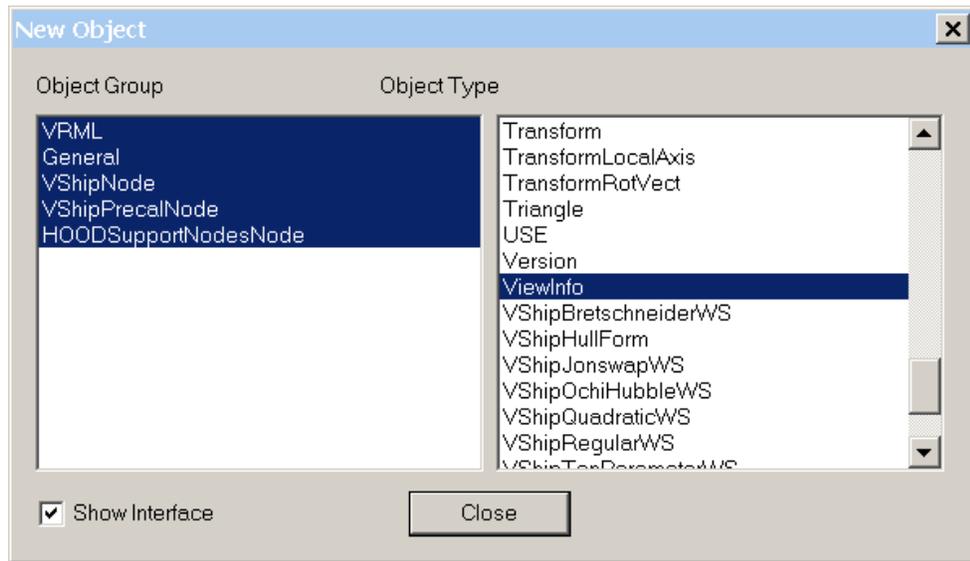


Figure 33: New Object Dialog

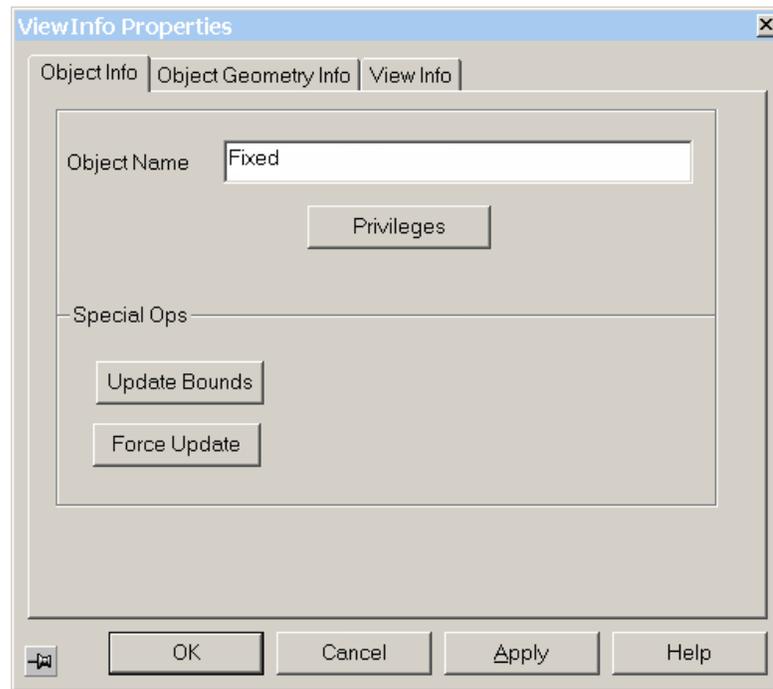


Figure 34: Naming ViewInfo Object

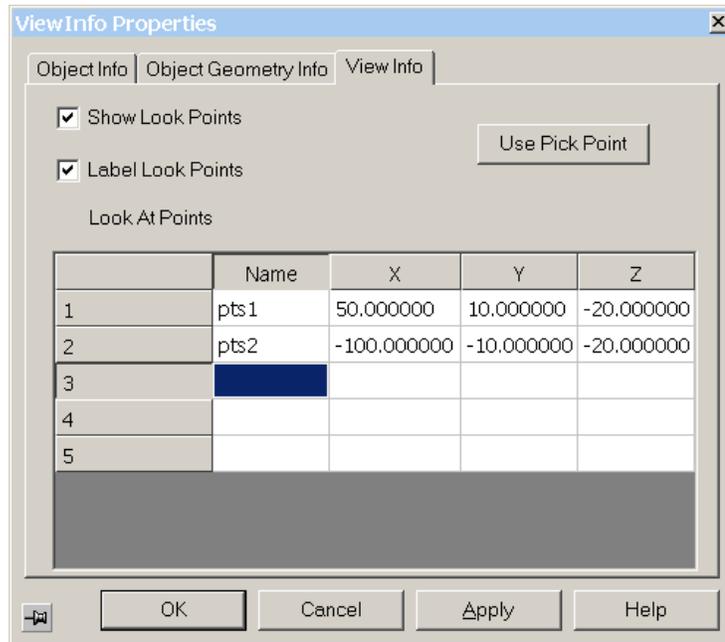


Figure 35: Setting Point Locations

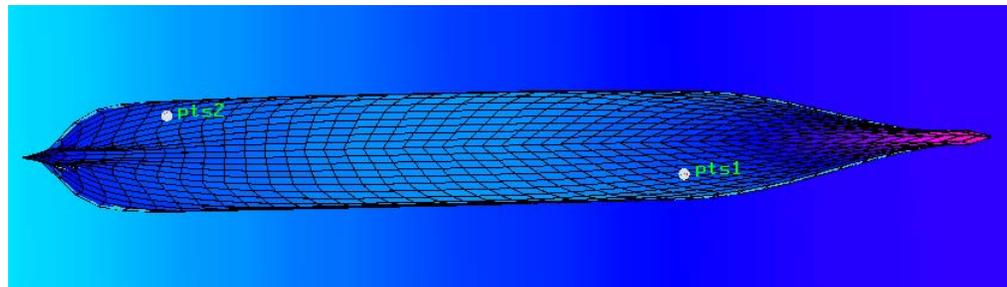


Figure 36: Screenshot Showing Fixed Look Points



Figure 37: LookAt Toolbar Showing New Look Points

7.1.2 Creating a Fly-by (Walk-through)

A Fly-by is similar to LookAt points, except that in the case of Fly-Bys, the position of the point changes over time. A Fly-by can be useful to view a model from several different angles and can be particularly effective when making AVI movies.

To start creating a Fly-by, right-click the topmost icon under the scene graph and select “New Object” from the pop-up menu, as shown in Figure 38.

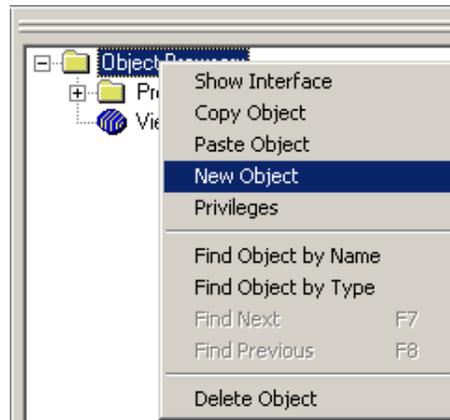


Figure 38: Picking New SceneGraph Object

Select “WalkThrough” from the right hand side of the New Object Dialog (see Figure 39) by double clicking. Make sure the Show Interface option is checked so that the property page pops up automatically when the WalkThrough object is created.

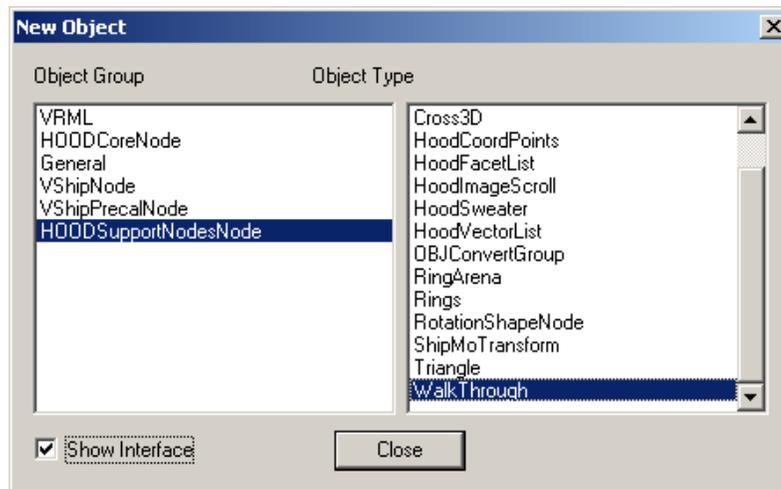


Figure 39: Selecting a WalkThrough Object.

On the WalkThrough Properties page, shown in Figure 40, enter a name in the “Object Name” text box. Next click the “Walk Through” tab to enter points.

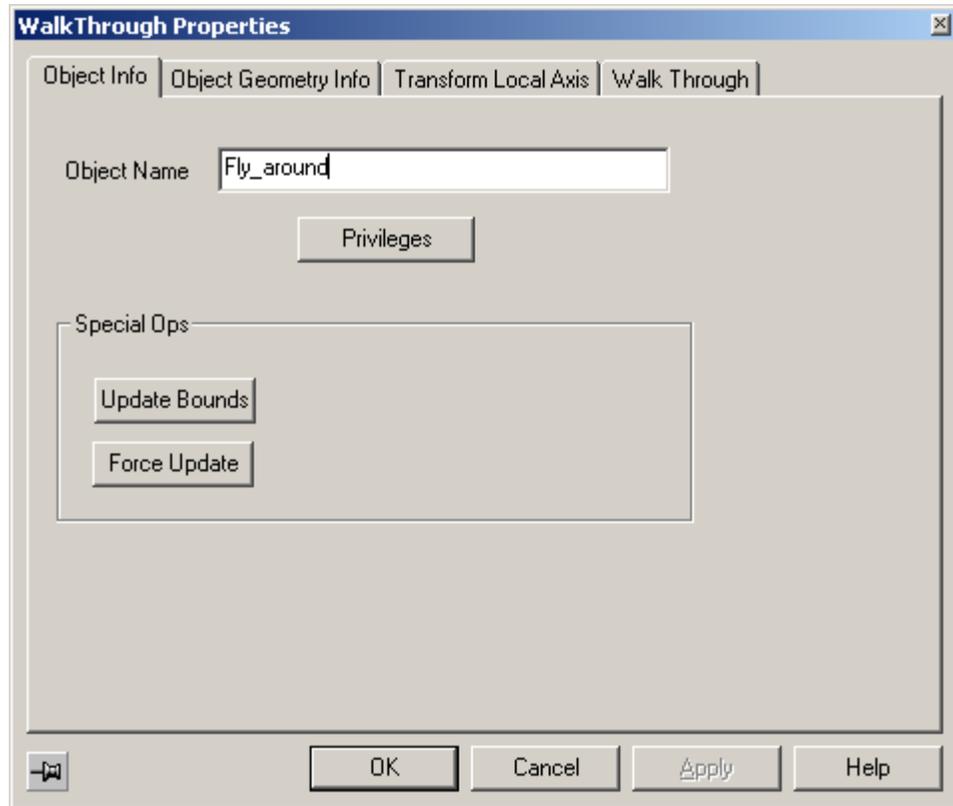


Figure 40: Naming The WalkThrough Object.

A fly-by can be as simple or complicated as the user wishes, from a straight line between two points to a complex circuit involving dozens or more points. The points in the fly-by specified in Figure 41, describe a circular route that starts and ends at the point [500, 0, 80].

There are several visualization options available for a fly-by. The “Display Position” checkbox option draws a small spherical cage at the current position of the fly-by; the “Display Path” option draws a line along the path of the fly-by; the “Display Points” option draws a small dot at the location of each of the specified points on the circuit, while the “Display Labels” option numbers each point according to the order they are entered in the grid. Figure 42 shows a HOOD model with the path of a fly-by visible.

The user can also enter a velocity value of the fly-by. The desired velocity may vary depending on the size and desired look of the fly-by, though a velocity of between 15 and 25 units per second¹ is a good starting point in general.

The final option is used to specify the action after the completion of the fly-by. It can loop indefinitely, starting over again at the first point of the fly-by (RESTART), stop at the end of one run (STOP), be removed from the scene graph (DISAPPEAR), or reverse direction and retrace the fly-by backwards (REVERSE).

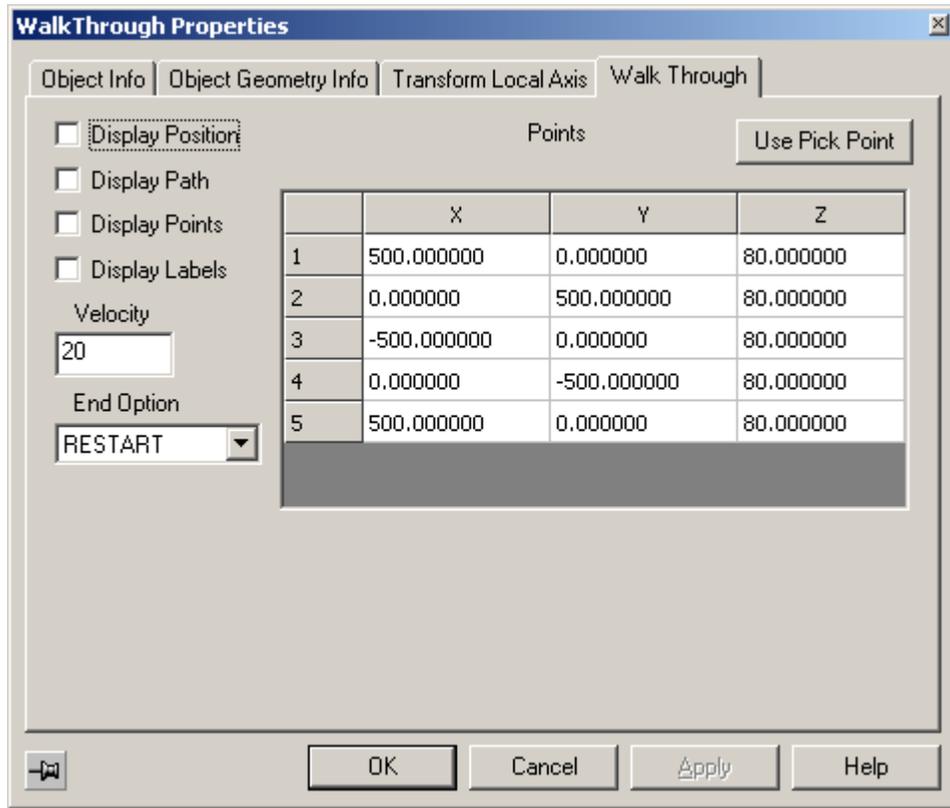


Figure 41: Setting Point locations.

¹ Note: units of distance are arbitrary in HOOD.

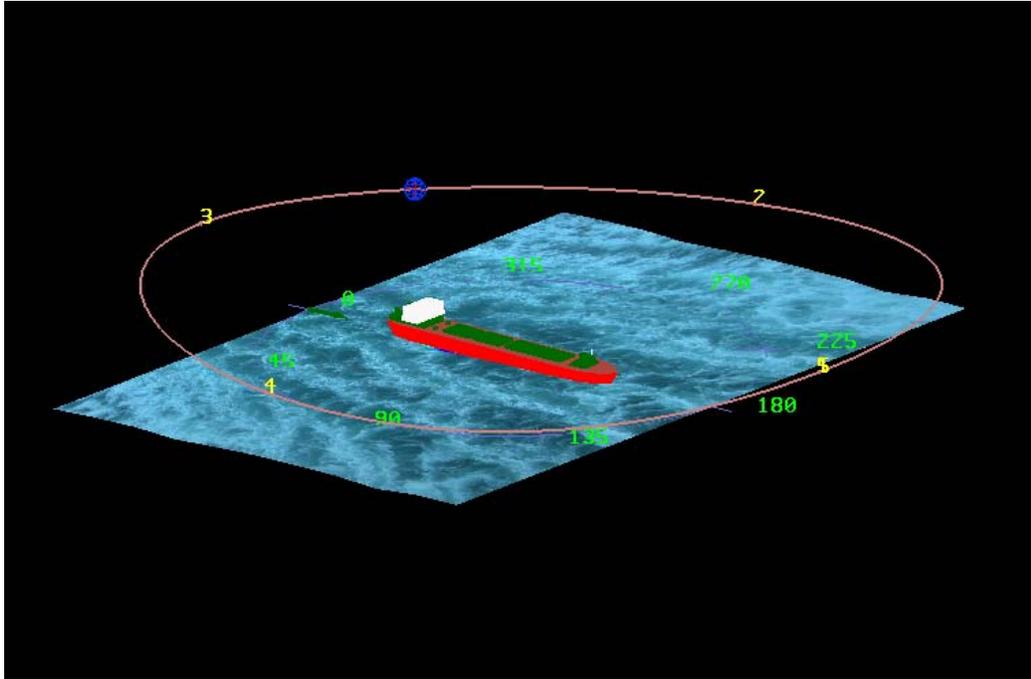


Figure 42: *Displaying the fly-by path, current location, and point coordinates.*

8. Creating An Arena

HOOD applications have the ability for the user to add an “Arena” to the scene graph. This is a background image that wraps around part or all of the space surrounding the model. The primary purpose is to give an added level of realism to models and simulations. Figure 43 shows a ship model with an arena defined.



Figure 43: A model of a ship with an Arena background image.

To create an arena object surrounding a model, click the Create Arena Object button (labelled “A”) on the View toolbar, as shown in Figure 44. This will automatically create an Arena object, and if there is a default arena texture associated with the particular HOOD application, it will load the image and display it in the viewport (see Figure 45.) Note that the properties page for arena objects (Figure 46) will be displayed automatically; if desired an object name can be entered for the arena.

Next, click on the “Arena” tab on the property page. This will show the object information specific to arenas, as shown in Figure 47. The various options on the Arena property page enable the user to adjust the size and location of the arena background, as well as specify whether it is to be a half-sphere or a complete sphere. In order for the model to be completely enclosed within the arena, the radius of the arena must be larger than the maximum dimension of the model itself. It must also have the correct offset from the origin. Most applications will choose default values for these variables that will be suitable for most models, though the user may want to adjust it to their own liking.



Figure 44: Selecting the Create Arena Object button from the View toolbar.

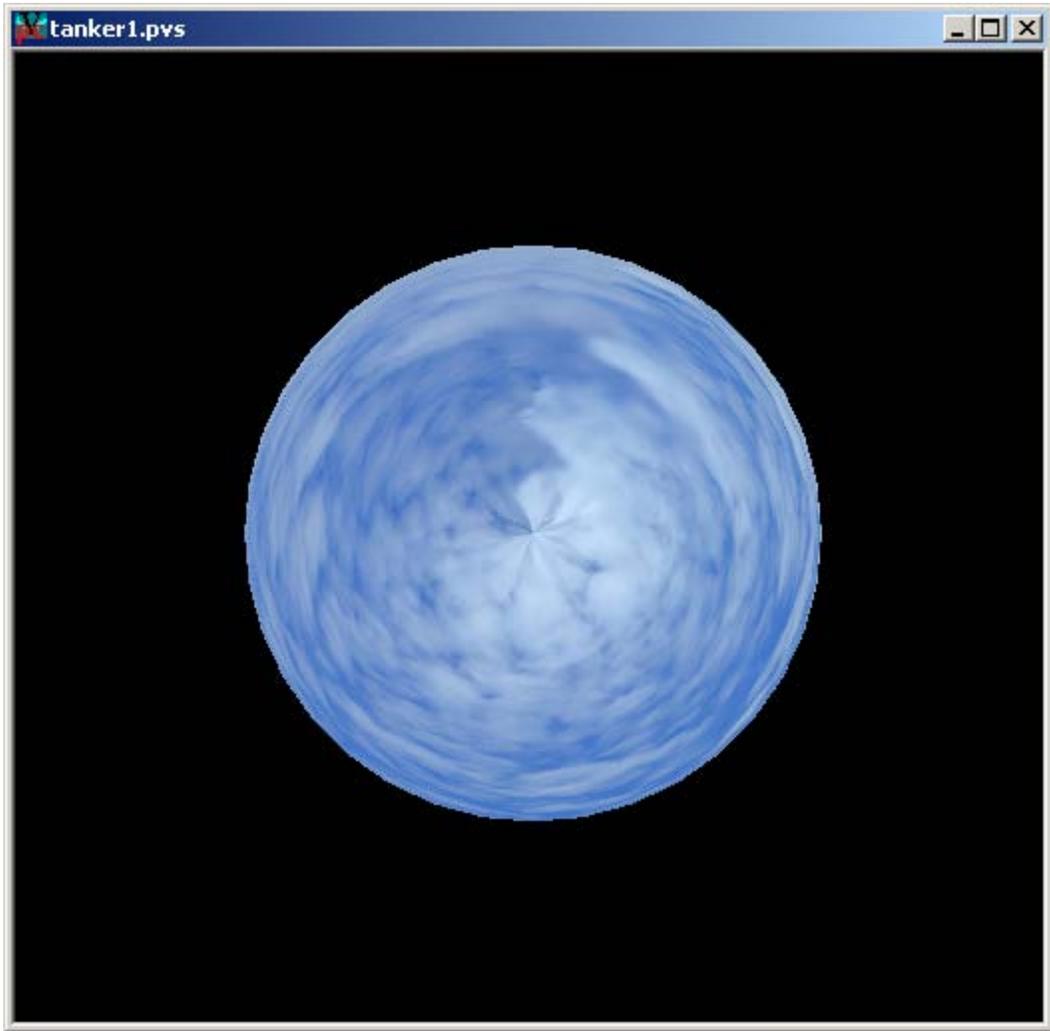


Figure 45: A Default Arena is created when clicking the Create Arena Object button.

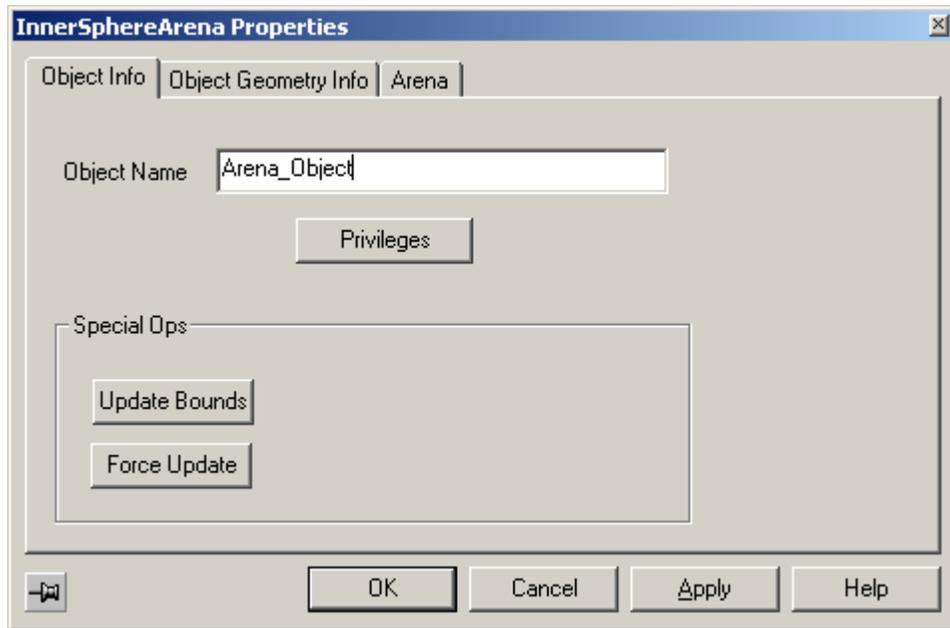


Figure 46: Arena Object property page.

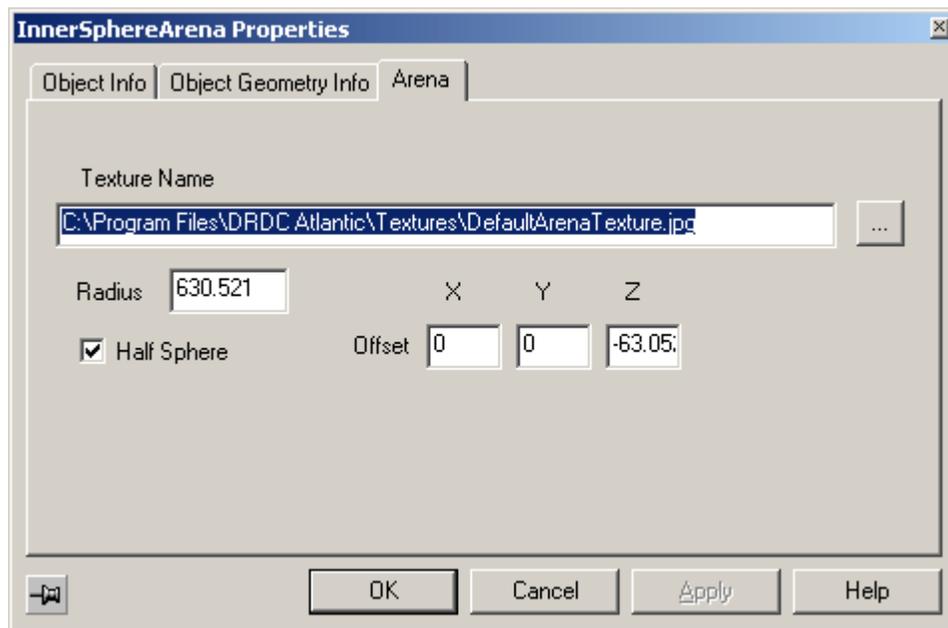


Figure 47: Arena-specific properties.

Initially, the arena may completely obscure the model. One method of peering inside the arena is to define look-at points so that the viewer's position is inside the arena. See Section 7 for instructions on how to define look-at points. Another option available is to take advantage of the Clip Plane. First click the "Adjust Clip Planes" button on the View Plane toolbar, shown in Figure 48. This will bring up the Clip Plane Adjustment dialog box, shown in Figure 49. Move the "Near Clip" slider towards the right by clicking on the vertical bar and dragging it while holding the mouse button down (alternatively, an exact value for the near clipping plane can be entered in the text box immediately above the slider.) At some point, the near clip plane will begin to intersect with the arena. Figure 50 shows the near clip plane intersecting with the arena. Adjust the location of the near clip plane to taste.



Figure 48: Clicking the Adjust Clip Planes button on the View Plane toolbar.

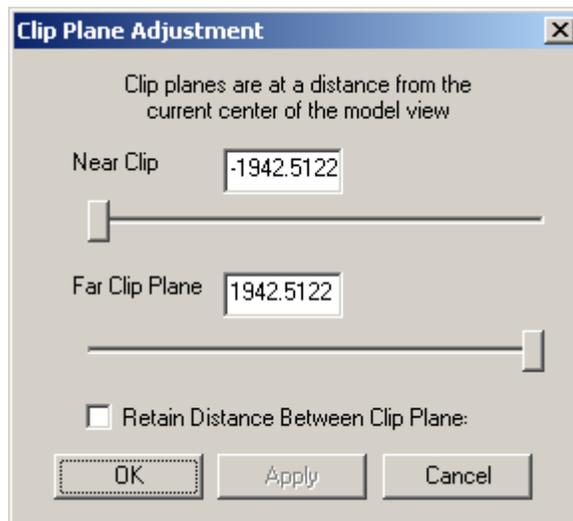


Figure 49: The Clip Plane Adjustment dialog box.

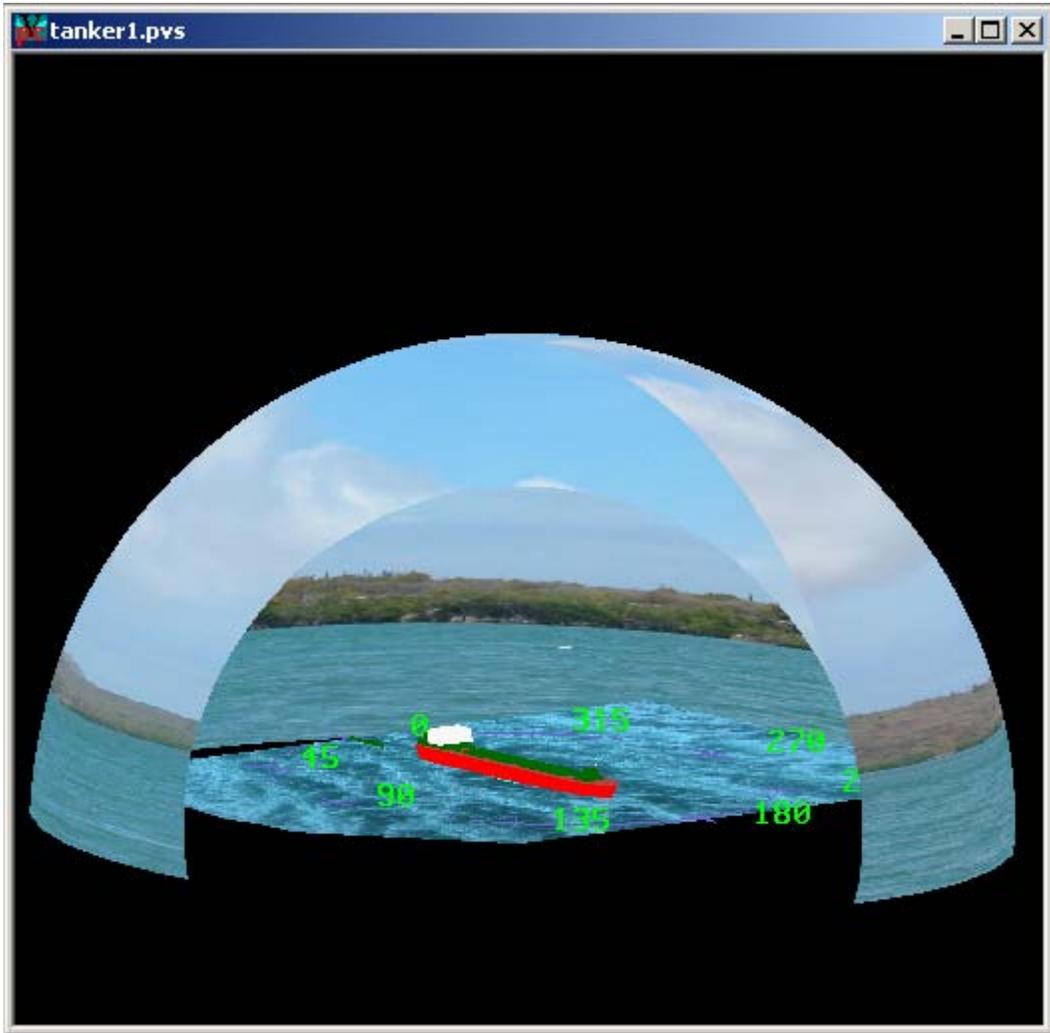


Figure 50: The clip plane cuts off the front part of the arena, displaying the interior.

9. ColorScaleIndicator

There are many visual elements in HOOD applications that can be coloured according to some criterion. For example, one may wish to colour the facets of a hull according to the size of the facet. This can provide a quick visual reference to locate the largest or smallest facets. There are times however when it may be important to have a numerical value associated with the colours. This is where the ColorScaleIndicator comes in to play. The ColorScaleIndicator is essentially a tweakable legend to describe the colour values that the user sees on the screen. In the ColorScaleIndicator dialog example shown in Figure 51, the colours describe facet sizes. The range of colours goes from a minimum value of 9.81 square units, and is described by yellow; the maximum value displayed is 78.2 and is represented by red.

The ColorScaleIndicator dialog generally doesn't appear automatically, however if there is one available for a given graphical object it shouldn't be very difficult to find. In most instances, it can be brought up by clicking an appropriately labelled button on that object's Interface page (see Section 6.1.1).

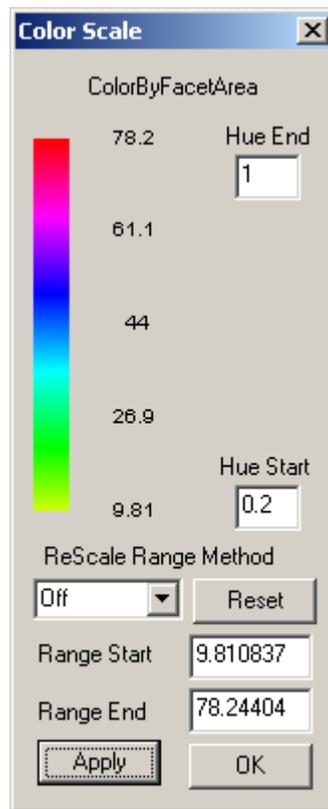


Figure 51: The ColorScaleIndicator dialog.

Figure 52 shows the ColorScaleIndicator along with a ship hull that has been coloured according to facet area. The user can quickly see that the largest facets—those coloured red—are located on the keel (bottom) of the ship, while the smallest facets—green and yellow ones—are at the fore and aft-most regions of the hull.

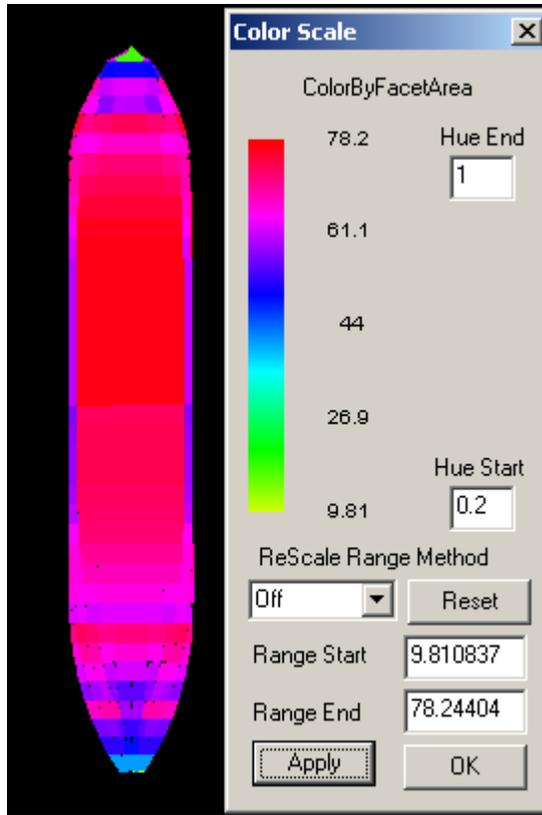


Figure 52: The ColorScaleIndicator dialog and a coloured ship hull.

The user also has several colour display options that they can change using the ColorScaleIndicator. One of these is the data range values. It is quite apparent that the vast majority of the facets have an area of about 50 or greater. If the user wanted to focus on those facets that are greater than 50, they could change the “Range Start” value to 50. Clicking the “Apply” button would result in a change in both the ColorScaleIndicator range, and the colouring of the model itself, as shown in Figure 53. In this example, all of the facets that have an area less than 50 are completely yellow. One can also see that there is a greater colour distribution among the remaining facets, making it easier to determine their approximate area. The same thing can be done with the “Range End” value; it can be modified to focus on facets that have a small area (using the current colour scheme, any facets with an area larger than the Range End would appear completely red.) Naturally, both the Range Start and Range End values can be changed at the same time.

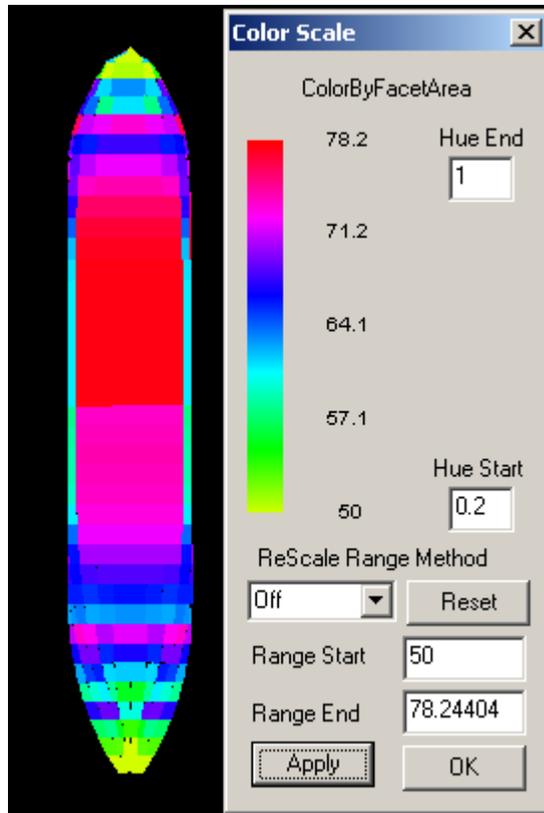


Figure 53: The ColorScaleIndicator dialog and a coloured ship hull with a Range Start value of 50.

Users also have the option to change the colour hue range. This is accomplished by modifying the values for “Hue Start” and “Hue End”. Most HOOD applications that use a ColourScaleIndicator leave the default hue range; this range goes from 0.2 (yellow) to 1.0 (red), but the user can pick any two nonnegative values for the hue range between 0.0 and 2.8. Note that the hue range has a period of exactly 1.0; thus if a hue range of greater than 1.0 is selected the colours will repeat themselves and some colours will be mapped to more than one value, as shown in Figure 54. In general, this is not a particularly useful colour range. The main reason that the hue range goes beyond 1.0 at all is so that the user can have the option of having different start and end colours. For example, for a range between light blue and light green, the user could select a Hue Start value of 0.5, and a Hue End value of 1.3, as in Figure 55. Also, because of the smooth transition between colours on the scale, a colour range of even one full period (say from 0.0 to 1.0) may cause confusion as values at both the bottom end and the top end of the data range will have almost the same colour. Hence a hue range of about 0.8 or lower is practical for most applications.

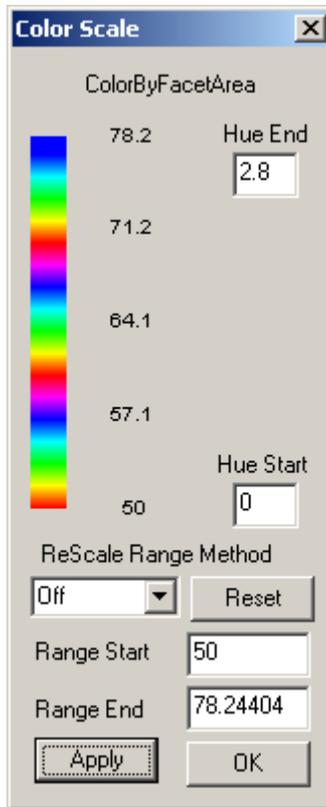


Figure 54: A ColorScaleIndicator with an inappropriate range.

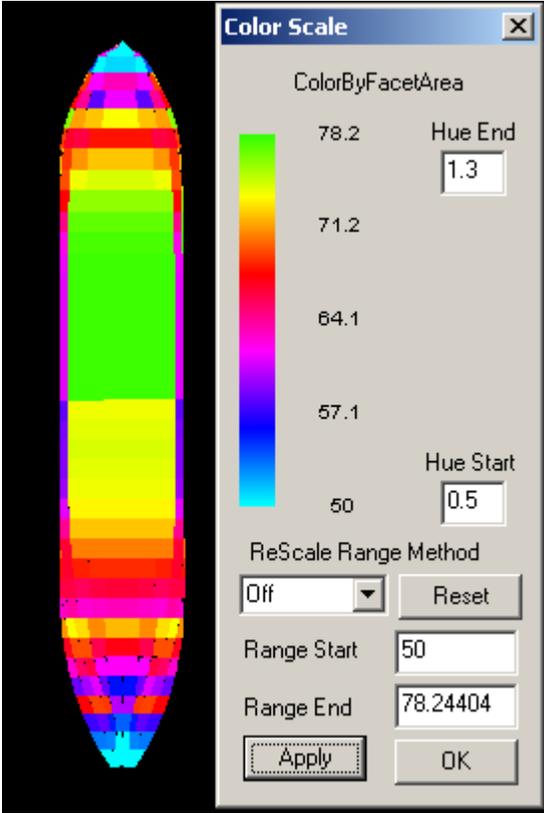


Figure 55: A ColorScaleIndicator with a different Hue Range

10. Concluding Remarks

Information and instructions on several of the basic operations and functions of all HOOD applications have been presented. This will assist end users in learning how to use HOOD applications and can serve as a reference for more experienced users. As the capabilities of HOOD grow, future updates to this document will be provided.

11. References

1. Stredulinsky, D.C. and Heath, D.C. (2003). Updated Vship Visualizer User's Manual. DRDC Atlantic ECR 2003-126. Defence R&D Canada – Atlantic.
2. Noble, D. PROWISE User's Manual. DRDC Atlantic document in preparation.
3. Affleck, R.A. and Stredulinsky, D.C. (2003). PRECAL GUI User's Guide. DRDC Atlantic ECR 2003-124. Defence R&D Canada – Atlantic.

List of symbols/abbreviations/acronyms/initialisms

DND	Department of National Defence
HOODTK	Hierarchical Object Oriented Developers Tool Kit (often written as “HOOD”.)
AVI	Audio Video Interleave. A common multimedia format for computers.
GUI	Graphical User Interface.
::	(double colon) A delimiter used in HOOD’s Scene Graph Browser to denote an instance of an object type. The type of object appears to the left of the delimiter, and the instance name appears to the right.
VRML	Virtual Reality Modelling Language. A common syntax for describing three-dimensional models.
Nurbs	Non-uniform rational B-Splines. Nurbs are mathematical representations of various geometric shapes. They are typically used when describing complicated geometries or those with many curves.

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DOCUMENT CONTROL DATA

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The Hierarchical Object Oriented Developer's Toolkit (HOODTK or simply HOOD) is a large database of C++ code created by the Virtual Naval Platforms group at Defence Research and Development Canada – Atlantic for use in developing engineering software applications. This manual addresses many of the features common to all HOOD applications. The intended audience is first time users, as well as those who may have only limited experience with HOOD applications. It explains the basic functions common to all applications developed with HOOD and provides step by step instructions for some of the more complicated operations.

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HOOD
HOODTK
Hierarchical Object Oriented Developer's Toolkit
Scene Graph
Graphical User Interface

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