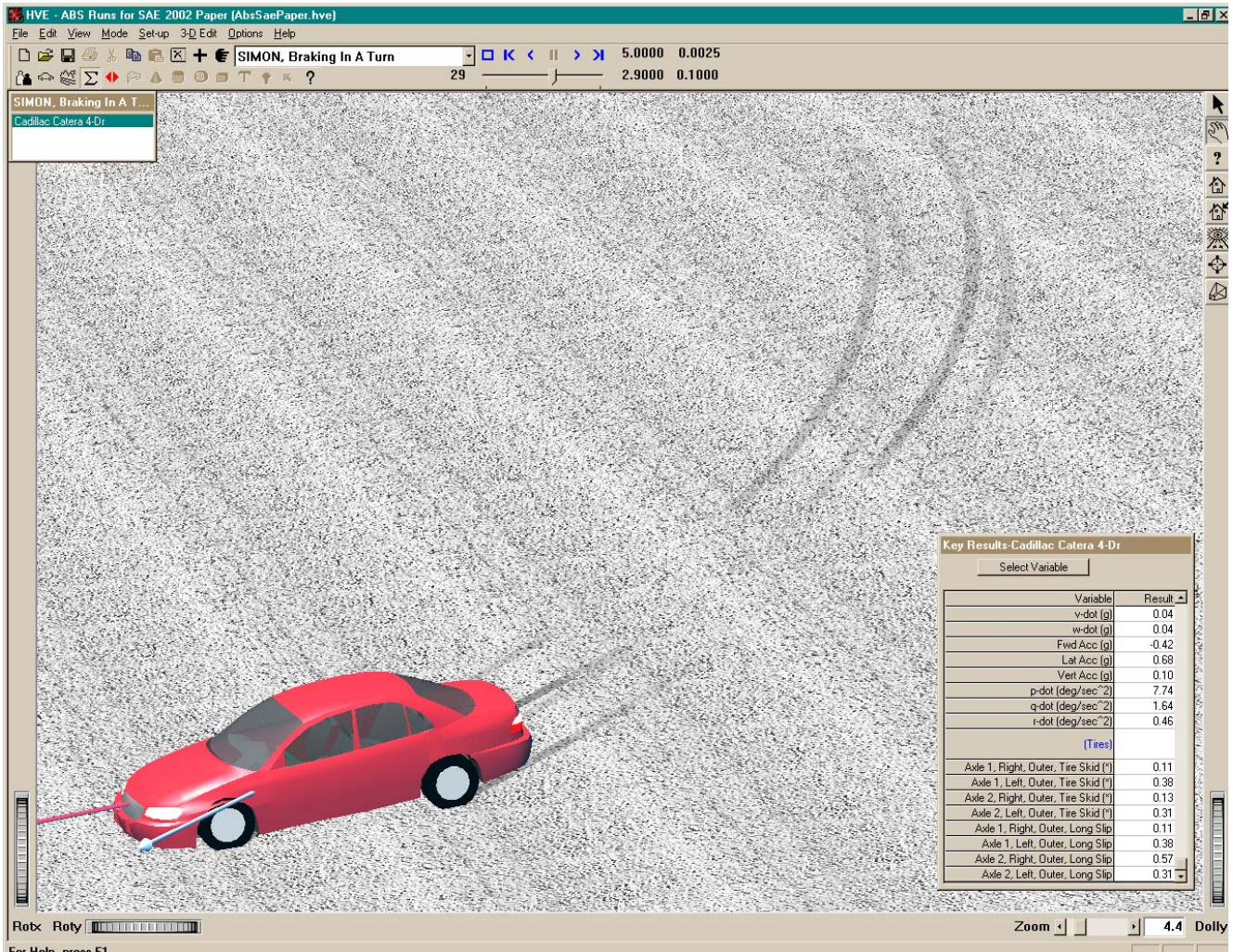


Technical Newsletter

ABS Simulation Model Introduced at 2002 SAE Congress



The new ABS Simulation Model for *HVE* was introduced at the 2002 SAE Congress in Detroit, Michigan. Terry D. Day, President of EDC, presented Technical Paper No. 2002-01-0559, "A Simulation Model for Vehicle Braking Systems Fitted with ABS". This paper is available to download directly from the EDC website (www.edccorp.com) as Document 033 in the Technical Reference Library section. You may also request a printed copy of the paper by contacting EDC Customer Service.

The Technical Session of this newsletter presents an overview of the new ABS Simulation Model and the *HVE* user interface for editing the parameters defining the vehicle's ABS components. The SIMON simulation in the above figure shows an example of how tire marks are now displayed for vehicles fitted with ABS undergoing steering and braking maneuvers.

For more information about *HVE* and the new ABS Simulation Model, please contact EDC Sales at sales@edccorp.com or by calling 503.644.4500.

Technical Session

This Technical Session is a continuation of our last Technical Session dealing with anti-lock braking systems (ABS). Our last Technical Session provided a general overview of ABS. This time we describe the new ABS model released with *HVE* Version 4.30.

General Description

The *HVE* ABS model works like the ABS system on an actual vehicle: It uses an algorithm to modulate the brake pressure at each wheel. The algorithm is designed to maximize brake force and prevent excessive wheel slip. The ABS model has been implemented in the SIMON vehicle simulation model (see SAE Paper No. 2002-01-0559).

ABS User Interface

The *HVE* ABS user interface allows the user to select an ABS algorithm and to enter and edit the independent parameters required by the selected ABS algorithm. The interface includes numerous options, thus, various algorithms may be supported. The interface is divided into two sections:

System Variables – Variables that are applicable to the entire vehicle

Wheel Variables – Variables that are applicable to (and may be specified independently for) each wheel

The interface, dialogs and associated variables are described below.

System Variables

The ABS System Data variables included in the *HVE* ABS model are presented in the ABS System Data dialog. The variables and a brief description are shown in Table 1. The ABS System Data dialog is shown in Figure 1. (A new chapter in the *HVE* User's Manual describes each of these parameters in detail.)

Table 1 – ABS System Variables

Variable	Description
Algorithm	ABS algorithm selected from a list of available algorithms
Control Method	ABS control method selected from a list of available control methods
Cycle Rate	Sets the time required for a complete ABS cycle
Threshold ABS Pressure	Minimum pressure for ABS activation
Threshold ABS Velocity	Minimum vehicle velocity for ABS activation
Friction Threshold	Tire-terrain surface friction threshold
Delay Method	Delay method selected from a list of available delay methods
Apply Delay	Time delay for controlled output pressure increase
Release Delay	Time delay for controlled output pressure release

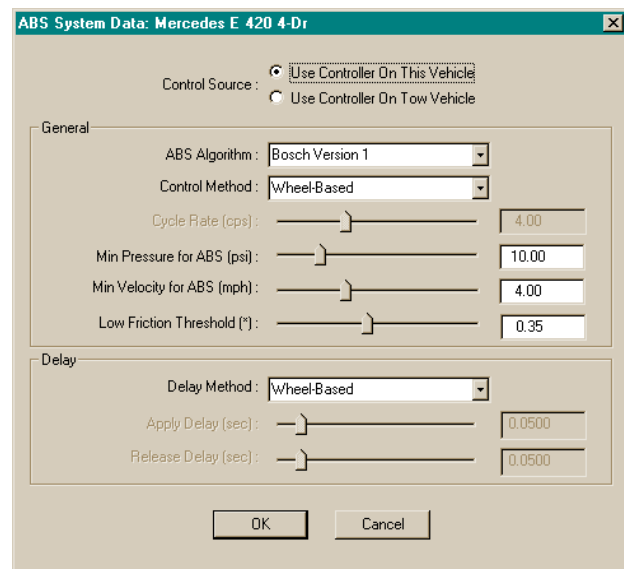


Figure 1 – ABS System Data dialog

Wheel Variables

Wheel variables are those ABS parameters that are assigned independently for each wheel. A brief description of the ABS Wheel Data variables included in the *HVE* ABS model is provided in Table 2. The ABS Wheel Data dialog is shown in Figure 2. (Again, the manual provides a detailed description.)

Table 2 – ABS Wheel Variables

Variable	Description
Cycle Rate	Sets the time required for a complete ABS cycle
Threshold Wheel Vel	Minimum wheel forward velocity for ABS control
Tire Min Slip	Minimum tire longitudinal slip for ABS control
Tire Max Slip	Maximum tire longitudinal slip
Wheel Min Spin Accel	Minimum wheel angular acceleration
Wheel Max Spin Accel	Maximum wheel angular acceleration
Apply Delay	Time delay for controlled output pressure increase
Primary Application Rate	Initial rate of controlled output pressure increase
Secondary Application Rate	Initial rate of controlled output pressure increase
Release Delay	Time delay for controlled output pressure decrease
Release Rate	Rate of controlled output pressure decrease

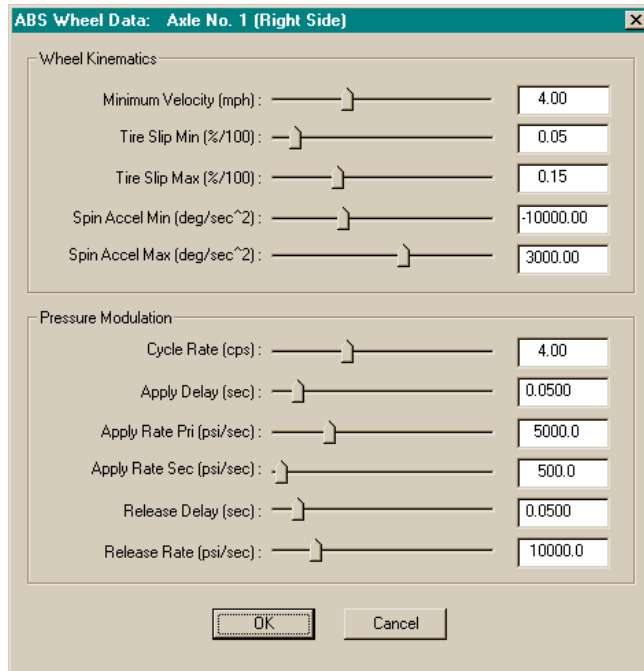


Figure 2 – ABS Wheel Data dialog

Current Algorithms

Two ABS algorithms are currently implemented in the *HVE* simulation environment. These are the *Tire Slip* algorithm and the *HVE Bosch Version 1* algorithm. These algorithms are described below.

Typical Tire Slip Algorithm Cycle

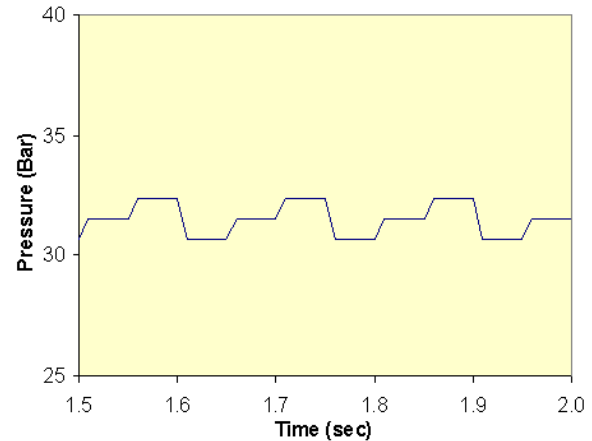


Figure 3 – Typical Pressure vs. Time History

Tire Slip Algorithm

This is a simple and straight-forward ABS algorithm. Its design is based on the fundamental goal of an ABS system, that is, to maintain tire slip in the vicinity of peak friction coefficient, μ_p (refer to Figure 1 in the December 2001 Technical Session). It is generally applicable to any type of vehicle (passenger car, truck, etc). Figure 3 shows a typical pressure vs. time history for a few cycles of a hard brake pedal application (i.e., enough system pressure to lock the tires).

HVE Bosch Version 1 Algorithm

The *HVE* Bosch Version 1 ABS algorithm is based on the information provided in Bosch technical literature¹. The Bosch ABS system is used on many US and foreign passenger cars. The algorithm is based on wheel spin acceleration and a critical tire slip threshold. Figure 4 shows a typical pressure vs. time history for a single cycle of a hard brake pedal application (i.e., enough system pressure to lock the tires).

Other ABS Algorithms

The ABS model implemented in *HVE* is not restrictive in terms of the algorithms it can support, other than its need to provide the parameters required by the algorithm. Endless tweaking of an algorithm is possible, resulting in different ABS system characteristics, each with its advantages and disadvantages. Thus, it is certain that new ABS algorithms will be developed and implemented in *HVE* over time, both to develop and to model new ABS systems.

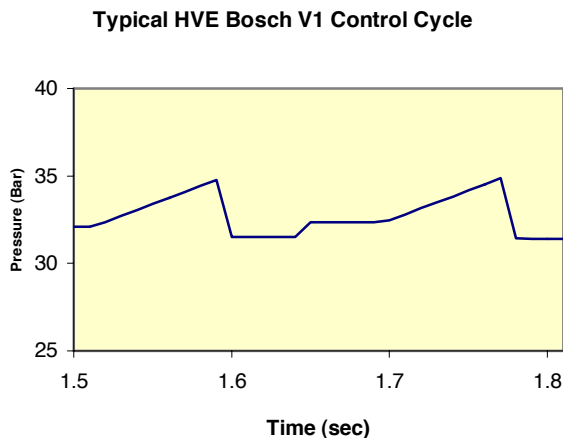


Figure 4 – Typical Pressure vs. Time History

Using the ABS Model

To set up and execute simulations using the new ABS model is quite easy. The Brake System dialog has been extended to include an “ABS Installed” check box. Simply click on this box and ABS simulation will be performed when a SIMON simulation is executed.

The effects of the ABS simulation are best observed in the *Wheel Brake Pressure* and *Tire Longitudinal Slip* results in the Key Results window or Variable Output table.

Tire Marks

To further enhance the results from an ABS simulation, *HVE* now includes a new method for displaying tire marks. In the new method, the opacity of a tire mark is varied between 0 and 1 (0 being transparent and 1 being opaque) according to the current vertical tire load (heavier tire loads produce darker marks), the percentage of longitudinal tire slip and the percentage of lateral tire slip (increased slip produces darker marks). In addition, a set of weighting coefficients determines the opacity of tire marks during combined braking and steering. The figure on the front page of this Newsletter shows an example of a vehicle pumping its brakes in a high-speed turn.

Since the vast majority of vehicles are now fitted with ABS, the new *HVE* ABS model is an important new feature, especially for simulating pre-impact braking and loss of control. Enjoy!

Reference 1: *Bosch Driving-Safety Systems*, 2nd Edition, Robert Bosch GmbH, ISBN 0-7680-0511-6, Society of Automotive Engineers, Warrendale, PA 1999

HVE and *HVE-2D* V 4.30 Available in April 2002

Development and testing of the next release of *HVE* and *HVE-2D* is almost complete! Version 4.30 is scheduled for release in April 2002. Users with current Update/Technical Support policies will be shipped their updates as soon as they are available.

HVE Version 4.30 provides users with the new ABS Simulation Model for vehicle simulation studies using SIMON. *HVE* Version 4.30 also includes several other enhancements and additional vehicles in the database.

HVE-2D Version 4.30 provides users with several new enhancements, as well as additional vehicles in the database.

If you have any questions about the Version 4.30 update or about your Update/Technical Support Policy, please contact EDC Customer Service.

Using *HVE* and *HVE-2D* on Windows XP

If you are considering the purchase of a new desktop or laptop computer for running *HVE* or *HVE-2D*, you have discovered that most new computers are only available with Windows XP. Our testing has shown that *HVE* and *HVE-2D* are compatible with Windows XP, however some computer hardware configurations may not provide the best performance. As with unexpected crashes on other Windows operating systems, the usual culprit is the graphics driver.

While most basic applications may run fine, sophisticated applications with intense engineering visualization capabilities such as *HVE/HVE-2D* are discovering the “weakpoints” in the graphics driver.

Windows XP is a very new operating system, so many of the graphics card manufacturers are having to make updates to their drivers as they learn more about their weaknesses. *HVE* and *HVE-2D* users with Windows XP computers should contact their graphics card manufacturer to see if an updated graphics driver is available.

Suggested Computer Requirements For *HVE* and *HVE-2D*

Our Technical Support Engineers have been collecting information about *HVE* and *HVE-2D* users computer hardware configurations in an effort to identify acceptable and unacceptable configurations. From this information, we are able to provide the following recommendations for computers that should provide good *HVE* and *HVE-2D* application performance. (NOTE: Your experience may vary, depending on other software and accessories installed on your computer.)

The main consideration for your computer purchase is Graphics Card/Chip Set. Users report that cards from ATI and nVIDIA have provided reliable performance. Both ATI and nVIDIA have websites posting the latest graphics drivers for their products. It is extremely important that you have the latest graphics driver!

One highly recommend computer configuration is a Dell 420 workstation with nVIDIA GeForce3 graphics card and Windows 2000 operating system.

Here is a guideline to follow in selecting a computer for running *HVE* or *HVE-2D*:

Configuration

- Intel Pentium III or faster processor
- 128MB RAM (the more the better!)
- 9 GB harddrive minimum
- 16 - 32MB Open GL-compatible graphics card
- 15" monitor (17" or 21" preferred)
- 3-button mouse

Operating System

- Windows 98, Me, NT, 2000, XP

New models of computers and graphics cards become available every month. We have found that users with common brand name computers with ATI or nVIDIA graphics cards are experiencing the best performance from their *HVE* and *HVE-2D* software.

If you have questions about specific models or computer configurations, please feel free to contact EDC Sales by phone at 503.644.4500, or by e-mail to sales@edccorp.com.

LAISSEZ LES BON TEMPS ROULER!

ECC 2002 HVE FORUM

Workshops

- Hands-on Workshops Using EDCRASH, EDSMAC, EDSMAC4, EDSYS & EDVDS
- Creating Lighted and Textured Environments Using the HVE 3-D Editor
- Advanced Case Studies Using SIMON, EDVSM, EDVDS & EDSMAC4
- Multi-Occupant Human Impact Simulation Using GATB
- Importing Scene Drawings as Environment Models
- Advanced Multi-vehicle Simulation Using SIMON
- Importing 3-D Environments from Total Systems
- Developing HVE-compatible Physics Models
- Theoretical and Applied Vehicle Dynamics
- Multi-Vehicle Collisions Using EDSMAC4
- Tractor-Trailer Simulation Using EDVDS
- Simulating Blow-outs and Rollovers
- DyMESH 3-D Collision Simulation
- Building Vehicles for HVE/HVE-2D
- Recording 3-D Simulation Movies
- HVE and HVE-2D User's Groups
- Powerful Tips and Techniques
- Navigating in HVE/HVE-2D
- Brake System Simulation
- WhitePaper Simulation
- ABS Simulation
- Animation

MAY 13-17, 2002
SHERATON NEW ORLEANS HOTEL
New Orleans, Louisiana

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2002 *HVE* Forum

The best opportunity for hands-on training for “how to use” *HVE* and *HVE-2D* is happening this May in New Orleans, Louisiana. The 2002 *HVE* Forum is going to be held May 13 –17, 2002 at the Sheraton New Orleans Hotel. The Forum offers workshops on how to navigate the user interface, build vehicle and environment models, simulate real-world crashes and produce professional quality results.

Early registration discounts expire April 1, 2002, so select your workshops and return your registration form before the end of the month! A special room rate for hotel rooms at the Sheraton New Orleans is also available for *HVE* Forum attendees.

If you need a registration packet or additional registration forms, you may download them directly from our website at www.edccorp.com or by contacting EDC Customer Service.

See you in New Orleans!

HINTS AND TIPS

- **Want to be more adept at navigating physics tutorials?** Following the tutorials for the different physics models can be frustrating if you are not already familiar with the *HVE* interface. To become familiar with the *HVE* interface refer to the Tutorial section of your Operations manual. This tutorial will give you the tools to navigate *HVE* with ease and efficiency.
- **Review Your Data!** Because *HVE* is a general purpose simulation environment, it supports numerous features not included in some simulation models. For example, the *HVE* Tire Data dialogs include load- and speed-dependent values for friction, cornering stiffness and camber stiffness. EDSMAC and EDSMAC4 do not have load-dependent tire models, so much of this data is not used in an EDSMAC or EDSMAC4 simulation. Here's the point: Always review the Vehicle Data output report to confirm that EDSMAC4 (or whatever model you are using) is using the expected data. Do this early in your analysis; it would be a shame to work for several days fine-tuning your simulation, then discover you were using the wrong cornering stiffness!
- **Driver Controls for 3-D Simulations.** 3-D simulations (EDVDS, EDVSM, and SIMON) all include a complete brake system that models brake torque according to the pedal force, proportioning values, lag and rise times, temperature, wheel brake assembly components (if the Brake Designer is used) and, possibly, ABS. In order to include the effects of the brake system on the simulation results, the default method for driver brake table is *Pedal Force*. Although the *Percent Available Friction* and/or *Wheel Force* driver brake tables are enabled, their use is discouraged because these methods bypass the effects of wheel spin inertia on the current level of braking force. The same is true for Throttle Tables. 3-D simulations include a Drivetrain model that calculates drive torque from the engine power curve and current gear ratios. The use of *Percent Available Friction* and/or *Tractive Effort* tables bypasses the effects of drivetrain inertia on the current level of tractive effort at each drive wheel.
- **Use Antialiasing!** Antialiasing is used to reduce the "jagged lines" resulting from the discrete pixel size on your computer monitor. It is especially useful when creating videos or printing graphical reports (e.g., Trajectory Simulations, Damage Profiles). To use Antialiasing, click on *HVE's* Options menu and choose *Render*. Set the Antialiasing level to 10. Do this just prior to printing or creating your AVI movie file. When finished, then reset Antialiasing back to 1 (Antialiasing increases rendering time significantly. You can work more quickly – and antialiasing is unnecessary – during the normal course of your analysis.)
- **Dual Processors.** *HVE* is not supported on computers using dual processors. If you wish to run *HVE* on such a computer, here's how:
 1. Start *HVE*.
 2. Launch Task Manager (press ctrl-alt-delete on your keyboard)
 3. Select the Processes list.
 4. Locate and select the *HVE.exe* process using the left mouse button.
 5. Click the right mouse button. On the pop-up menu, select *Set Affinity*. On the Set Affinity dialog, you will see a list of all the processors that the process is assigned to, typically CPU 0 and CPU 1.
 6. Deselect one of the processors, most likely CPU 1.

Now you can run *HVE* on your dual processor computer! You will need to do this each time you start *HVE* (or *HVE-2D*)

Thanks to Chuck Rogers of Friedman Research for providing this feedback to EDC!
- **Layers and Objects.** If you are creating an environment model or scene drawing in AutoCAD and want to retain the ability to edit individual objects in the 3-D Editor, you must place each object on a separate layer. For example, every line or surface you create that is a piece of the road will be assigned to the road layer. Every piece of the sidewalk should be assigned to the sidewalk layer. This will ensure that the road and sidewalk will be separate objects in *HVE* and *HVE-2D*, thereby making it easier to edit the drawing later.

HVE and HVE-2D FAQ

This section contains answers to frequently asked questions submitted to our Technical Support staff by *HVE* and *HVE-2D* users.

Q: I've been able to make real-time simulation movies using the Playback Window, but how do I make a slow motion movie?

A: At this time, the movies created using *HVE* or *HVE-2D* will only play in real-time. If you change the output time interval in the Playback Editor from the default of 0.0333 (1/30 of a second) to 0.0167 (1/60 of a second), twice as many "frames" of the movie will be recorded which provides greater resolution of the motion, however the movie will still play back in real-time. The movie player will play movies recorded with 30 frames per second at 30 frames per second and movies recorded at 60 frames per second at 60 frames per second.

The solution is to use a non-linear editing program such as Adobe Premier to modify the Clip Speed Rate of the movie file. You would simply import the avi file, adjust the Clip Speed to 50% and the movie would then display the motion of the 60 frames per second movie at 30 frames per second. You have just made a slow-motion movie of your simulation!

Q: How can I get my HVE or HVE-2D simulation movies onto videotape, if my computer doesn't have a video out capability already?

A: One method is to hire a local video production company to make the videotape for you. Typically you would provide them with the avi files produced using *HVE/HVE-2D*, the wording for any title slides and a "story board" of the sequence of movie files and transitions. They would use a combination of off-line and on-line editing to produce the completed videotape. This is exactly how the *HVE* Demo Video was created. If you would like a copy of the *HVE* Demo Video as an example, please contact EDC Customer Service.

Another method is to purchase a "video-out" device for your computer. Several users have recommended the Pinnacle DV500 Plus, as it includes the video out card for your computer as well as Adobe Premier 6 for editing your movie files into a complete sequence. For more information, contact your local computer store, or visit the Pinnacle Systems website at www.pinnaclesys.com

Another option is to not produce a videotape of your work, but rather a CD or DVD. The avi files of your simulation movies can be integrated directly into Powerpoint presentations or just "burned" directly onto a CD.

The hardware for producing a DVD containing all of your simulation movie files, title slides and other information is continuously improving. We know of one user who is presently providing his clients with DVD's and finds it very professional to be able to quickly access any simulation movie, play it forward or backward, and even present a crystal clear still frame image from the movie.

Q: What are the recommended steps to follow to prepare my environment model/scene drawing built in AutoCAD for importing as an environment geometry in HVE and HVE-2D?

A: Here are the recommended steps to prepare your model/drawing in AutoCAD:

1. Make sure the scale of the model/drawing is in the units of Decimal Inches.
2. *HVE* recognizes the origin (0,0,0) of the World Coordinate System (WCS) in AutoCAD as the origin of the model/drawing when it is imported. If (0,0,0) is not located on your model/scene in a convenient reference location for your simulation work, you should move your model/drawing in AutoCAD so that it is.
3. Rotate your model/drawing in AutoCAD 180 degrees about the X axis.

(For a 2D line drawing, this can be done by using the Mirror command in a Top view. Be sure to draw your mirror line along the X axis.)

4. Finally, export your model/drawing as a R12, R13, R14 or 2000 dxf format file.

To better understand the behaviors of common linetypes and orientations of drawings imported into *HVE* from AutoCAD, view the Sample.dxf file located in the supportFiles/images/environments folder. You can open this file in *HVE* as an environment and in AutoCAD as a regular dxf file.

Learn more about preparing models/scenes by attending the workshops on Environment Modeling at the 2002 *HVE* Forum!

For more FAQ's and the latest product and training information visit the EDC Website at www.edccorp.com



EDC Training Courses

EDC Reconstruction & EDC Simulations

EDC offers an excellent training course on the use of the EDC reconstruction program, EDCRASH. Both new and long-time users of EDCRASH agree that the **EDC Reconstruction** course is extremely beneficial and challenging.

EDC also offers an excellent training course on the use of EDC simulation programs, such as EDSMAC, EDSMAC4, EDSVS and EDVTS. The **EDC Simulations** course offers the fastest way to learn what you really need to know – how to efficiently use the program and get the right results.

These one-week courses are designed to fully investigate the program's inner workings. Lectures are full of helpful hints gained from years of experience. During the course, students will use the programs (e.g. EDCRASH, EDSMAC4) in either the *HVE* or *HVE-2D* simulation environment to complete several workshops highlighting the capabilities of the programs.

HVE Forum

The *HVE* Forum is an excellent opportunity for *HVE* and *HVE-2D* users to jump to a new level of ability. By participating in workshops, attendees brush up on their present skills, learn new techniques, and learn how to use the latest advancements in the software. The *HVE* Forum also presents a great opportunity to meet other users and expand your network of resources.

Engineering Dynamics Corporation Training Courses

EDC Simulations

Los Angeles, CA.....January 20-24, 2003
Coral Gables, FL.....November 2003

EDC Reconstruction

Los Angeles, CA.....January 2004
Coral Gables, FL..... November 11-15, 2002

Theoretical and Applied Vehicle Dynamics

Raleigh, NC.....March 25–27, 2002
New Orleans, LA (Short Course)....May 13-14, 2002

2002 HVE Forum

New Orleans, LA.....May 13-17, 2002

Vehicle Dynamics

Theoretical and Applied Vehicle Dynamics extends the theory of the basic SAE course and includes direct applications using several vehicle simulation programs (e.g. SIMON, EDVSM) within the *HVE* simulation environment, as well as a solid theoretical background for such simulations. The course is focused towards vehicle design engineers and safety researchers with an interest in a greater understanding of vehicle dynamics and automotive chassis systems development.

Hands-on Training

Intensive hands-on training on how to use your *HVE* or *HVE-2D* system software, physics programs and databases is available. Contact EDC Customer Service for more information about having this two-day on-site course at your office.

Course Registration

You may register for a course by contacting EDC Customer Service at 503.644.4500, or by email to training@edccorp.com. You can also visit the Education & Training pages on our website and download a course registration form. All courses are eligible for Continuing Education and ACTAR credits. See you at our next course!

Related Training Courses

Northwestern University Center for Public Safety, NUCPS (previously NUTI), offers four different courses using EDC software programs. The courses are:

MATAR (*EDCRASH*)

COMPTAR I (*EDCRASH*)

COMPTAR III (*EDSMAC*)

COMPTAR IV (*EDCRASH* & *EDSMAC* Extended)

For more information about these courses, please contact NUCPS at 800.323.4011.

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