

HVE Tutorial

Chapter

32

Overview

This chapter presents a series of basic tutorials that demonstrate various HVE techniques and capabilities. The purpose of these tutorials is to provide a solid grasp of the fundamentals of using HVE, and to help the user become as efficient as possible. This is accomplished through a series of high-level, task-oriented procedures using a step-by-step approach.

While this tutorial explores many of HVE's important features, it does not provide detailed explanations. For these details, the tutorial refers to specific chapters, and the user should refer to those chapters when necessary. Additional information, including a comprehensive index, may be found in the Appendix.



NOTE: In addition to this tutorial, every EDC physics model has a Program Manual that includes a comprehensive tutorial specific to that physics model. Manuals from 3rd party vendors typically include a tutorial as well.

The Tutorial is divided into four individual lessons:

- **Lesson 1 - Navigating in HVE** - This lesson shows techniques that promote efficiency. The user learns how to move quickly within HVE to perform fundamental tasks.
- **Lesson 2 - Running a Simulation Model** - This lesson shows the best way to set up and execute HVE-compatible physics models (reconstructions and simulations involving human and vehicle dynamics).
- **Lesson 3 - Combining Multiple Events** - This lesson explains how to merge two or more individual simulations into a coherent and seamless sequence involving multiple humans and vehicles.
- **Lesson 4 - Creating a Video** - This lesson provides a quick and easy lesson describing how to create your first video.

Let's begin with the first lesson.

Lesson 1 - Navigating in HVE

Lesson 1 is a lesson in fundamentals, with an emphasis on efficiency. In this lesson you will learn to perform the following fundamental tasks:

- Starting HVE
- Learning About the Menu Bar
- Managing Dialogs and Viewers
- Choosing an Editor
- Using Dialogs
- Using Viewers
- Shutting Down HVE

Do not skip this lesson! By spending time performing these tasks, you will be able to navigate within HVE more quickly, more efficiently and (perhaps most important) more intuitively! You'll be able to effortlessly view the action from the desired viewpoint. You'll be able to set up your viewers to gain maximum efficiency and information from what HVE is telling you. Put simply, this lesson helps you get the most out of your HVE system. Let's get started.

Starting HVE

To start HVE, use the Start, Programs cascade menu to select the HVE program menu and then the HVE program icon, just as would start any other program on your computer. After starting HVE, the HVE Menu Bar and current HVE Editor dialog are displayed (in this case it is the Vehicle Editor), as shown in Figure 32-1.

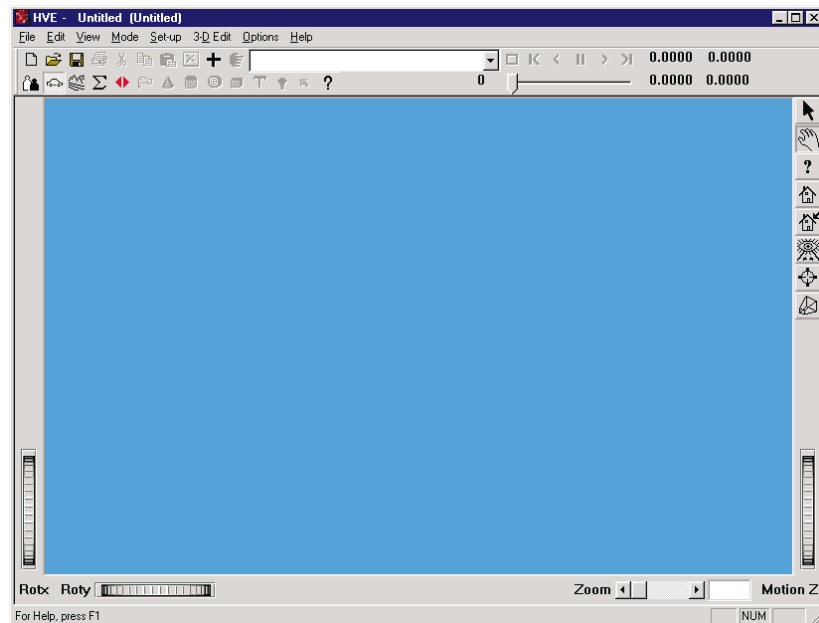



Figure 32-1 The Desktop, after starting HVE. HVE has a main program window with a Menu Bar, Tool Bar, integrated Event and Playback Controller, Viewer Manipulators and Zoom Slider.

 **NOTE:** HVE saves the current editor when you exit; thus, the editor now displayed is the one you were using when you last exited HVE.

Learning About the Program Window

We will be using many terms throughout this (and other) tutorials. If you have not worked with Windows before, many of these terms will be new to you. The actions you will be performing will be new as well.

Let's start off by identifying and experimenting with the components that make up what is called the *Menu Bar*. Many of the functions accessed using the menu option may also be selected by clicking on various toolbar buttons.

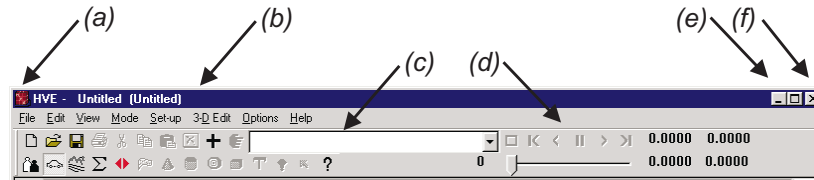



Figure 32-2 Menu Bar. HVE's menu bar is very traditional, with *File*, *Edit*, *View*, *Mode*, *Set-up*, *3D-Edit*, *Options* and *Help* menu options. It also includes the *Dialog Control* button (a), the *Title Bar* (b), the *Active Objects List* (c), the *Event Controller* (d), the *Minimize* and *Maximize* buttons (e), the *Close* button (f), and several toolbar buttons for quick access to functions.

Menu Bar

A Menu Bar, shown in Figure 32-2, is common to all Window-type programs. It contains the program's fundamental options. In the case of HVE, these options are *File*, *Edit*, *View*, *Mode*, *Set-up*, *3D-Edit*, *Options* and *Help*. Let's briefly explore these options:

- Click on *File*. The File menu is displayed. This menu provides basic system operations, such as starting new cases, opening and saving files, working with video, printing and exiting HVE.
- Click on *Edit*. The Edit menu is displayed. This menu provides operations that allow you to edit selected objects.

 **NOTE:** No Edit menu options are currently available because no object is selected. Other menus will also have disabled options until the appropriate situation allowing the use of the option is present.

- Click on *View*. The View menu options are displayed. This menu provides operations that determine how you look at simulations.
- Click on *Mode*. The Mode menu options are displayed. This menu allows you to select which Editor you are currently using, and also to add new or previous objects into the Editor (e.g. Select *Mode*, *Add*, *New* or *Previous*).
- Click on *Set-up*. The Set-up menu options are displayed. This menu allows you to enter inputs for setting up your simulation or reconstruction events.
- Click on *3D-Edit*. The 3D-Edit menu options are displayed. This menu allows you to launch and close the 3D Editor while in Environment mode, plus edit material attributes, colors and textures or change manipulators while in the 3D Editor.

- Click on *Options*. The Options menu is displayed. This menu provides several user-definable options and preferences.
- Click on *Help*. The Help menu is displayed. This menu provides access to the various HVE Help System options.

The *Dialog Control* button is located in the upper left corner of the Menu Bar (see Figure 32-2 (a), above).

- Click on the *Dialog Control* icon. The dialog control options are displayed. These options allow you to move the dialog, change its size, minimize it (replace the dialog with a small icon - handy if you're not currently using the dialog), and maximize it (make the dialog as large as possible).

All dialogs and viewers have a *Dialog Control* button.

The Menu Bar also includes the *Title Bar*. This component (b) displays the current case title, followed by the current filename in parentheses. All dialogs and viewers also have a Title Bar, and it has an important function:

- Click on the *Title Bar* and drag the mouse. The dialog (i.e., the *HVE program window* in this case) follows your mouse cursor. This is a fundamental navigation task that allows you to move dialogs and viewers anywhere you wish.

The *Active Objects List* is integrated into the Menu Bar. This component (c) displays a drop-down list of active objects while in the Human, Vehicle, Environment and Event mode. By clicking the button on the right side of the list, the complete list of objects is displayed. The current object is displayed in the viewer. To add a new object to the list, click on the *Add New Object* button (looks like a + sign) located two buttons to the left of the list on the toolbar. To display the Information dialog for the current object, click on the *Object Info* button (looks like a hand pointing) immediately to the left of the list on the toolbar.

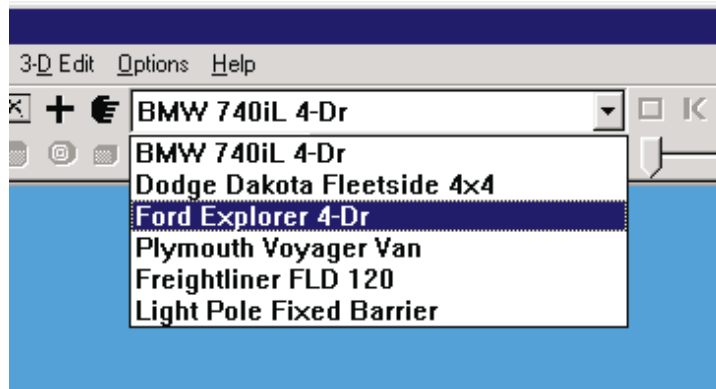


Figure 32-3 Active Objects List drop-down display shown in Vehicle Mode. *Add New Object* and *Object Info* toolbar buttons are located to the left of the list.

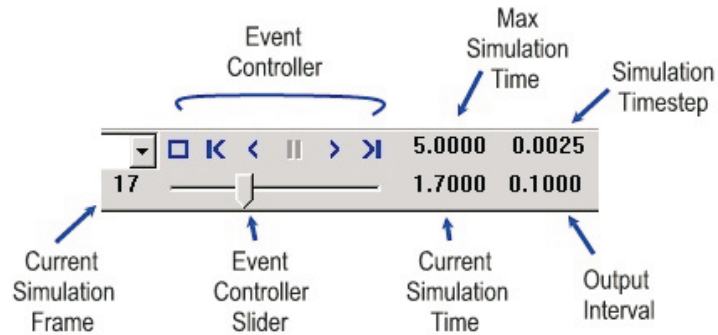


Figure 32-4 Event Controller


The *Event (and Playback) Controller* is integrated directly into the Menu Bar. Additional information displays used in conjunction with the Event Controller are shown in Figure 32-4. These information displays are as follows:

- **Current Simulation Frame** - Displays the current frame of simulation output. A frame is equivalent to one timestep of output.
- **Max Simulation Time** - Displays the selected Simulation Controls Maximum Simulation Time termination condition.
- **Simulation Timestep** - Displays the integration timestep used for typical vehicle trajectory calculations as set in Simulation Controls.
- **Current Simulation Time** - Displays the current timestep of the complete event.
- **Output Interval** - Displays the timestep interval used for display results as set in Simulation Controls.

The Event Controller Slider can be used to move forward or backward through each simulation frame. This provides the user with an easy means to locate a specific point in a simulation, without having to Play and Stop the simulation.

The Menu Bar includes *Minimize* and *Maximize* buttons, as shown in Figure 32-2 (e).

- Click on the *Minimize* button. The dialog disappears! Actually, it turned into an icon and is displayed along the bottom of the Windows desktop.
- Click on the HVE icon. The current HVE program window is redisplayed.
- Click on the *Maximize* button. The Menu Bar fills the screen.

 **NOTE:** Using the *Maximize* button to maximize the program window allows you to use the whole screen for your work. Setting your display to 1024 x 768 or 1280 x 1024 resolution provides you with an even larger work area.

- Click the *Maximize* button again (which is now the *Restore* button). The dialog returns to its original size.

Finally, the Menu Bar (and all windows and dialogs) includes a *dialog frame* that surrounds the dialog. The dialog frame has two functions:

- Click on the frame and drag the mouse. The dialog changes size.

Depending on where you click on the frame, the dialog changes size in the direction you drag. If you click on the corner, it changes size in both directions.

- Click and drag on various parts of the dialog frame, experimenting with this feature.

 **NOTE:** Some dialogs cannot be resized.

The second function of clicking on the frame is that it raises the dialog to the top of the display, a useful feature if the dialog is partially covered and you need access to it. We'll explore this use later in this tutorial.

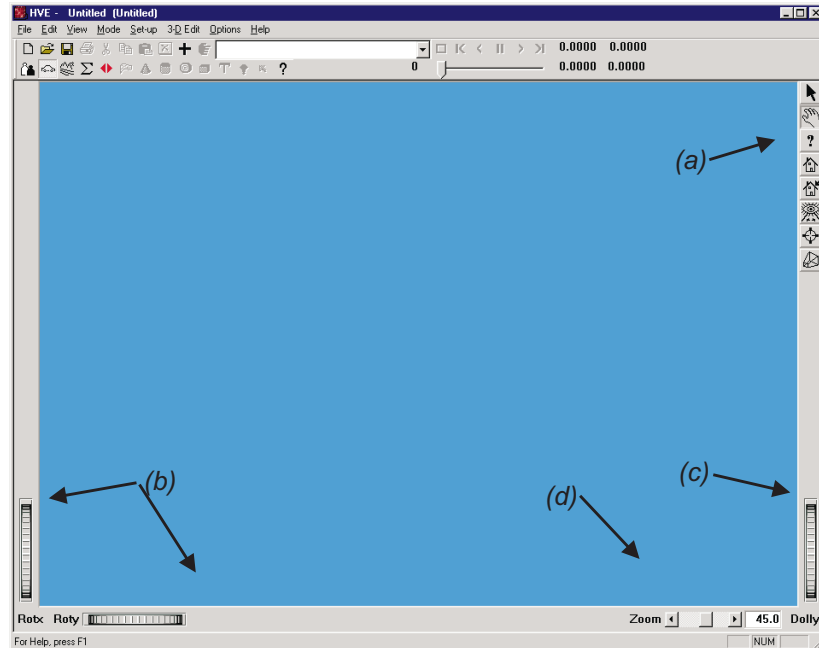


Figure 32-5 Typical Viewer. *Pick Mode* or *Manipulate Mode* is selected by choosing the arrow or hand, respectively, near the upper right edge of the viewer (a). *RotX* and *RotY* thumb wheels (b) rotate the object in the viewer about the viewer's X and Y axes, respectively. The *Dolly* thumb wheel (c) increases or decreases the size of the object by moving the camera away from or towards the object. The *Zoom* slider (d) increases or decreases the size of the object by reducing or increasing the viewer's included angle.

Viewers

Viewers are used to display 3-D objects. A typical viewer is shown in Figure 32-5.

Viewers have the same window manager components that were just explored using the Menu Bar. In addition, viewers also have the following components:

- **Viewer Mode Selector** - This component, shown in Figure 32-4 (a), allows the user to switch between *Pick* mode, used for choosing objects in the viewer and performing an editing operation on that object, and *Manipulate* mode, used for changing the 3-D view using direct manipulation.
- **Viewer Controls** - These components include *Viewer X* and *Y* rotation thumb wheels, shown in Figure 32-4 (b), *Dolly* thumb wheel, Figure 32-4 (c), and *Zoom* slider, Figure 32-4 (d).

These components will be explored later in this tutorial.



Figure 32-6 HVE Mode Selector, located at the left hand side of the toolbar. The Mode Selector is used to switch between modes. The depressed button appearance indicates the Vehicle Editor is currently selected.

HVE Mode Selector

The *HVE Mode Selector* is integrated into the toolbar at the left hand side of the Main Menu. As shown in Figure 32-5, the *Mode Selector* has five buttons, as follows (left to right):

- **Human Editor Button** - Displays the Human Editor, placing HVE in Human mode.
- **Vehicle Editor Button** - Displays the Vehicle Editor, placing HVE in Vehicle mode.
- **Environment Editor Button** - Displays the Environment Editor, placing HVE in Environment mode.
- **Event Editor Button** - Displays the Event Editor, placing HVE in Event mode.
- **Playback Editor Button** - Displays the Playback Editor, placing HVE in Playback mode.

Let's get a little practice using the HVE Mode Selector:

- Click on each button in the Mode Selector to display the various HVE editors.

Managing Dialogs and Viewers

Becoming an efficient HVE user requires using a few simple, but important, procedures. These procedures include:


- Arranging your desktop to allow you to be as efficient as possible
- Raising viewers and dialogs to the top of the desktop
- Minimizing windows to help improve system performance (especially for 3-D viewers that must be rendered)


Minimizing Windows

While using HVE, you may find your desktop becomes cluttered with numerous data windows and viewers. This is especially true while using the Playback Editor under the following two scenarios:

- You are working with a case that has multiple events and you have created several output reports for each event.
- You are working with a case that has multiple Trajectory Simulation windows and you are in the process of rendering the Playback Window containing multiple Trajectory Simulation events.

In these instances, you can minimize the window containing the report so it takes less screen space.

 **NOTE:** A minimized window maintains all the data associated with it; minimizing simply removes the visual representation of the window and replaces it with an icon.

 **NOTE:** Minimized 3-D viewer windows are not rendered. Because it takes time and computer resources to render a window, minimizing 3-D viewer windows can significantly speed up your work!

Let's practice minimizing windows in the Playback Editor. Start by opening a case:

- Click on *File* menu option and choose *Open*. The HVE File Selection dialog is displayed.
- Select EdhisTutorialEDC and press *OK*.
- Choose *No* to the request to save the changes to the current case.

The selected case file is loaded into HVE and the Vehicle Editor displays the current vehicle in the Active Vehicles list and 3-D viewer.

- Choose *Playback* mode. The Playback Editor is displayed, as shown in Figure 32-7.
- Click on the *Traj Sim* window to bring it to the top of the desktop.

- Click on the Dialog Control button and choose *Minimize*. The Traj Sim window is turned into an icon as shown in Figure 32-8.

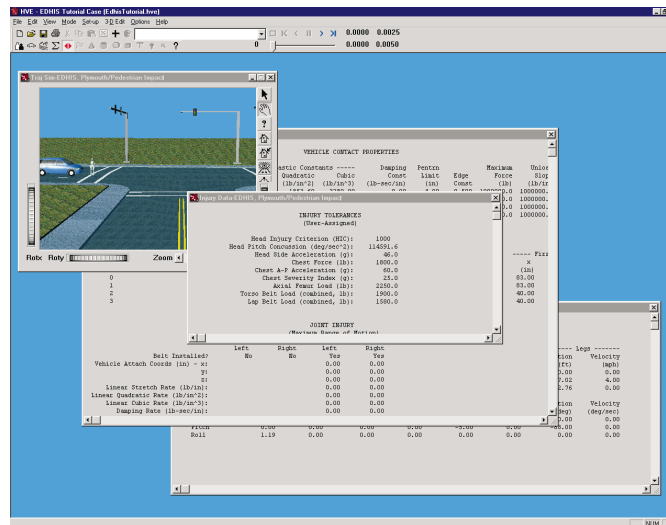


Figure 32-7 Playback Editor with multiple reports. In this case, the numerous reports make it difficult to manage the desktop, so we'll iconify the Traj Sim.

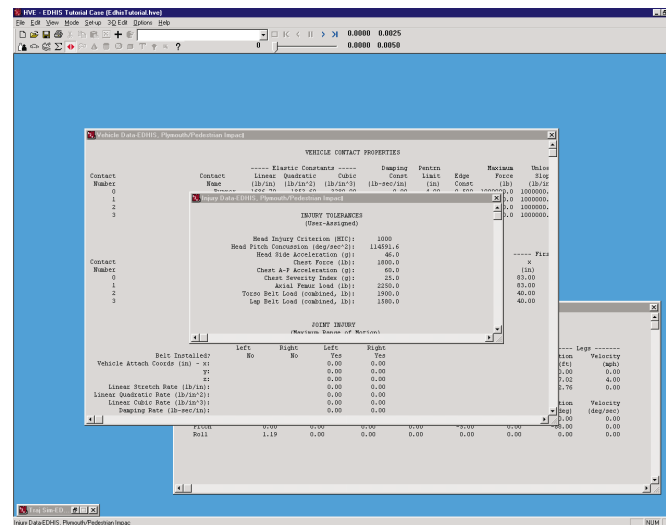


Figure 32-8 Playback Editor with multiple reports. This case differs from Figure 32-7, above, in that one of the report windows has been iconified (note the HVE Traj Sim icon is displayed along the bottom of the desktop).

Choosing an Editor

HVE is designed around five fundamental editors. These editors are:

- **Human Editor** - Used for selecting and editing 3-D humans
- **Vehicle Editor** - Used for selecting and editing 3-D vehicles
- **Environment Editor** - Used for selecting and editing 3-D environments
- **Event Editor** - Used for setting up and executing reconstruction and simulation models
- **Playback Editor** - Used for creating visual and numeric output reports and videos

This lesson teaches you how to quickly navigate between these editors. To make this lesson a little more interesting and useful, we'll use the current case to illustrate the various HVE editors. Continuing from the previous discussion, we're in the Playback Editor. Let's switch to Human mode.

 **NOTE:** Switching to Human mode is synonymous with selecting the Human Editor.

Switching editors is performed using the Mode Selector located at the left hand side of the toolbar (refer to Figure 32-5). To switch to Human mode:


- Press the Mode Selector's *Human* pushbutton. The Human Editor is displayed with the current human, *Female Adult Pedestrian*, selected in the Active Humans list and displayed in the Human 3-D viewer (see Figure 32-9).

Switch to Vehicle mode:

- Press the Mode Selector's *Vehicle* pushbutton. The Vehicle Editor is displayed with the current vehicle, *Plymouth Voyager Van*, selected in the Active Vehicles list and displayed in the Vehicle 3-D viewer, as shown in Figure 32-10.

Next, let's display the Environment Editor. To switch to Environment mode:

- Press the Mode Selector's *Environment* pushbutton. The Environment Editor is displayed with the current environment, *Untitled Environment*, displayed in the Environment 3-D viewer, as shown in Figure 32-11.

 **NOTE:** There is no Active Environments list, because there is only one environment.

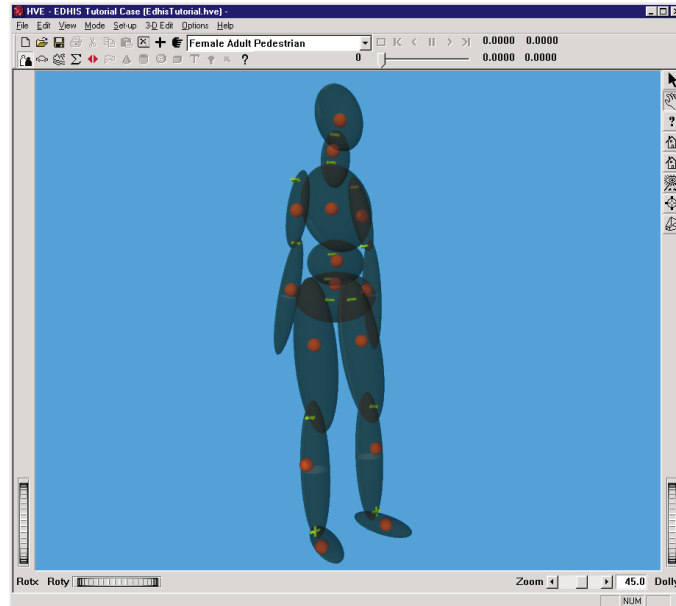


Figure 32-9 Human Editor with the active human, *Female Adult Pedestrian*, displayed in the Human 3-D Viewer.

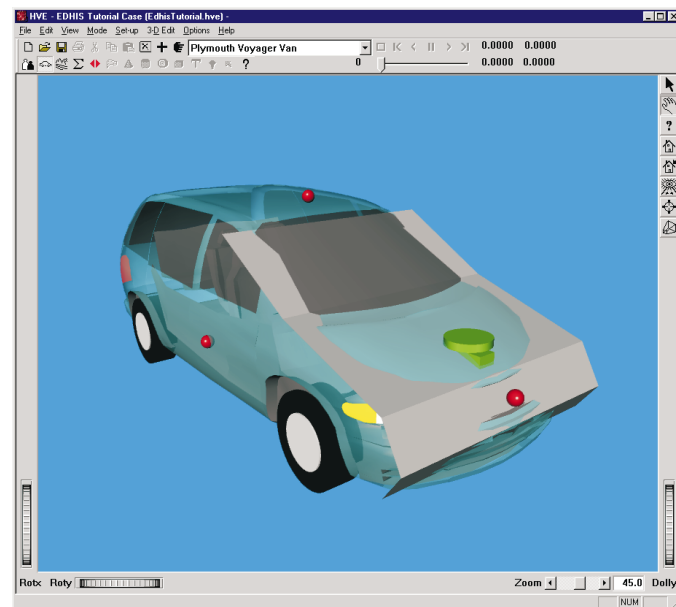


Figure 32-10 Vehicle Editor with the active vehicle, *Plymouth Voyager Van*, displayed in the Vehicle 3-D Viewer. Contact surfaces, used for the pedestrian impact simulation, are displayed on the vehicle if the Show Contacts option is selected.

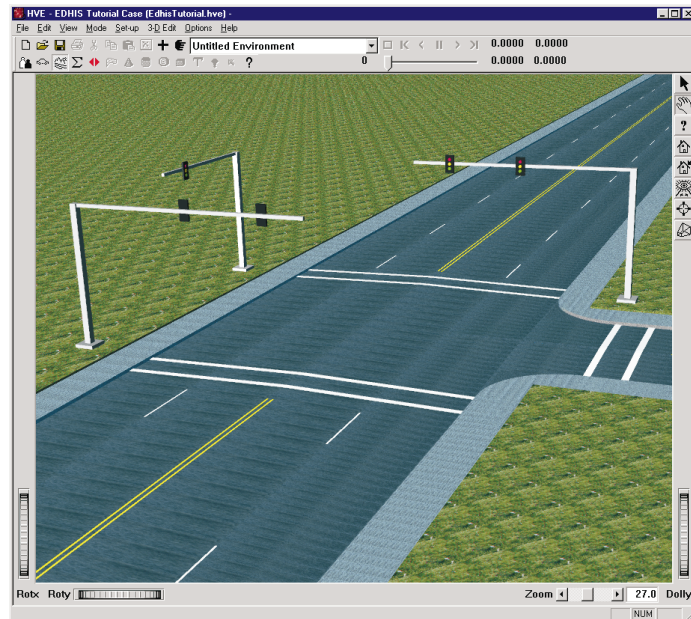


Figure 32-11 Environment Editor with the current environment, *Untitled Environment*, displayed in the 3-D viewer.

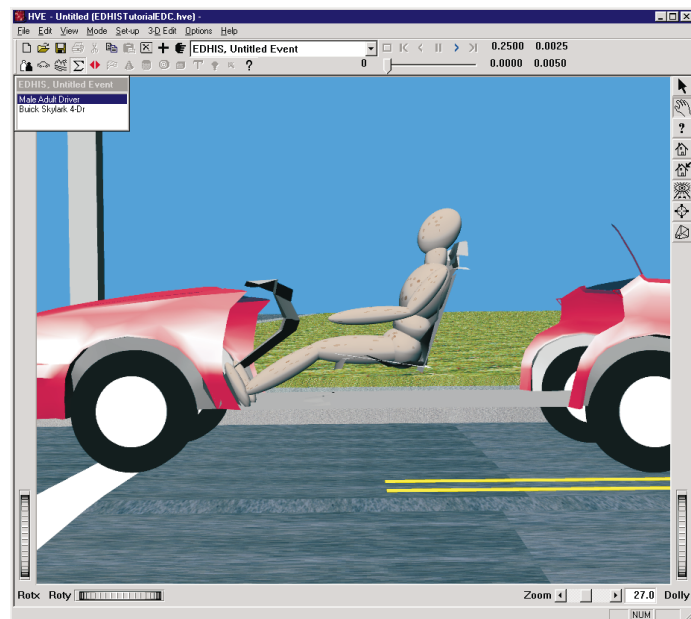


Figure 32-12 Event Editor with the current event, *EDHIS, Buick/Ford, 90 deg*, displayed in the 3-D viewer.

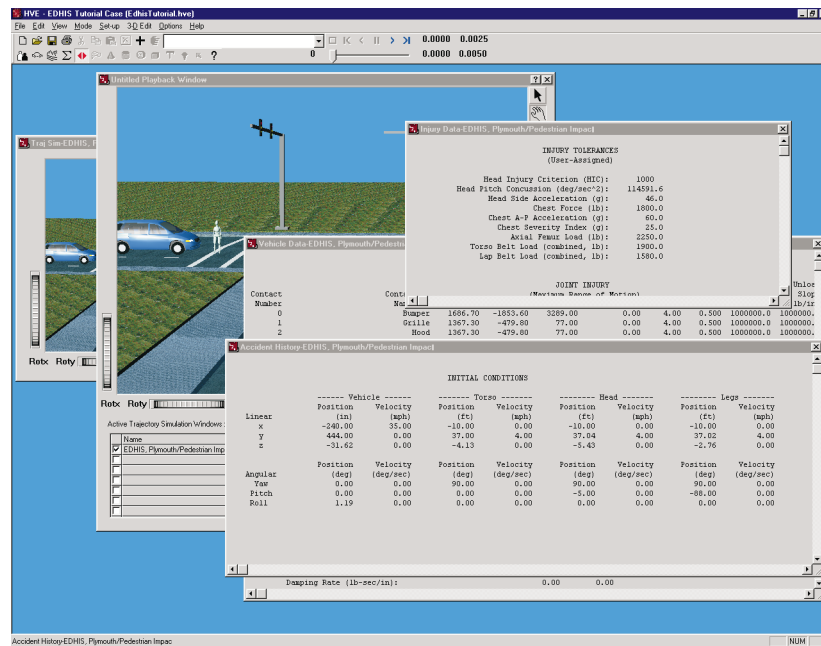


Figure 32-13 Playback Editor with several report windows displayed on the desktop.

Switch to Event mode:

- Press the Mode Selector's *Event* pushbutton. The Event Editor is displayed with the current event, *EDHIS, Buick Occupant*, displayed in the Active Events list and displayed in the Event 3-D viewer, as shown in Figure 32-12.

Switch to Playback mode:

- Press the Mode Selector's *Playback* pushbutton. The Playback Editor is displayed and several reports are displayed, as shown in Figure 32-13.

 **NOTE:** The Playback Editor displays all selected reports. This allows you to compare results from several events.

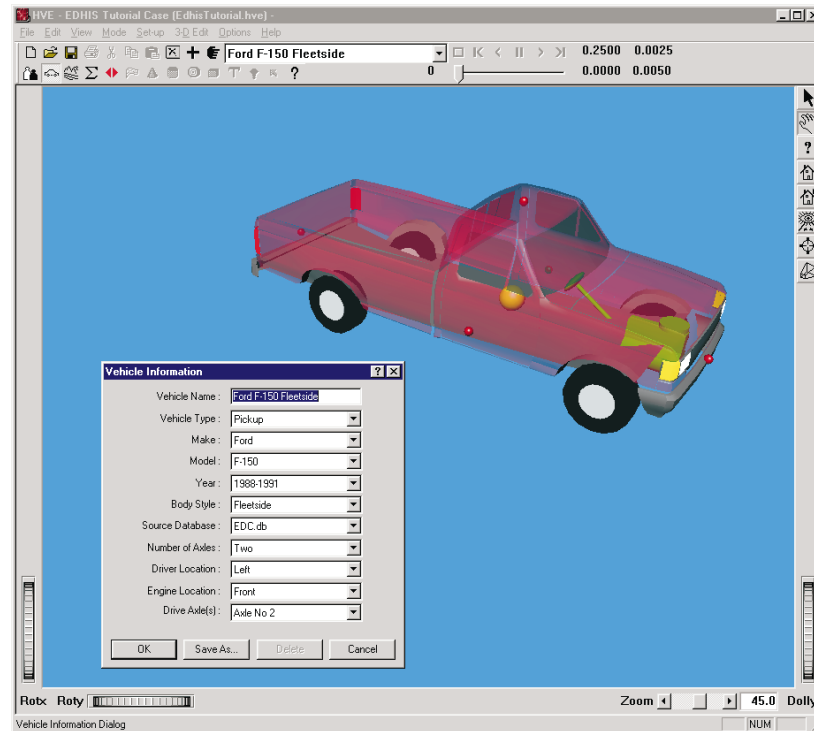


Figure 32-14 Vehicle Information dialog, displaying the current vehicle's basic attributes.

Switch back to Vehicle Mode:

- Press the Mode Selector's *Vehicle* pushbutton.

The Vehicle Editor is displayed with the current vehicle. Let's change the current vehicle:

- Choose *Ford F-150 Fleetside* in the Active Vehicles list. The chosen vehicle becomes the current vehicle and is displayed in the 3-D Vehicle viewer.

Let's take a look at *Ford F-150 Fleetside*'s basic vehicle attributes (*Driver Location*, *Engine Location*, *Number of Axles*, *Drive Axles*):

- Click on the *Object Info* button on the toolbar.. The Vehicle Information dialog for *Ford F-150 Fleetside* is displayed, showing its basic attributes, as shown in Figure 32-14
- Press *Cancel* to remove the Vehicle Information dialog.

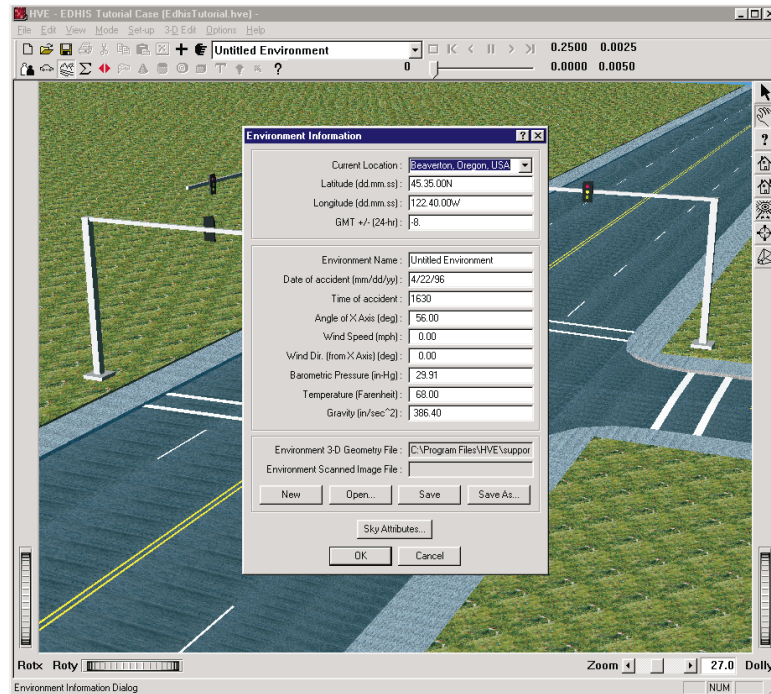


Figure 32-15 HVE Environment Editor, displaying the Environment Information dialog. This dialog is used for assigning the primary environment attributes, such as temperature, barometric pressure, and other information.

Switch to Environment mode:

- Press the Mode Selector's *Environment* pushbutton. The Environment Editor is displayed with the current environment in the 3-D viewer.

Let's take a look at the current environment attributes. These are displayed in the Environment Information dialog. To display this dialog, perform the following steps:

- Click on the *Object Info* button on the toolbar. The Environment Information dialog is displayed, as shown in Figure 32-15.

The Environment Information dialog is used for assigning physical event information (*sun position*, *wind direction* and *velocity* for aerodynamics calculations, *air temperature* and *pressure* for use in air density calculations, and *gravity constant*, for NASA engineers doing Martian vehicle simulation).

The Environment Information dialog may also be used for assigning a 3-D geometry file to drive on, as well as sky color and fog for visibility studies.

- Press *Cancel* to remove the Environment Information dialog.


Using Dialogs

HVE has more than 200 dialogs for entering and editing information. All HVE dialogs have default information already assigned. Therefore, when using a dialog, you are always editing existing default data.

Modal vs Modeless Dialogs

HVE (and most other applications) use two different types of dialogs: *Modal* and *Modeless*.

A *modal* dialog requires the user to complete an action by pressing *OK* or *Cancel* before another action can be performed.

 **NOTE:** You cannot make any other program selection until you remove the modal dialog.

On the other hand, a *modeless* dialog allows you to enter and edit data in the dialog, as well as to make selections from the menu bar and manipulate objects in viewers while the dialog is still displayed.

Let's explore the use of these dialogs. First, let's look at a typical modal dialog:


- Click on *File* menu option and choose *Open*. The HVE File Selection dialog is displayed.
- Using the HVE Mode Selector, choose *Event* mode.

Note that HVE beeps. This happens is because the File Selection dialog is a modal dialog. You cannot perform any other operations until the File Selection dialog is removed, either by pressing the dialog's *OK* or *Cancel* button.

- Choose *Cancel*. The File Selection dialog disappears.
- Choose *Event* mode. The Event Editor is displayed, and the current event is displayed in the 3-D viewer.

Now, let's look at a modeless dialog. The most important example is the Position/Velocity dialog used by the Event Editor:

- Click on *Male Adult Driver's* pelvis segment in the Event 3-D viewer. The Position/Velocity dialog for the current human is displayed, as shown in Figure 32-16.

 **NOTE:** You can tell right away that the Position/Velocity dialog is a modeless dialog because it does not have the *OK/Cancel/Help* buttons like a modal dialog.

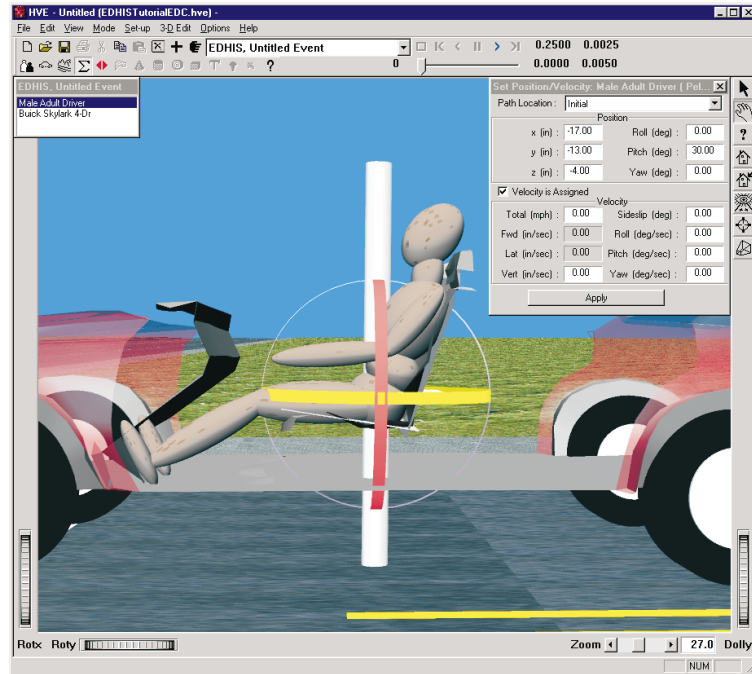


Figure 32-16 HVE Event Editor's Position/Velocity dialog.

Let's get some practice using a modeless dialog:

- Place the mouse cursor in the Position/Velocity dialog's Z coordinate field and change the value to -20.00 inches from -4.00 inches.
- Press the <Enter> key or the *Apply* button. The human's position is updated.

NOTE: Notice that nothing happened until you pressed the <Enter> key! This is a big difference between modal dialogs (with an OK button) and a modeless dialog: Pressing OK on a modal dialog is like pressing <Enter>; since a modeless dialog does not have an OK button, you must explicitly press <Enter> for the value(s) in the dialog to be updated.

NOTE: You can enter several values into the dialog, then press <Enter> once to have all the values updated at the same time. This can save some time when updating a human's or vehicle's position, since HVE re-renders the viewer whenever the viewer's contents change.

Using 3-D Viewers

HVE uses 3-D viewers to display humans, vehicles and the environment. Of course, 3-D viewers are also used to visualize the motion of these objects during Event and Playback modes.

HVE's 3-D viewers have many features that make it easy for the user to select how the 3-D objects are displayed. In particular, the user can perform the following viewer operations:

- Resizing the viewer
- Panning the contents in the viewer
- Zooming in and out
- Dollying in and out
- Changing the camera position

These operations are described below.


Resizing Viewers

The size of the viewer is controlled by the user. To resize a 3-D viewer, perform the following steps (refer to Figure 32-17):

- Close the Position/Velocity dialog still displayed on your screen. Be sure *Show Key Results* has been selected from the *Options* menu.
- Click on the right edge of the Key Results viewer frame (note the cursor changes shape) and drag it to the left. The viewer grows in width.
- Click on the lower edge of the viewer frame and drag it down. The viewer grows in height.
- Click on the bottom left corner edge of the viewer frame and drag it to the lower left corner of the screen. The viewer grows in both width and height.

Notice by resizing the Key Results viewer, we've covered up the Event ObjectsList viewer. Perform the following steps:

- Click on the left edge of the Event Objects List to bring the dialogs to the top of the desktop.

 **NOTE:** While 3-D viewers may be resized, dialogs normally cannot.

Spend a few moments practicing resizing the viewers and bringing various desktop objects to the top of the desktop.

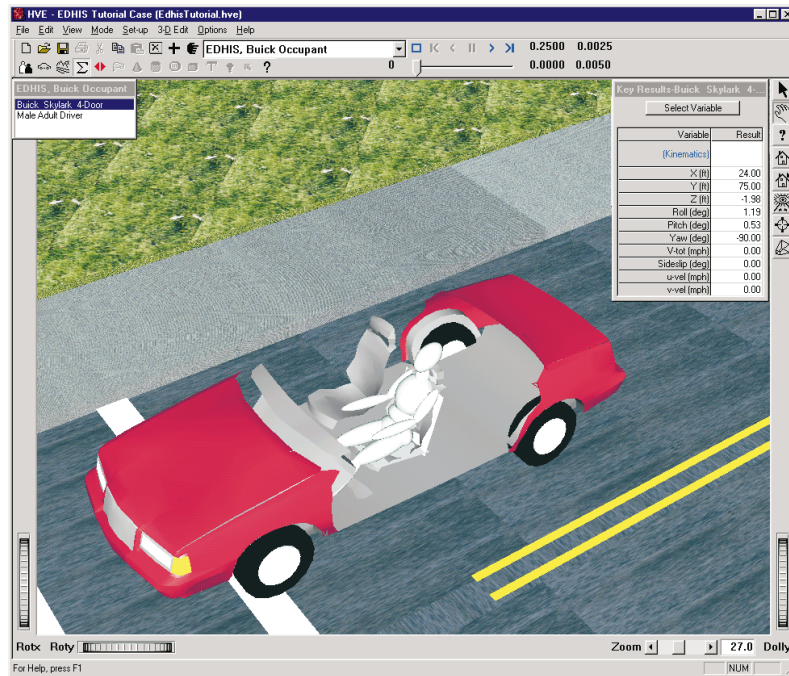


Figure 32-17 Using HVE 3-D viewers. Click on any edge and/or corner to resize the viewer. In general make your viewers nice and *BIG!*

Panning

Panning involves moving the scene horizontally and vertically within the 3-D viewer.

To pan the scene, perform the following steps:

- Confirm the viewer is manipulate mode (the current viewer mode is set by clicking on the hand icon along the upper right edge of the viewer). If necessary, click on the hand icon.
- Place the mouse cursor in the middle of the viewer.
- Press the middle mouse button and drag to the right. You may also press the left mouse button while holding down the <Shift> key to perform the same operation. The viewer contents are dragged to the right, as shown in Figure 32-18.
- Press the middle mouse button and drag to the left. The viewer contents are dragged to the left.
- Use the same procedures to drag the viewer contents up and down.

Spend a few moments practicing panning the contents in the viewer.

Zooming In and Out

Zooming involves changing the lens of the virtual camera that HVE uses to display the objects in the viewer. The current zoom status and zoom slider are located along the right end of the lower edge of the viewer.

To zoom in, perform the following steps:

- Click on the *Zoom* slider and drag the slider to the left. The camera zooms in on the scene. This is analogous to changing from a 50 mm camera lens to a 150 mm telephoto lens.

To zoom out, perform the following steps:

- Move the slider to the right. The camera zooms back away from the scene. This is analogous to changing back to a 35 mm lens.


Zoom back to the original camera state:

- Move the slider back to the left until the scene returns to its original size in the viewer, as shown earlier in Figure 32-17.

Dollying In and Out

Dollying involves changing the camera position, moving it closer to, or further away from, the object (just like in filming a movie scene). To dolly in and out, perform the following steps:

- First confirm the viewer is in manipulate mode: Place the mouse cursor in the middle of the viewer and press the <Escape> key. The viewer switches modes, as indicated by the icons along the upper right edge of the viewer.
- Press the mouse cursor in the middle of the viewer and press <Escape> again, and again, and again... Note the viewer toggles between *Pick* and *Manipulate* mode. Leave the viewer in *Manipulate* mode.

 **NOTE:** We've illustrated two equivalent methods for switching viewer modes (clicking the viewer Mode icons or pressing <Escape>). The method you choose is up to you.

- Place the mouse cursor in the middle of the viewer.
- Press both the left and middle mouse buttons and drag down. You may also press the left mouse button while holding down the <Shift> + <Ctrl> keys to perform the same operation. The camera dollies in, as shown in Figure 32-19.

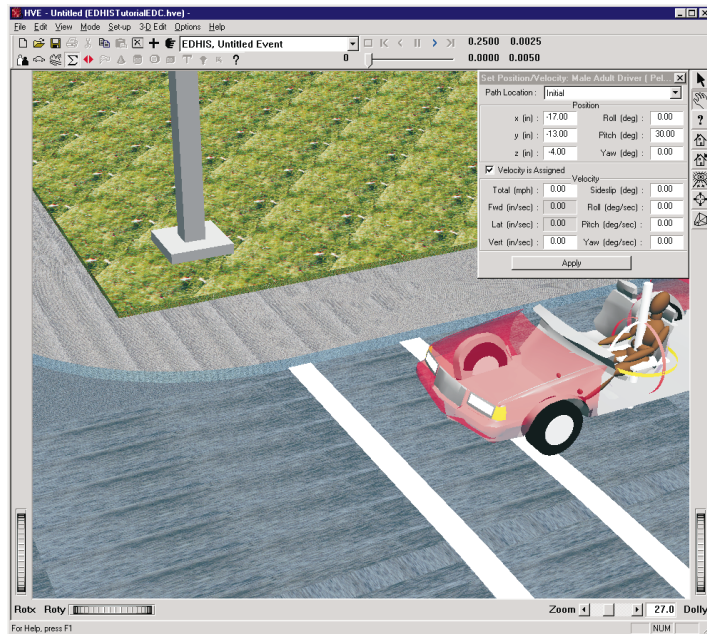


Figure 32-18 Panning the camera in a 3-D viewer.

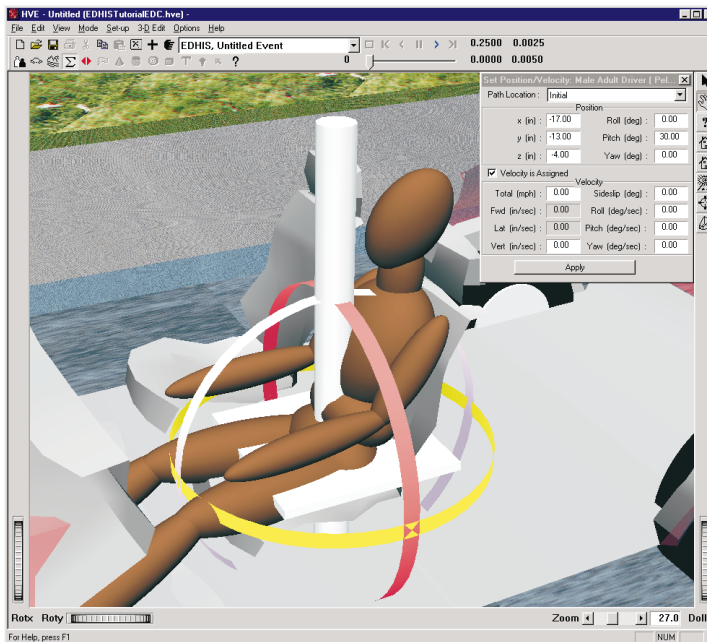




Figure 32-19 Dolly the camera in a 3-D viewer.

- Place the mouse cursor in the middle of the viewer, press both the left and middle mouse buttons and drag up. The camera dollies out.


Let's use a different method to dolly in and out:

- Click the mouse cursor near the top of the *Dolly* thumb wheel (located along the lower right edge of the viewer) and drag down. The camera dollies in.
- Drag the *Dolly* thumb wheel up. The camera dollies back.
- Click on the *Dolly* thumb wheel and drag the mouse cursor to the top of the viewer. The camera dollies waaaaaaay back.

 *NOTE: We've just illustrated the thumb wheel's range of motion is not limited by its visible size.*

 *NOTE: We've also illustrated you can dolly in and out using direct manipulation in the viewer or using the Dolly thumb wheel. These two methods are equivalent. The method you use is up to you.*

Use either method (direct viewer manipulation or *Dolly* thumb wheel) to dolly back in until the vehicle returns to its original size.

 *NOTE: Both dollying and zooming appear to have the same effect, that is, to make objects appear larger. However, if you zoom in too close, the objects become distorted just as if you were using a fisheye lens. For this reason, we recommend dollying instead of zooming if your goal is to get a close-up view.*

Changing Camera Position

The final task we need to learn about viewer manipulation is changing camera position. This is a very important task, because if you're good at it, you can quickly and effortlessly look exactly where you want to look. The initial view of the vehicle was shown earlier in Figure 32-17. To look at the back of the vehicle, perform the following steps:

- Place the viewer in *Manipulate* mode, using either of the methods described above.
- Place the mouse cursor about 2 inches (5 cm) to the left of the center of the viewer.
- Click the left mouse button and drag the mouse horizontally. The vehicle spins about the viewer's vertical axis.
- Place the mouse cursor about 2 inches below the center of the viewer.

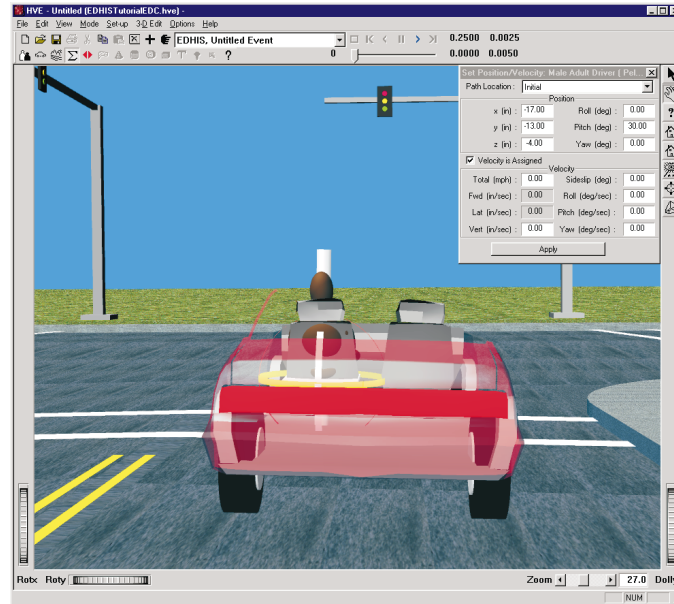




Figure 32-20 Moving the camera in a 3-D viewer.

- Click and drag the mouse vertically. The vehicle spins about the viewer's horizontal axis.
- Place the mouse cursor somewhere else in the viewer (you choose the location) and drag vertically. The vehicle spins about the center of the viewer.

 **NOTE:** This is an important concept! While using direct manipulation of the viewer, it always spins about the center of the viewer.

- Spend a moment or two to practice using direct manipulation to change the view. As a final exercise, see how quickly and easily you can recreate the view shown in Figure 32-20.

 **NOTE:** We suggest deciding on an area of the vehicle to look at, then see how quickly you can manipulate the scene to get it in the middle of the viewer.

As a final tutorial exercise, continue looking at various parts of the vehicle using direct manipulation and a combination of panning (middle mouse or left mouse + <Shift>), dolly (left and middle mouse or left mouse + <Shift> + <Ctrl>) and rotating (left mouse). Spend some time here! By mastering the task of viewer manipulation, you will benefit every time you use HVE. In particular, you will be able to work faster, and you will be able to better visualize your work.

Shutting Down HVE

When you are finished working with HVE, you will end your session by saving your work and exiting HVE. It is important to exit HVE gracefully because HVE asks you to save your work if it has changed since your last save, and because HVE updates your configuration file so your next HVE session uses the same preferences and options you've selected for use in the current session. HVE also saves the current editor when you exit; thus, when HVE is next used, it will display the same editor you were using when you last exited HVE.

To shut down HVE:

- Click on the *File* menu and choose *Exit*.

Because your work case file has changed since your last save, HVE asks you to save or cancel these changes.

- Choose *No*.

HVE is shut down and you may now go have lunch.

Lesson 2 - Running a Simulation Model

Lesson 2 is a high-level overview describing how to use HVE to execute a single event (reconstruction or simulation program). In this tutorial, we'll execute an EDVSM simulation.


In this lesson you will learn to perform the following tasks:

- Selecting Humans
- Selecting Vehicles
- Selecting Environments
- Creating Events
- Setting Up Events
- Executing Events

Mastering these tasks is important because they are the same tasks you'll use every time you use HVE - regardless of the reconstruction or simulation model you're executing.

Let's get started. Before we can get into the individual tasks, we need to have HVE up and running:

- If necessary, start HVE and arrange your desktop.

 **NOTE:** If you don't know what we are talking about, return to Lesson 1!

Selecting Humans

We'll start by adding a human to our case:

- Switch to *Human* mode. The Human Editor is displayed.

Let's add a 50th percentile male adult:

- Click *Add New Object*. The Human Information dialog is displayed. The Human Information dialog includes option buttons allowing the user to select a seat position within the vehicle (alternatively, *Pedestrian* could be selected), and assign the human's attributes according to *Sex*, *Age*, *Weight Percentile* and *Height Percentile*.
- Using these option buttons, click each button to choose the following human attributes:
 - Location = *Front, Left*
 - Sex = *Male*
 - Age = *Adult*
 - Weight Percentile = *50*
 - Height Percentile = *50*

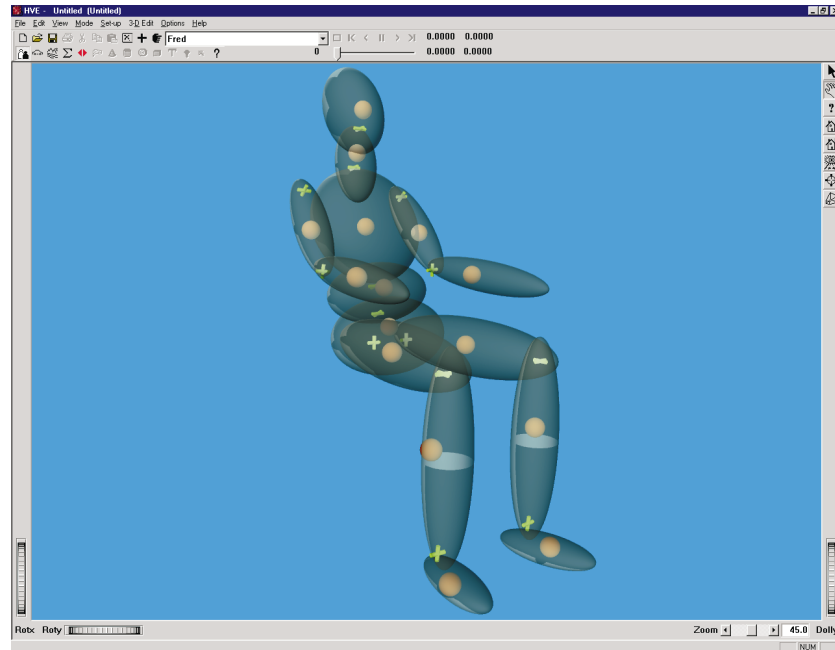



Figure 32-21 Human Editor with *Fred* displayed in the 3-D viewer.

Let's replace the default name with more meaningful one:

- Enter: *Fred*.
- Press *OK*.

Fred is displayed in the Human Editor's 3-D viewer, as shown in Figure 32-21. He is in a seated position because we assigned *Fred* as an occupant.

Spend a few moments visualizing *Fred* using the techniques we used in Lesson 1 (Using 3-D Viewers).

 **NOTE:** If you spin him really fast, *Fred* should appear to be break dancing.

Selecting Vehicles

Now, let's add a 1968 Dodge Charger to the case:

- Choose *Vehicle Mode*. The Vehicle Editor is displayed.

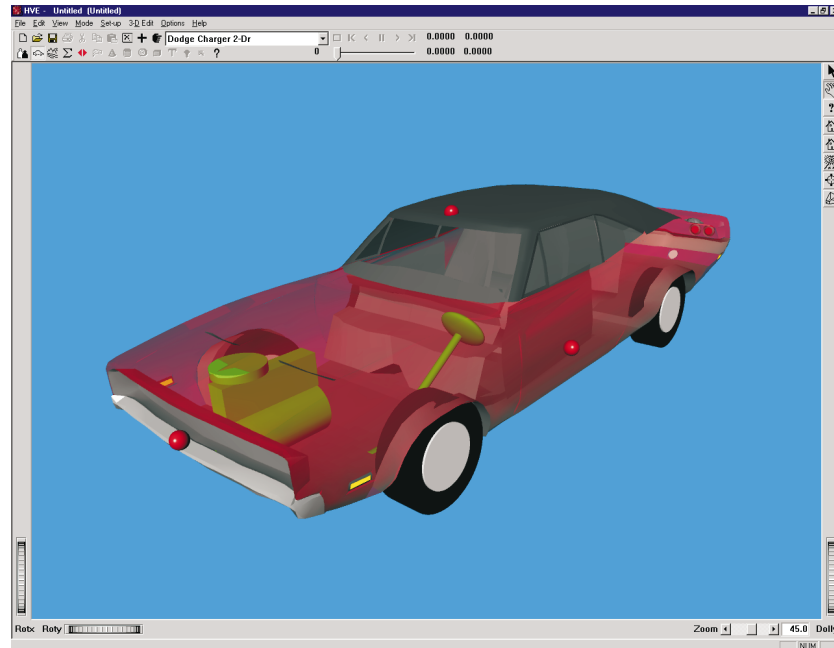



Figure 32-22 Vehicle Editor with *Dodge Charger 2-Dr* displayed in the 3-D viewer.

- Click *Add New Object*. The Vehicle Information dialog is displayed. The Vehicle Information dialog allows the user to select the basic vehicle attributes according to *Type*, *Make*, *Model*, *Year* and *Body Style*.

 **NOTE:** The Vehicle Information dialog also allows you to edit the *Driver Location*, *Engine Location*, *Number of Axles* and *Drive Axle(s)*. These options affect the basic vehicle configuration and do not need to be changed for our tutorial.

- Using the option buttons, click each button to choose the following vehicle from the database:
 - Type = *Passenger Car*
 - Make = *Dodge*
 - Model = *Charger*
 - Year = *1968 - 1970*
 - Body Style = *2-Door*
- Click *OK* to add *Dodge Charger* to the Active Vehicles list.

The 1969 Dodge Charger is displayed in the Vehicle Editor's 3-D viewer, as shown in Figure 32-22.

Again, visualize the Charger, spinning it around and dollying in and out.

Selecting Environments

Next, let's add an environment to the case.

- Switch to *Environment* mode.
- Click on *Add New Object*. The Environment Information dialog is displayed.

Let's not bother with all the options here. But, we do want an environment to drive on.

- Choose *Open*. The 3-D Geometry File Selection dialog is displayed (see Figure 32-23).

If the current format option is not HVE:

- Click on the *Files of Type* option list and choose HVE files. 3-D geometry files of the HVE format are displayed in the listbox.

Now, let's select a 3-D geometry file for our EDVSM event:


- Scroll down and choose *4x2_Intersection.h3d*.
- Press *OK*. The File Selection dialog is removed.

Next, let's replace the default environment name (Untitled Environment):

- Enter *Tutorial Lesson 2 Intersection*
- Press *OK*.

The selected environment is displayed in the Environment Editor's 3-D viewer, as shown in Figure 32-24.

Spend a few moments spinning it around and dollying in and out.

 **NOTE:** We hope you are becoming an expert at using the viewer controls to visualize 3-D objects. This is an important part of becoming an efficient HVE user.

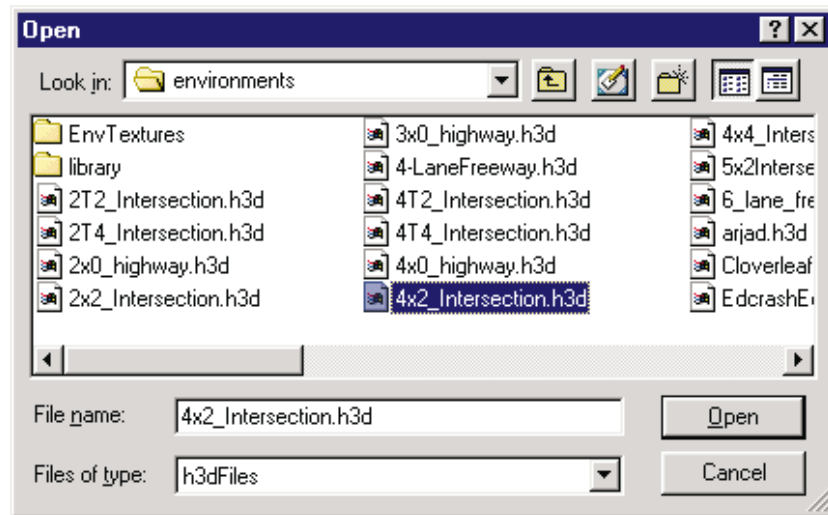


Figure 32-23 3-D Geometry File Selection dialog, used for selecting a 3-D geometry file for driving on. The *Files of Type* options list allows us to select the HVE file format.

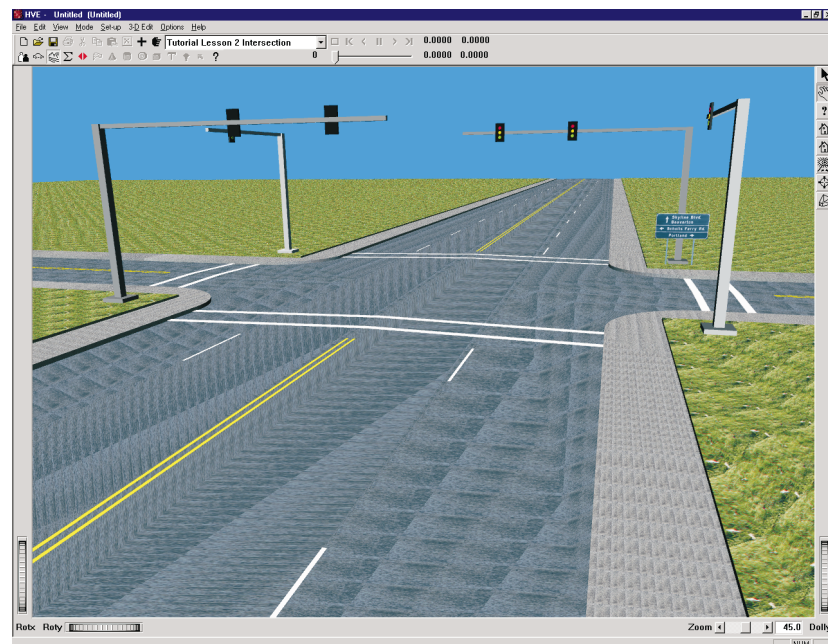


Figure 32-24 Environment Editor with *Tutorial Lesson 2 Intersection* displayed in the 3-D viewer.

Event Editor

Now, let's get to the major focus of this lesson: Using the Event Editor. This involves three steps:

- **Creating the Event** - This step involves choosing the humans and vehicles, and the calculation method (reconstruction or simulation model) for the event.
- **Setting Up the Event** - This step involves assigning the position and velocity for each human and vehicle in the event. This step can also involve assigning driver controls, restraint systems, damage profiles, and numerous other event set-up options for each object, as well as assigning simulation controls and various calculation-specific options.
- **Executing the Event** - This step involves pressing the Execute pushbutton and observing the results. It also normally involves making adjustments to specific input parameters to improve the results as well as to perform range-checking runs to identify potential sensitivities in various input parameters.

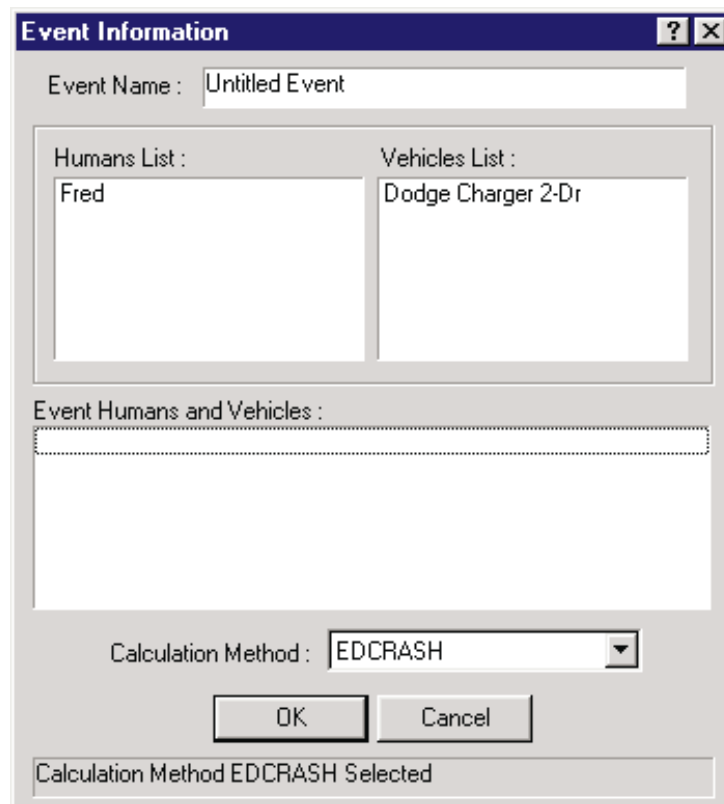
Let's create our event:

- Switch to *Event Mode*.
- Click on *Add New Object*. The Event Information dialog is displayed, as shown in Figure 32-25 on the following page. Among its components, the Event Information dialog contains the *Active Humans list*, *Active Vehicles List* and *Calculation Method* option list. These are the key components required for creating an event.
- Select the *Dodge Charger* from the Active Vehicles list. It is added to the Event Humans & Vehicles list.
- Click on the *Calculation Method* option list and choose *EDVSM*.
- Change the default event name. Enter *Sample Event*.
- Press *OK*.

We have created an EDVSM event using the Dodge Charger. The Event 3-D viewer displays our environment.



NOTE: Although our human, Fred, is available for service for an occupant crash simulation, we're not going to use him in our tutorial (right now, Fred's feeling pretty lucky).




The image shows a software dialog box titled "Event Information". It has a standard Windows-style title bar with a question mark icon and a close button (X). The dialog contains several input fields and lists:


- Event Name :** A text box containing "Untitled Event".
- Humans List :** A list box containing the name "Fred".
- Vehicles List :** A list box containing the text "Dodge Charger 2-Dr".
- Event Humans and Vehicles :** A large, empty rectangular area with a dotted border, likely for additional details or a diagram.
- Calculation Method :** A dropdown menu currently showing "EDCRASH".
- Buttons:** "OK" and "Cancel" buttons are located below the dropdown.
- Status Bar:** At the bottom, a text box displays "Calculation Method EDCRASH Selected".

Figure 32-25 Event Information dialog, used for creating events. Creating an event involves choosing the humans, vehicles and calculation method that will be used for the event.


The next step is to set up our event. For our sample event, we'll need initial position and velocity and a steer table. Let's proceed:


- If necessary, select *Dodge Charger* in the Event Humans & Vehicles list.
- Choose *Set-up* from the menu bar. The Event Set-up options for EDVSM are displayed in the Set-up menu, as shown in Figure 32-26.

 **NOTE:** *If no object is selected, no options will be enabled in the Set-up menu.*

 *Only the event set-up options applicable to EDVSM are displayed in the Set-up Menu. That's because each physics program tells HVE which set-up options to make available in the Set-up Menu.*

- Select *Position/Velocity*. The Initial Position/Velocity dialog is displayed and the Dodge Charger appears in the Event 3-D viewer at the earth-fixed origin (see Figure 32-27).
- Enter the initial position coordinates: Place the mouse cursor in the X-coordinate field and enter -70.0 ft. Place the mouse cursor in the Y-coordinate field and enter 37.5 ft.
- Enter the initial velocity: Place the mouse cursor in the Total Velocity field and enter 25.0 mph, followed by <Enter>.

 **NOTE:** *We just did something subtle but smart: We waited until we had entered all our data before pressing <Enter>. We absolutely must press the <Enter> key to update the position and velocity. However, by waiting until we entered all the data before pressing <Enter>, we saved some time because the 3-D viewer was only updated once. If we pressed <Enter> after entering each individual coordinate value, the 3-D viewer would need to be re-rendered three times.*

 **NOTE:** *Clicking the Apply button is the same as pressing the <Enter> key.*

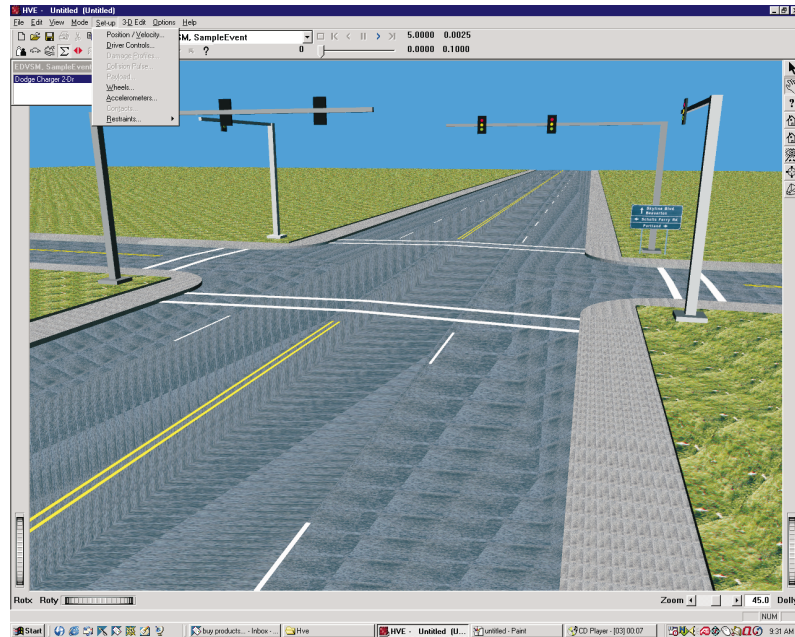


Figure 32-26 Event Editor's Set-up Menu. The Set-up Menu is used for setting up the event by entering event-related parameters for the selected human or vehicle.

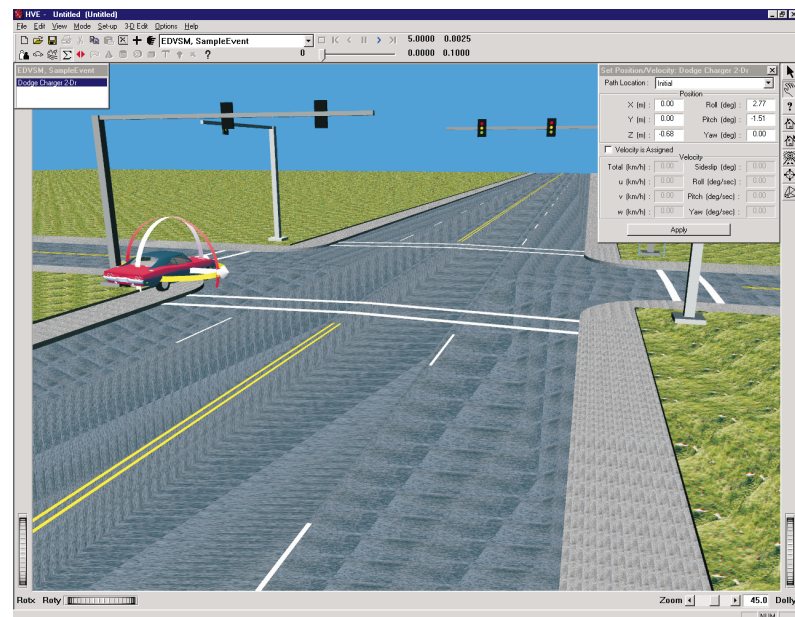


Figure 32-27 Event Editor just after placing our Charger into the event. Its default location is the earth-fixed origin.

Now, let's enter the steer table. For our example, we'll enter a simple left turn:

- Choose *Set-up* from the menu bar. The Event Set-up options for EDVSM are displayed.
- Select *Driver Controls*. Select the *Steer* tab on the dialog. The Steer Table dialog for the Dodge Charger is displayed.
- Enter the steer table, as shown in Table 32-1, below (see also Figure 32-28):


Table 32-1. Steer Table Table entries for the Dodge Charger's left turn.

Time (sec)	Steering Wheel Angle (Degrees)
0.00	0.0
0.50	0.0
1.00	-150.0
3.50	-150.0
4.00	0.0

- Press *OK* to accept the steer table.

Use the Event Controller, shown in Figure 32-29, to execute the EDVSM event. The Event Controller's buttons have the following functions, as described from right to left:

- **Reset** - Reinitialize the calculation model for re-execution
- **Rewind to Start** - Return to the start of the simulation
- **Reverse** - Play the simulation backwards
- **Pause** - Pause the simulation
- **Execute/Play** - Execute the event or play the simulation forwards
- **Advance to End** - Advance to the end of the simulation

 **NOTE:** If you make changes to any of the event set-up options (see previous section), those changes will have no effect unless you press *Reset* before pressing *Play*.

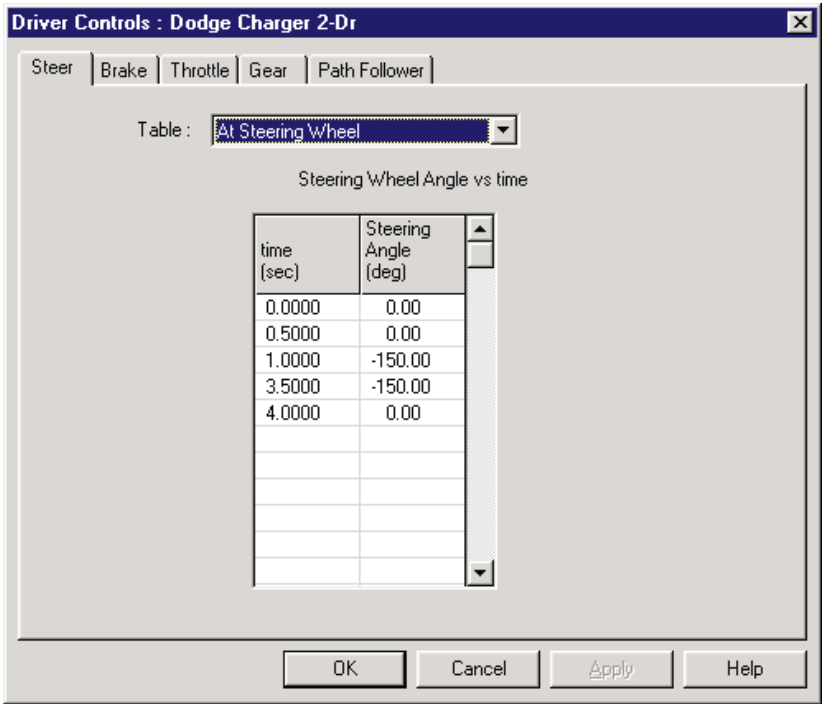


Figure 32-28 Steer Table dialog. Use this dialog to enter an open-loop steering table as a function of time. The steer table data are presented in the table below.



Figure 32-29 The Event Controller functions like a VCR controller.


To execute the event:

- Press *Execute/Play*.

The Dodge Charger begins moving as its motion is simulated according the Charger vehicle model, the current environment terrain, the initial position and velocity, and the specified driver steering inputs. See Figure 32-30. The vehicle simulation continues until the default maximum simulation time, 5.0 seconds, is reached.

Let's replay the event a few times, illustrating some useful options.

- Using the Event Controller, press *Rewind*.

 **NOTE:** Pressing *Rewind* allows us to rerun the event without re-executing the simulation; it simply redisplay the current output tracks. This saves a little time because the physics calculations are not re-executed.

As technical people, we tend to be interested in numeric data (as opposed to simply a nice animation of the motion). These numeric results are displayed in Key Results windows for each timestep while the simulation is executed. Our example includes a Key Results window for the Charger. If a Key Results window is not displayed on your desktop, let's display it:

- Choose *Options* from the menu bar, and click *Show Key Results*. The Key Results window for the Dodge Charger is displayed.

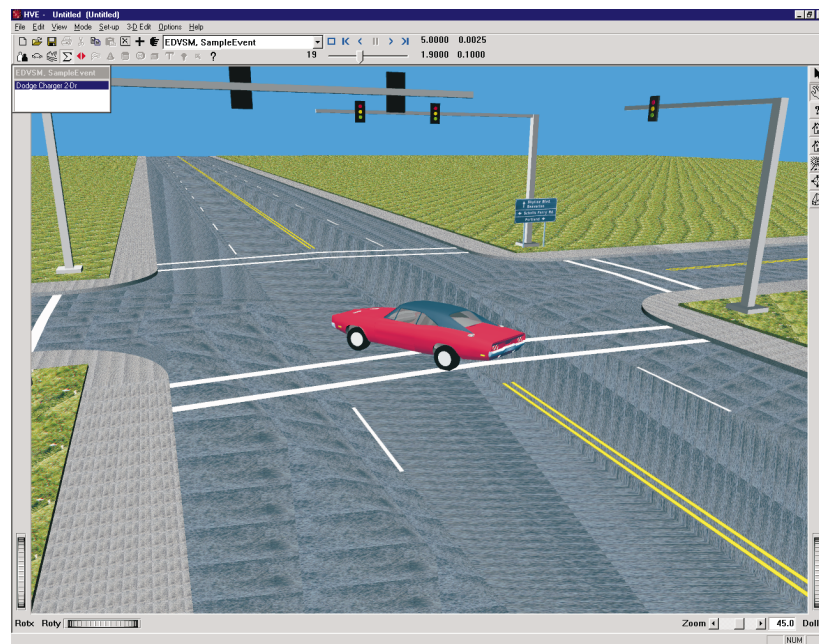


Figure 32-30 Event Editor while executing the event. We've dollied in closer for a better view. Feel free to practice your viewer manipulation skills.

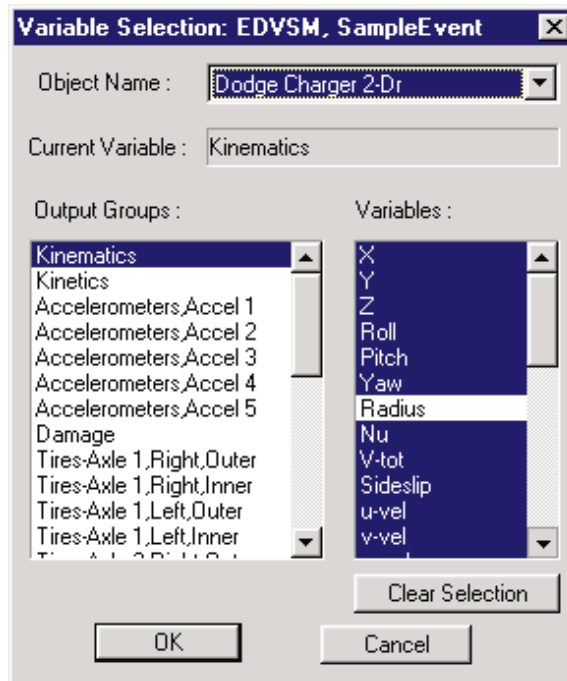


Figure 32-31 Variable Selection dialog for selecting Key Results.

By default, the vehicle's Sprung Mass Kinematics results are displayed (see Figure 32-31). Let's add Tire Forces to the Key Results window:

- Click on *Select Variables* in the Key Results window. The Variable Selection dialog is displayed.
- Click *Tires, Axle 1, Right, Outer*.

The Variables listbox for the select tire is displayed.

- Select F_x , F_y and F_z .
- Press *OK*.

The selected variables are added to the Key Results window (scroll down or, better yet, drag down the bottom of the Key Results window to increase its size so you can see all the window's results). The Event Editor with the Key Results window is shown in Figure 32-32.

- Using the Event Controller, press *Execute/Play*. The event is redisplayed, showing the selected Key Results for each timestep.

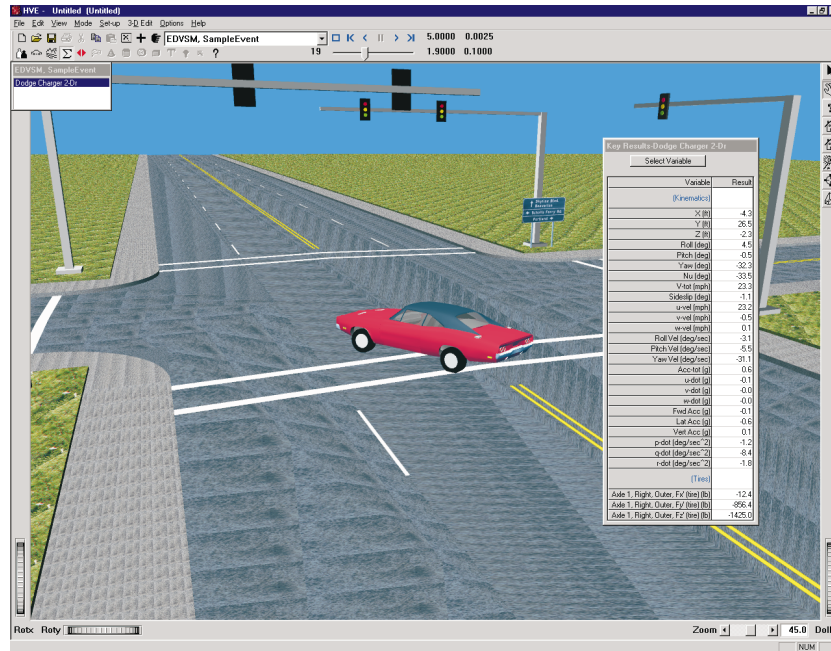



Figure 32-32 Event Editor with Key Results window displaying tire forces for the right front tire.

Spend a few moments replaying the event from different views, changing the camera position, panning and dollying in and out, using the techniques you learned earlier.

 **NOTE:** Like all events, our EDVSM event has produced several output reports (Accident History, Messages, Vehicle Data and several others). The Playback Editor is used to view (and possibly print) these reports. Refer to the EDVSM Program manual (or other program manual for a different simulation program) for further information.

This concludes Lesson 2 - Running a Simulation model. You can go ahead and shut down HVE or proceed directly to Lesson 3.

Lesson 3 - Combining Multiple Events

Most crashes involve a sequence of events (e.g., loss of control, collision, occupant ejection). HVE's open architecture allows users to choose the tool best suited for each specific event from a wide variety of reconstruction and simulation tools. The HVE Playback Editor includes the ability to combine these individual events into a single window, and to edit the sequence so each event is timed properly with respect to the other events. The result is a seamless, real-time view of the entire multiple-event sequence.

Lesson 3 is a tutorial describing how to use the HVE Playback Editor to combine multiple events into a single, coherent sequence.

In this lesson you will learn to perform the following tasks:

- Displaying Multiple Trajectory Simulation Events
- Combining the Multiple Events Into a Single Playback Window
- Editing the Time Sequence for the Events

As a result of performing these tasks, you will have prepared a powerful and compelling visualization of an entire multi-event collision sequence. These tasks are also a prerequisite for creating video output, the subject of Lesson 4.

Let's get started. Before we can get into the individual tasks, we need to have HVE up and running:

If necessary, start HVE.



NOTE: If you don't know what we are talking about, return to Lesson 1!

We'll start by opening an existing case in which several events have already been executed. We can use this case to illustrate the use of the HVE Playback Editor. Start by opening the case:

- Click on *File* menu option and choose *Open*. The HVE File Selection dialog is displayed.
- Select *HveTutorialLesson3EDC* and press *OK*.

The selected case file is loaded into HVE and the current editor (Human Editor, Event Editor...) displays the latest object in its Active 'Objects' list. We'll start by reviewing the previously executed events:

- If the Event Editor is not currently displayed, choose *Event* mode.


The Event Editor is displayed.

Our tutorial case includes five events. The last of the five events, *EDVDS, Tractor-Trailer Avoidance*, is displayed in the Event 3-D Viewer, as shown in Figure 32-33. The complete list of events in the Active Events list is as follows:

- **Event 1** - *EDSMAC4, 3-Vehicle Crash*. The three vehicles are a Ford Taurus, a Honda Accord, and a Chevrolet Suburban.
- **Event 2** - *EDVSM, Ford Taurus Post-impact*.
- **Event 3** - *EDVSM, Honda Accord Post-impact*.
- **Event 4** - *EDVSM, Chevrolet Suburban Post-impact*.
- **Event 5** - *EDVDS, Tractor-trailer Avoidance*.

Let's go through the individual events, one at a time:

- Choose *EDSMAC4, 3-Vehicle Crash* from the Active Events list. *EDSMAC4, 3-Vehicle Crash* is displayed in the Event Viewer. All vehicles are displayed at their initial positions.
- Using the Event Controller, press *Play*. *EDSMAC4, 3-Vehicle Crash* is visualized in the Event 3-D viewer.

 **NOTE:** You are encouraged to manipulate the scene in the 3-D viewer and watch the event from different perspectives.

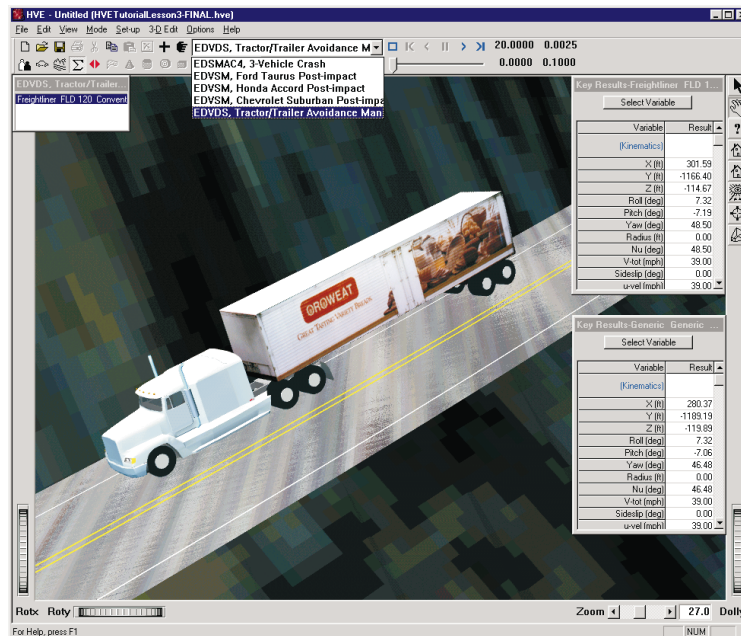



Figure 32-33 Event Editor. The Active Events list displays the names of five events that were part of the case file we opened. The last of these events, *EDVDS, Tractor-trailer Avoidance*, is displayed in the 3-D viewer.

Now, let's look at the second event, *EDVSM, Ford Taurus Post-impact*:

- Choose *EDVSM, Ford Taurus Post-impact*, from the Active Events list. *EDVSM, Ford Taurus Post-impact* is displayed in the Event 3-D viewer, with the Ford Taurus at its initial position.
- Press *Play* and watch as *EDVSM, Ford Taurus Post-impact* is visualized in the 3-D viewer.

Now, let's look at the third event, *EDVSM, Honda Accord Post-impact*:

- Choose *EDVSM, Honda Accord Post-impact*, from the Active Events list. *EDVSM, Honda Accord Post-impact* is displayed in the Event 3-D viewer, with the Honda Accord at its initial position.
- Press *Play* and watch as *EDVSM, Honda Accord Post-impact* is visualized in the 3-D viewer.

 **NOTE:** These events begin at separation, not at the start of the entire sequence.

Repeat the above steps to review the remaining two events. We encourage you to practice becoming an expert using the viewer controls.

Displaying Multiple Trajectory Simulations

Now, let's use the HVE Playback Editor to combine the events into a single sequence.

- Choose *Playback* mode. The Playback Editor is displayed, as shown in Figure 32-34.

Initially, no reports are displayed. Let's add our Trajectory Simulation reports:

- Click *Add New Object*. The Report Window Information dialog is displayed, showing each of our events in the Active Events list, as shown in Figure 32-35 on the following page.
- Select the first event in the Active Events list, *EDSMAC4, 3-Vehicle Crash*.
- Click on the *Select Output* option list and choose *Traj Sim*.
- Press *OK*.

The Trajectory Simulation window for the first event is displayed (see Figure 32-36).

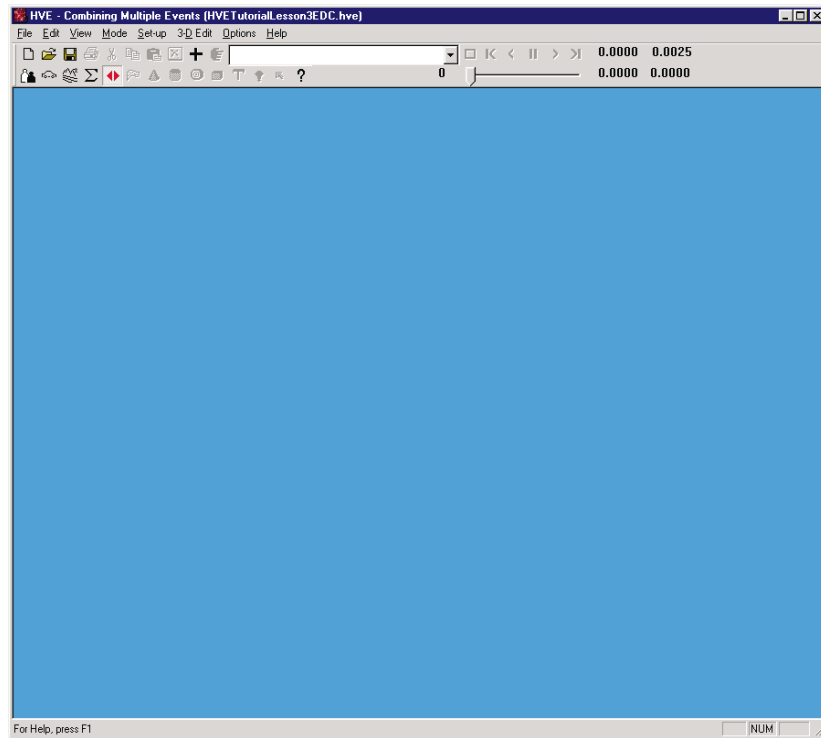


Figure 32-34 Playback Editor. Initially, no reports have been created, so only the Playback Editor and HVE Menu Bar are displayed.

Figure 32-35 Report Window Information Dialog. The Active Events list displays the name of each of the five events in our case. The Select Output options list includes all the available reports for the selected event.

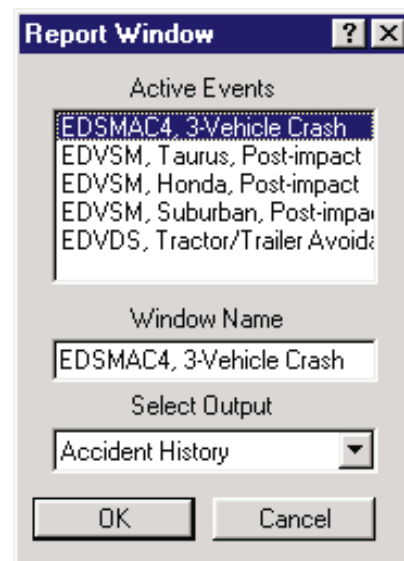




Figure 32-36 Trajectory Simulation window for our first event, *EDSMAC4, 3-Vehicle Crash*. You may wish to spend a few moments using the viewer controls to choose the view you like.

Let's add the second event:

- Click *Add New Object*. The Report Window Information dialog is displayed. Select *EDVSM, Ford Taurus Post-impact* from the Active Events list.
- Click on the *Select Output* option list and choose *Traj Sim*.
- Press *OK*.

The Trajectory Simulation window for the second event is displayed (see Figure 32-37).

Using the above procedures, add the remaining three Trajectory Simulation windows. After adding the fifth window and arranging them somewhat, your desktop should appear as shown in Figure 32-38.



Figure 32-37 Trajectory Simulation window for our second event, *EDVSM, Ford Taurus Post-impact*. Again, spend a few moments using the viewer controls to choose the view you like.

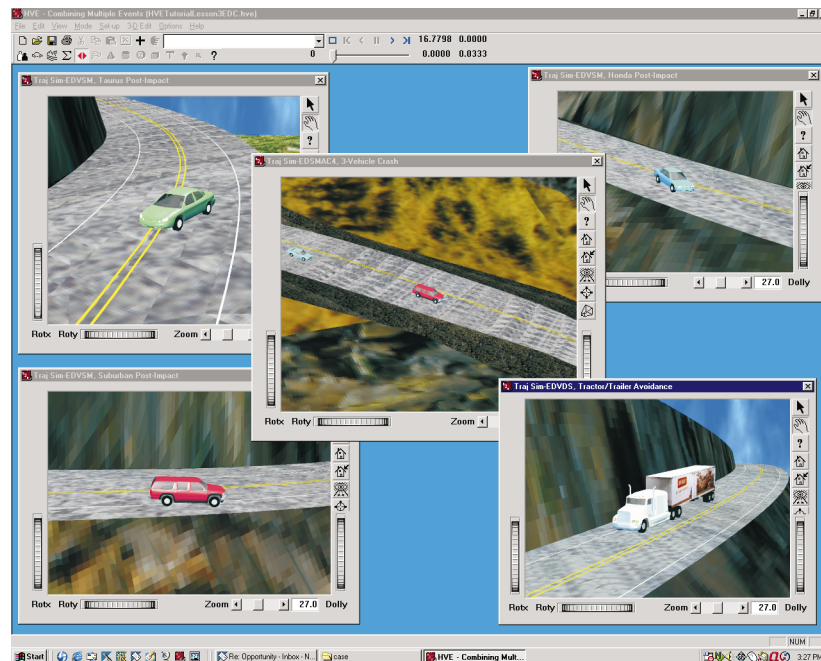


Figure 32-38 Desktop with Playback Editor and five Trajectory Simulation windows.

Editing the Time Sequence

Three of the five events require editing the start time in order to make the motion for the event to begin at the proper time. Because these events begin at separation following the 3-vehicle collision, we can easily get the times for the start of the individual events. These times are available in the Accident History report from our first event, *EDSMAC4, 3-Vehicle Crash*. To display the Accident History report for this event, perform the following steps:

- Click *Add New Object*. The Report Window Information dialog is displayed (shown earlier in Figure 32-35).
- Select *EDSMAC4, 3-Vehicle Crash*.
- Click on the *Select Output* option list and choose *Accident History*.
- Press *OK*.


The Accident History report for *EDSMAC4, 3-Vehicle Crash* is displayed, as shown in Figure 32-39.

	time (sec)	X (m)	Y (m)	PSI (deg)	Vtot (km/h)	U (km/h)	V (km/h)	Yaw Vel (deg/sec)
----- ACCIDENT HISTORY -----								
-Start of Simulation-								
Ford Taurus 4-Door	0.0000	118.4	-320.6	58.5	71.5	71.5	0.0	0.0
Honda Accord 4-Door		19.0	-33.3	-95.1	68.0	68.0	0.0	0.0
Chevrolet Suburban K		17.1	-58.9	-89.2	56.3	56.3	0.0	0.0
----- At Impact -----								
Ford Taurus 4-Door	8.3400	113.0	-158.3	154.9	48.0	44.8	-17.1	12.9
Honda Accord 4-Door		112.8	-156.2	-24.3	83.4	83.4	0.3	-2.1
Ford Taurus 4-Door	8.8900	109.1	-155.6	132.4	24.4	23.5	6.5	-38.4
Chevrolet Suburban K		106.0	-152.0	-28.5	56.2	56.2	0.4	3.7
--- At Separation ---								
Ford Taurus 4-Door	8.4000	112.5	-157.9	153.9	35.7	35.4	-4.9	-49.0
Honda Accord 4-Door		114.0	-156.7	-25.1	78.1	77.1	12.6	-21.5
Ford Taurus 4-Door	9.0300	108.9	-155.8	111.0	23.3	-23.2	2.0	-219.0
Chevrolet Suburban K		107.6	-152.6	-29.2	33.4	32.2	8.7	-0.8
--- At Final/Rest ---								
Ford Taurus 4-Door	10.0000	110.0	-159.6	-15.0	5.9	0.8	-5.8	-57.9
Honda Accord 4-Door	10.0000	147.8	-169.4	-47.8	88.9	77.4	43.7	-8.7
Chevrolet Suburban K	10.0000	115.8	-155.7	-16.5	32.3	32.3	0.6	25.6

Figure 32-39 Accident History report for *EDSMAC4, 3-Vehicle Crash*. This report provides the time of separation for each of the three vehicles. We will use this information to establish the proper timing between events.

Using the Accident History report, we find that separation for the three vehicles are as follows:

- **Event 2 - EDVSM, Ford Taurus Post-impact.** According to the Accident History report, separation begins at 9.03 seconds. However, note that the vehicle still has residual velocity left at the end of simulation time (10.0 seconds), so we will use the final position for the start of this event.

 **NOTE:** This vehicle is involved in two impacts; we choose the end of the second impact (with the Chevrolet Suburban) for our separation conditions.

- **Event 3 - EDVSM, Honda Accord Post-impact.** According to the Accident History report, separation occurs at 8.40 seconds.
- **Event 4 - EDVSM, Chevrolet Suburban Post-impact.** According to the Accident History report, the event's starting time must be delayed until separation occurs at 9.03 seconds.

Editing the event sequence is performed using the Playback Window. In the next step, we will delay the timing for individual events displayed in the Playback Window to correspond with the values we just found in the Accident History report.

Combining the Multiple Events

Now we're ready to create a Playback Window that combines the motion for all five events:

- Select *Options, Add Playback Window* from the main menu. The Playback Window is displayed, as shown in Figure 32-41. The Active Trajectory Simulations list displays all five Trajectory Simulation windows in the order that we created them.
- Make sure all five Trajectory Simulations are selected for display in the Playback Window (indicated by the check boxes next to the event name).

Now we're ready to set the timing of each event to create a properly timed sequence of events. To edit the start time for *EDVSM, Ford Taurus Post-impact*, *EDVSM, Honda Accord Post-impact*, and *EDVSM, Chevrolet Suburban Post-impact*, perform the following steps:

- Locate the T_{delay} field for *EDVSM, Ford Taurus Post-impact*, and enter 10.0000 seconds, followed by <Enter>.

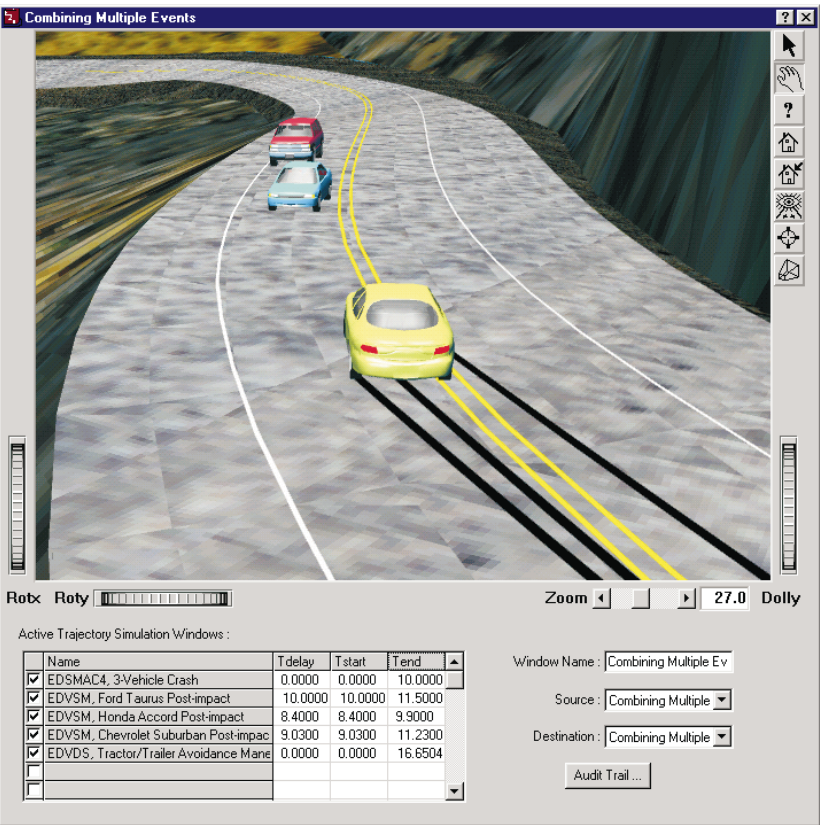


Figure 32-41 Playback Window Dialog. Use the viewer controls to manipulate the view to your liking.

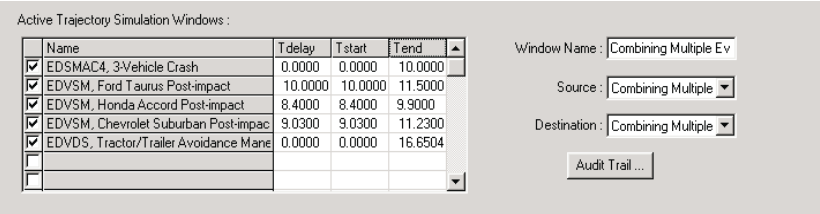



Figure 32-42 The Active Trajectory Simulations list displays the name of each of the five trajectory simulations in our Playback Editor.

 **NOTE:** We must press <Enter> for the data to be accepted because this is a modeless dialog (refer to lesson 1 if you need a refresher on modal vs modeless dialogs).

- Locate the T_{delay} field for *EDVSM, Honda Accord Post-impact*, and enter 8.4000 seconds, followed by <Enter>.
- Locate the T_{delay} field for *EDVSM, Chevrolet Suburban Post-impact*, and enter 9.0300 seconds, followed by <Enter>.

Now we're ready to display the properly timed sequence of events. The Playback Window contains all five selected events. Let's view the (properly timed) accident sequence:

- Press *Play*.

The playback window shows the entire sequence properly timed. Although you cannot tell by inspection, the motion for all three colliding vehicles is first handled by EDSMAC4, then transferred to EDVSM following their impact.


Combining Multiple Events Audit Trail				
Preview Name	Event Name	Object Name	startT (sec)	endT (sec)
Preview #0	EDSMAC4, 3-Vehicl...	Ford Taurus 4-...	0.0000	10.0000
Preview #0	EDSMAC4, 3-Vehicl...	Honda Accord ...	0.0000	8.4000
Preview #0	EDSMAC4, 3-Vehicl...	Honda Accord ...	9.9000	10.0000
Preview #0	EDSMAC4, 3-Vehicl...	Chevrolet Subur...	0.0000	9.0300
Preview #1	EDVSM, Ford Tauru...	Ford Taurus 4-...	10.0000	11.5000
Preview #2	EDVSM, Honda Acc...	Honda Accord ...	8.4000	9.9000
Preview #3	EDVSM, Chevrolet S...	Chevrolet Subur...	9.0300	11.2300
Preview #4	EDVDS, Tractor/Tra...	Freightliner FLD...	0.0000	16.6504
Preview #4	EDVDS, Tractor/Tra...	Generic Class 4 ...	0.0000	16.6504

Figure 32-43 Playback Window Audit Trail, displaying a table containing the events that are controlling the motion of each object in the Playback Window.

Let's display the Audit Trail for the current Playback window. The Audit Trail is a table report of each event in the Playback window. To display the Audit Trail, perform the following steps:

- Press *Audit Trail*.


A table describing the event sequence is displayed in Figure 32-43.

 **NOTE:** *The Audit Trail tells the user which events are controlling the motion in the Playback window.*

- Press *OK*. The Audit Trail is removed.

Spend a few moments manipulating the view. Dolly in and watch the motion of the sequence from different perspectives.

When you are finished reviewing the results, let's save the case file. We'll use it in our next lesson.

 **NOTE:** *Our next lesson describes how to route this Playback Window directly to videotape.*

To save the case file, perform the following steps:

- Click on the *File* menu option and choose *Save*. The HVE File Selection dialog is displayed.
- Enter a case title: `Combining Multiple Events`.

 **NOTE:** *The Case Title appears as a heading on all printed output reports.*

- Enter a filename: `HveTutorialLesson4`.
- Press *OK*.

The data are saved in file *HveTutorialLesson4*; this file may be found in the HVE\supportFiles\case subdirectory.

This concludes Lesson 3 - Combining Multiple Events. You can now shut down HVE or proceed directly to Lesson 4.

Lesson 4 - Creating a Video

The final task while using HVE often includes creating a videotape of the crash sequence. Because it is visual, a videotape presentation is often the best means of describing and explaining how a crash occurred.

HVE's Playback Editor includes an integrated video output interface that allows you to produce a simulation movie without the need for additional software. If you wanted to create a full-length movie containing one or more views of the crash sequence, then you would need to use a software program dedicated to editing movie clips together.

Lesson 4 is a tutorial describing how to use the HVE Playback Editor to create a simulation movie of the complete crash sequence.


In this lesson you will learn to perform the following tasks:

- Route a multi-event crash sequence to a video compressor
- Replay the sequence in *real time*
- Save the sequence to a Video for Windows (AVI) file

As a result of performing these tasks, you will have prepared a powerful and compelling visualization of an entire multi-event collision sequence.

Let's get started. Before we can get into the individual tasks, we need to have HVE up and running:

If necessary, start HVE and arrange your desktop.

 **NOTE:** If you don't know what we are talking about, return to Lesson 1!


Let's first confirm that the video compressor you wish to use is selected. Let's check our video set-up:

- Click on the *File* menu option and choose *Video*. The HVE Video Set-up dialog is displayed, as shown in Figure 32-44 on the following page.
- Click on the *Compressor* option list and scroll through the list of available choices. Choices you may wish to consider are *Full Frames (uncompressed)*, *Microsoft Video 1*, or *Cinepak Codec*. For this tutorial, select *Microsoft Video 1* from the list and then press *OK*.
- Press *OK* on the Video Set-up dialog after setting or confirming your compressor selection.

Your HVE Video Interface is now ready to use for creating a simulation movie file.



Figure 32-44 HVE Video Set-up Dialog used for selecting video devices and AVI files.


 **NOTE:** You can skip the next step if you just finished Lesson 3 and you're still in the Playback Editor with all your reports displayed. If this is the case, proceed with the next section, Route to Video Compressor, below.

Let's open a case file that contains a playback window that we want to route to video:

- Click on *File* menu option and choose *Open*. The HVE File Selection dialog is displayed.
- Select *HveTutorialLesson4EDC* and press *OK*.

The selected case file is loaded into HVE and the current editor (Human Editor, Event Editor...) displays the latest object in its Active 'Objects' list. We'll start by going directly to the Playback Editor:

- If the Playback Editor is not currently displayed, choose *Playback* mode. The Playback Editor is displayed, along with the five Trajectory Simulation 3-D viewers.

 **NOTE:** These reports might be minimized in a single stack located in the bottom left corner of the desktop. If this is the case, drag them onto your desktop and arrange them to your liking.

We're now ready to proceed.


Route to Video Compressor

Let's begin with a short discussion about the HVE video interface. It has three simple components:

- **Playback Controller** - a VCR-like panel that allows you to display and record the results of your simulation
- **Source Option List** - an option list containing all the possible sources of the simulation displayed in the Playback Window
- **Destination Option List** - an option list containing all the possible devices that can receive the simulation displayed in the Playback Window.

The Option Lists are shown in Figure 32-45. Think about the *Source* and *Destination* options for a moment. It is really a simple concept: Get the simulation from *Source* and put it *Destination*. To route our simulation to AVI, we choose *Untitled Playback Window* as our Source and *AVI* as our destination. Let's proceed:

- Click on the *Source* option list. The three options are displayed: *Untitled Playback Window*, *S-Video/Composite Video* and *AVI*.
- Choose *Untitled Playback Window*.

 **NOTE:** *The above step was obviously unnecessary, since Untitled Playback Window was already selected. We asked you to perform this task just to help you better understand the available options.*

- Click on the *Destination* option list. Again, two options are displayed.
- Choose *AVI*.

Because we already created the Playback Window in Lesson 3, we have already done most of the work. Let's perform a couple of final checks:

- Confirm the current simulation time is 0.0000 seconds (otherwise we'd start recording after the beginning of the sequence).
- Click on the *Options* menu option and choose *Playback*. The Playback Options dialog is displayed. Confirm the Playback Interval is set to 0.0333 seconds (NTSC video) or 0.0250 seconds (PAL video). Press *OK* after confirming the correct Playback Interval.


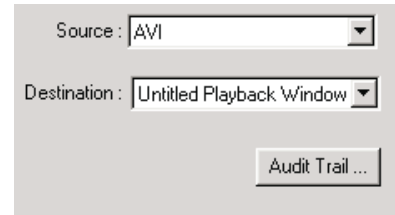
 **NOTE:** *If you halve the Playback Interval, the simulation will record twice as many frames, which will help preserve the quality of the movie file if played in slow motion (twice as slow as normal) in an external program.*

Figure 32-45 Close-up of part of the Playback Window Dialog, used for playing and recording simulations.




- Confirm that you have set the view in the Playback Window to your liking. If desired, manipulate the 3-D viewer to set the desired perspective. An example is shown in Figure 32-46.
- Finally, confirm no other windows are covering the Playback Window. Otherwise, they will show up in your simulation movie.

Now, we're ready to record our simulation:

- Press *Play*.

The simulation is recorded to the disk. The simulation is also displayed in the Playback Window so you can monitor its progress.

 **NOTE:** It takes about 3 seconds per frame to record to AVI. You may wish to go get a cup of coffee (or tea) while recording.

Replay in Real Time

After the simulation has been recorded to disk using the video compressor, we can replay the entire sequence in real time. Again, think about the *Source* and *Destination* options for a moment. All we need to do is switch the current *Source* and *Destination*!

To replay the sequence in real time, perform the following steps:

- Click on the *Source* option list and choose *AVI*.
- Click on the *Destination* option list and choose *Untitled Playback Window*.
- Press *Play*.

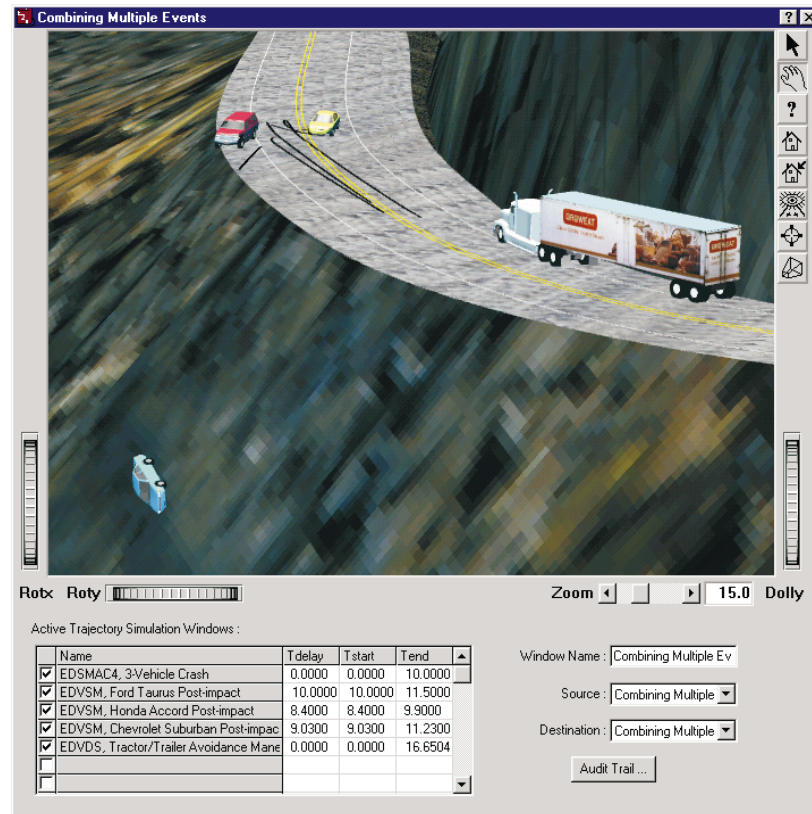



Figure 32-46 HVE Playback Window routed to the video compressor.

The simulation data is retrieved from the disk and displayed in real time in the Playback Window.


 **NOTE:** The viewer controls are not available while replaying a AVI simulation. That's because the view was established when we recorded the simulation and cannot be modified once it has been recorded.

Route to Videotape


The next step in Lesson 4 is to create the videotape. Again, once the simulation has been recorded to disk using the video compressor, we can replay the entire sequence in real time. However, this time we'll choose our video device as the Destination.

To record the sequence in real time, perform the following steps:


- Click on the *Destination* option list and choose *S-Video/Composite Video*.
- Activate the video out capability of your computer.
- Press the Play button on the Playback Controller to activate a special display designed to integrate with the computer's video subsystem.
- Turn on your VCR.
- Insert a good-quality, blank tape in the carriage.
- Advance the tape about 20 seconds (this provides 20 seconds of leader).
- Press the VCR's *Record* button to begin recording.

 **NOTE:** You may wish to use the VCR's *Pause* button until you are ready to begin the video transfer from HVE.

- After the VCR has recorded 5 seconds, press the *Play* button on the special display viewer.

 **NOTE:** By waiting 5 seconds, HVE records an initial still image 5 seconds in length. This is a wise video technique; it allows the viewer to become prepared for what he or she is about to view.

- After the HVE simulation sequence is finished, wait another 5 seconds.
- Press the VCR's *Pause* or *Stop* button.


 **NOTE:** Again, waiting 5 seconds provides an additional opportunity for the viewer to interpret what he/she just viewed.

Saving the AVI File

The final step in Lesson 4 is to save the simulation movie file for convenient future viewing. To save the AVI file, perform the following steps:

- Click on the *File* menu option and choose *Video*. The Video Set-up dialog is displayed.
- Choose *Save As*. The HVE File Selection dialog is displayed.
- Enter a filename: `HveTutorialLesson4`.
- Press *OK*.

The AVI video is saved in file *HveTutorialLesson4*; this file may be found in the hve\supportFiles\images\movies subdirectory.

 **NOTE:** HVE appends the .avi extension, so the file is listed as *HveTutorialLesson4.avi*.


- Press *OK* again to remove the *Video Set-up* dialog.

Changing the View

Figure 32-46 shows a view of the crash scene from an interesting perspective. All the collision action is displayed. However, it does not show what each driver saw as the crash sequence evolved. These views are obviously important: By viewing the sequence as seen by each driver, it's actually rather obvious how the crash occurred and which driver made the first mistake.

To view the sequence from each driver's perspective, we simply attach a *virtual camera* to each vehicle and replay the simulation. The view is attached to the vehicle as it moves. To attach the camera to the vehicle and view the crash scene from the driver's perspective, perform the following steps:

- Click on the *View* menu and choose *Set Camera*. The Set Camera dialog is displayed, as shown in Figure 32-47.
- Click the *View From* option list and choose *Honda Accord. 4-Dr.*
- Replace the current *Camera* coordinates with the location of the driver's head. Enter $x = 0.0$ ft, $y = -1.5$ ft, $z = -2.0$ ft
- Replace the current *Picture Center* coordinates with the vehicle-fixed location directly ahead of the driver. Enter $x = 100.0$ ft, $y = -1.5$ ft, $z = -2.0$ ft.

 **NOTE:** These coordinates are vehicle-fixed; thus, the *y* and *z* coordinates remain unchanged. Only the *x*-coordinate changes to reflect the fact that the driver is looking 100 feet in front of him/her.

- Press *OK*. The Set Camera dialog is removed and the scene is viewed from the Honda driver's perspective, as shown in Figure 32-48.
- Press *Play*. The Playback viewer displays the entire sequence as viewed by the driver of the Honda.

Figure 32-47 HVE Set Camera dialog, used for setting the view in the selected window. In this case, we use the Set Camera dialog to show how the driver of the Honda Accord saw the sequence.

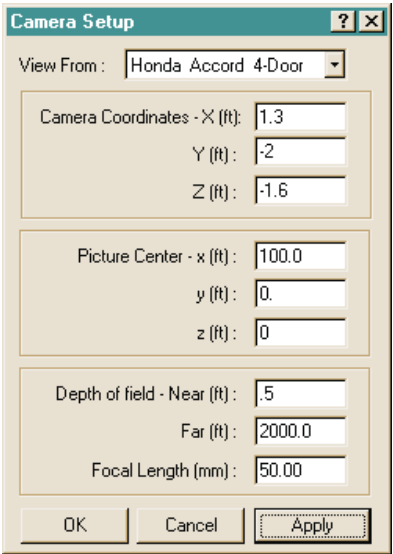


Figure 32-48 HVE Playback Window showing the Honda Driver's view at the start of the crash sequence. The Honda driver is about to try to pass the Chevrolet Suburban.

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Repeat the above steps, using the *Set Camera* dialog to change the view to watch the sequence from each driver's perspective. Simply click on the *View From* option list and select each vehicle in the list. The coordinates don't require adjusting.



NOTE: Even though you used the Set Camera dialog to set the view, you can still use the viewer controls (thumb wheels and direct manipulation) to fine-tune the view.

Ending the Tutorial

This concludes Lesson 4 - Creating a Video. In Lesson 4, we learned how to create a simulation movie file, play it back on our computer in real time, create a videotape, and save the simulation movie file for future viewing using HVE (or any other AVI viewer).

You can now shut down HVE.