

Technical Newsletter

Available on-line in the EDC Library at www.edccorp.com

Version 9 - Available Spring 2012!

HVE, *HVE-2D* & *HVE-CSI* Version 9 are in the final stages of development and testing and will be available this Spring! Here are a few of the new features and enhancements users will find in Version 9:

DyMESH Version 3 • Wheel Impact

DyMESH Version 3 computes the collision forces and moments for wheel-to-wheel and wheel-to-sprung mass impacts. The model is rigorous, that is, each wheel is a *DyMESH* object with a mass and a mesh (just like a vehicle). Its properties are defined by the tire dimensions, inertias and radial stiffness. The kinematics of the tire are included, so spinning wheels create moments and forces from tangential friction. Wheel steer and camber are also accounted for. The resulting forces and moments go directly into the equations of motion. Those forces and moments may also produce wheel displacement (linear, camber and steer), directly simulating wheel/suspension damage. Applications include Monster Truck simulations, trailer under-ride resulting in wheel impact, and, of course, the typical intersection collision where a wheel represents a hard region affecting collision dynamics.

DyMESH Version 3 • 3-D Stiffness Coefficients

DyMESH Version 3 uses 3-dimensional stiffness coefficients that employ a 3rd-order force vs. displacement relationship with crush saturation. This new model allows the user to start with the nominal A,B model and then extend it to include the non-linear effects associated with severe crush. Individual coefficients are tuned with a user-editable conversion coefficient that relates existing A,B to the new A,B,C,D coefficients.

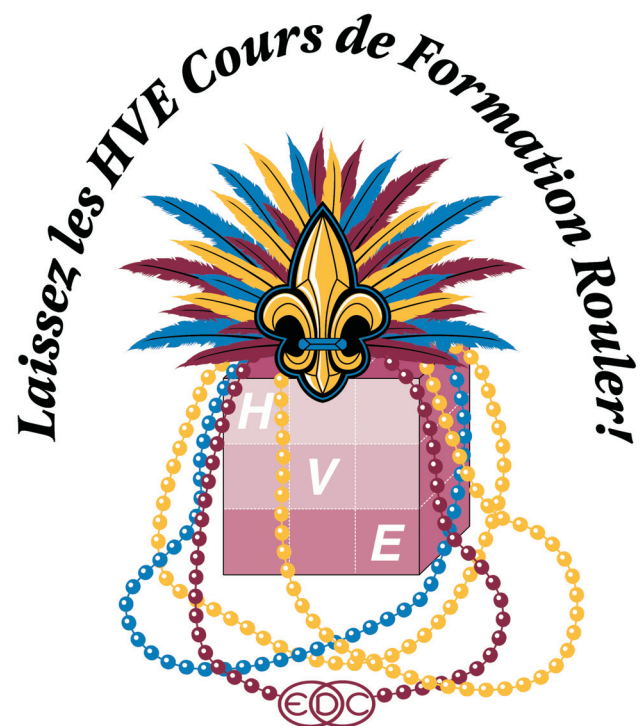
High-Definition Video Output

The Playback Window, used for creating simulation movies, has been redesigned and is now called the *Video Creator*. Users can take advantage of new off-screen rendering capabilities to produce movies in standard (640x480), DVD (720x480) and high definition HD (1280x720 and 1920x1080) formats. Improvements also include the ability to control the recording speed frame rate to be able to produce slow-motion movies directly from the *Video Creator*.

HVE Driver Model Path Visualization

The intended path of travel that the *HVE* Driver Model attempts to follow is now visualized directly in the event. Once the user establishes the path by placing targets in key locations and orientations and activates the *HVE* Driver, the path calculated by the spline algorithm is displayed as a continuous line connecting the targets. This helps the user to easily determine if their target locations and orientations need to be adjusted to fine tune their intended path.

More information about these and other enhancements available in *HVE*, *HVE-2D* and *HVE-CSI* Version 9 can be found online at www.edccorp.com/Version900 or by attending the workshops at the **2012 HVE Forum**.



2012 HVE FORUM
FEBRUARY 27 TO MARCH 2
JW MARRIOTT • NEW ORLEANS, LA

Technical Session

This Technical Session presents a basic tutorial that demonstrates *DamageStudio* for *EDSMAC4*. The purpose of this tutorial is to provide a solid grasp of the fundamentals of using *DamageStudio*. This is accomplished through a series of task-oriented procedures using a step-by-step approach.

An important note: *DamageStudio* and its supporting parameters, called *CollisionData*, have been updated for *EDSMAC4*. The result is the *EDSMAC4* V7.21 patch. This patch was found to be necessary because *EDSMAC4* bases its force calculations on the vehicle-based *rho* vectors, while the *CollisionData* parameters are determined by the deformation of the vehicle mesh. Details of the changes in *EDSMAC4* are included with the patch. If you have not already done so, please download and install the *EDSMAC4* V7.21 patch (www.edccorp.com/support/downloads.html).

The following tutorial example illustrates the use of *DamageStudio* for a very important application: A validation using a rigid barrier crash test.

While this tutorial explores many of *DamageStudio*'s important features, it does not provide detailed explanations. Before exploring this tutorial, the reader should first review the Technical Sessions in the Spring 2010 and Summer 2010 Technical Newsletters (you can download these for free at www.edccorp.com).

The most basic application of *DamageStudio* is a barrier crash test simulation, comparing the simulation results with the experimental results from an actual fixed, rigid barrier crash test. The simulation is set up using the actual test velocity as an independent variable. Simulation results for crush depth, peak acceleration, peak force, delta-V and collision pulse

may all be compared directly with the experimental results.

Experimental Results

We first download from the NHTSA crash test database (see <http://www-nrd.nhtsa.dot.gov/database.aspx/vehdb/queryvehicle.aspx>) a fixed barrier frontal crash test for the 2003 Honda Element (NHTSA test number 455); see Figure 1. The following crash test results were included in this test:

Damage Photographs - Figure 2 shows the frontal vehicle damage.

Test Speed - The test speed was 56.01 km/h (35 mph). The sideslip angle was zero.

Damage Profile - Measured damage width was 1770 mm (69.7 in), damage offset was zero and maximum static crush at the vehicle centerline was 510 mm (20.1 in). Free space resulted in static crush depths of 272 mm (10.7 in) and 268 mm (10.6 in) on the right front and left front corners, respectively.

Acceleration vs. Time History (Collision Pulse) - Figure 3 shows the measured acceleration vs. time history. Peak acceleration at the right rear cross member was -46.8 g, occurring at $t=0.0341$ seconds.

Velocity and Delta-V - Figure 4 shows the measured velocity vs. time history. The measured delta-V was 63.3 km/h (39.3 mph).

Simulation Set Up

Based on the information contained in this report, we will create an *HVE* case file that includes the test vehicle, a 2003 Honda Element, a generic fixed, rigid



Figure 1 - 2003 Honda Element used in NHTSA Crash Test number M35305



Figure 2 - 2003 Honda Element after crash test

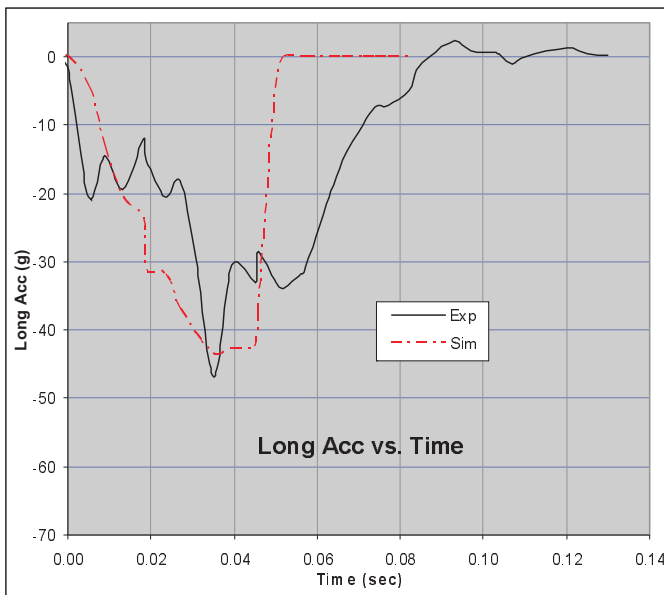


Figure 3 - Longitudinal acceleration vs. time history, measured vs. simulated

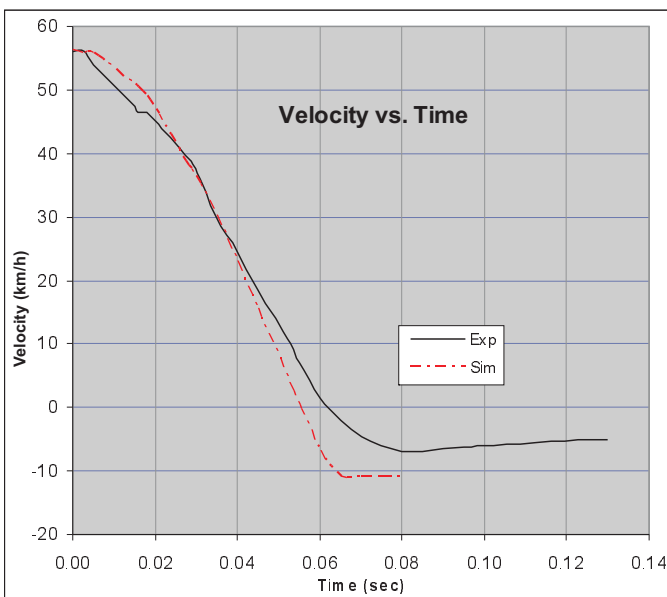


Figure 4 - Velocity vs. time history, measured vs. simulated

barrier, and an *EDSMAC4* event simulating the crash test. Let's get started.

- Start *HVE*.
- Go to the Vehicle Editor and add the 2003-2011 Honda Element SUV and a Generic SAE J-850 Fixed Barrier.

- Go to the Environment Editor and add the Proving Ground environment (always use an environment with a terrain, if only for visual context).
- Go to the Event Editor and add an *EDSMAC4* event using the Honda and the barrier.
- Set up the event, first the Honda:
 - Set the initial X,Y,Ψ position to 0,0,0 m; deg (0,0,0 ft; deg).
 - Set the initial velocity to 56.01 km/h (35 mph).
- Next the Barrier:
 - Set the initial X,Y,Ψ position to 4.57,0,0 m; deg (15,0,0 ft; deg).
 - Set the initial velocity to 0.0 km/h (0.0 mph).
- Choose *Options, Simulation Controls* and make the following changes:
 - Change the *Trajectory* and *Separation Timesteps* and *Output Time Interval* to 0.001 seconds. This ensures that the simulation results are computed and recorded at a small time interval.
 - Change the *Maximum Simulation Time* to 0.5 seconds.
 - Change the *Linear* and *Angular Termination Velocities* to 0.0. This ensures the event doesn't terminate when the vehicle slows to zero and then reverses its direction during rebound.
- Choose *Options, Calculation Options* and increase the *Minimum Velocity for Friction* to 10 in/sec.

NOTE: Increasing the *Minimum Velocity for Friction* helps to prevent a sensitivity in the PDOF for perfectly aligned head-on crashes, such as this crash test. This is not necessary for vehicle-to-vehicle collisions.

- Execute the event.

Simulation Results

Here's the real start of our tutorial. We will create a set of output reports and a *DamageStudio* window to compare the simulation results with the experimental results. First, let's edit the default *Playback Interval*:

- Go to the Playback Editor.
- Choose *Options, Playback* and set the *Playback Interval* to 0.001 seconds.

NOTE: Setting the *Playback Interval* equal to the event's *Output Time Interval* ensures that we don't miss any acceleration or force peaks. This is important!

Now, let's add a Variable Output table to display our simulation results:

- Click *Add Report*. The Report Window information dialog is displayed. Click on the *Report Type* listbox and choose *Variable Output*.
- Press *OK*.

The Variable Output table is displayed. By default, the table is initially empty unless your user preferences are set to copy the results from your event. Let's display the variables we need for comparison with the experimental results, that is longitudinal acceleration and forward velocity:

- Click *Select Variables* at the top of the Variable Output table and choose the following simulation results:
 - *Kinematics* group, *Fwd Acc* (forward acceleration component)
 - *Kinematics* group, *u-vel* (forward velocity component)
- Press *OK*.

The selected variables are displayed in the Variable Output table at 0.001 second intervals. We have copied these results to an Excel spreadsheet for comparison with the experimental results (see graphs in Figures 3 and 4).

Next, let's display the Damage Data report:

- Click *Add Report*. The Report Window information dialog is displayed.
- Choose *Damage Data*.
- Press *OK*.

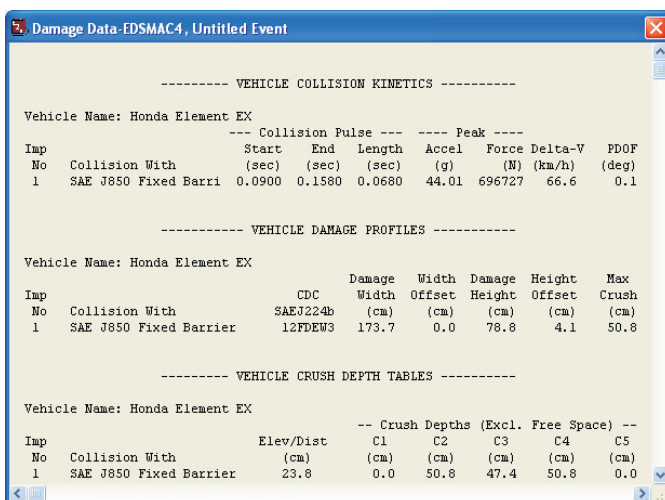


Figure 5 - Damage Data output report produced by EDSMAC4, showing CollisionData simulation results.

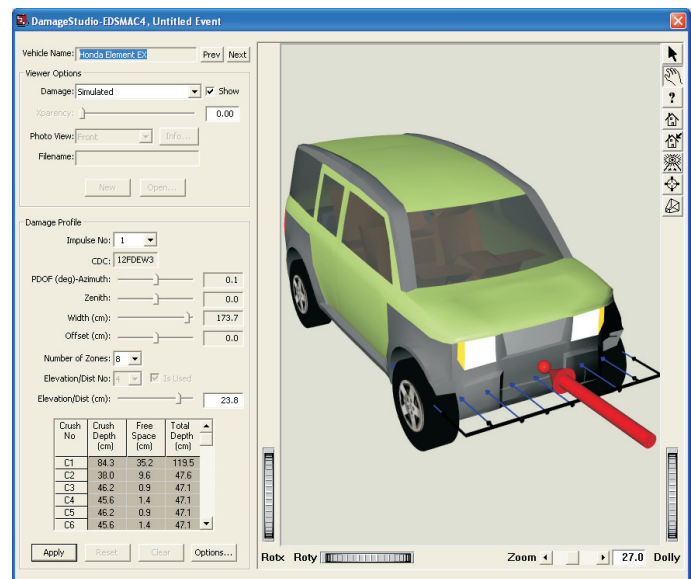


Figure 6 - DamageStudio window, showing the impulse information for the Honda Element barrier crash test.

The Damage Data report is displayed (see Figure 5), showing the CollisionData results for the simulated crash test.

The CollisionData show that the collision pulse duration was 0.068 seconds, the peak acceleration was 44.0 g, and the delta-V was 66.6 km/h. In addition, the maximum crush (excluding free space), was 508 mm

Table 1 - Comparison of experimental and simulation results

Parameter	Exp	Sim
Maximum Static Crush (mm)	510	508
Peak Long. Accel (g) @ time (sec)	-46.8 @ 0.018	-44.0 @ 0.040
Pulse Duration (sec)	0.085	0.068
Delta-V (km/h)	63.3	66.6

and occurred at an elevation 238 mm below the CG, across the middle of the vehicle. See Table 1.

Finally, let's add a *DamageStudio* window:

- Click *Add Report* and choose *DamageStudio*.
- Press *OK*.

The *DamageStudio* window is displayed (see Figure 6). You will notice that the *Impulse No.* listbox initially displays *Auto*.

- Press the Playback Controller's *Play* button.
- After the collision begins (at 0.090 seconds), press *Pause*.

DamageStudio displays a time history of the damage that occurred at 0.001 second intervals during the crash test. The current damage profile information (CDC, PDOF, Damage Width and Offset) are displayed, along with a table of crush depths at the current elevation. The crush table displays Actual Crush, Free Space and Total Crush (the sum of actual crush and free space).

By default, the damage width is divided into four crush zones; this is user-editable:

- Click on the *Number of Zones* listbox and choose 8.

The damage width is now divided into eight zones. The crush table and viewer are updated to reflect eight zones and 9 crush depths.

The *Elevation/Dist* field displays the elevation associated with the greatest crush depth. The user can view crush depth data at other elevations:

- Click in the *Elevation/Dist* field and change the value to 0.0, followed by <Enter> or *Apply*. The crush table and viewer are updated to reflect the damage at the vehicle's center of gravity.

NOTE: *Elevation* is a vehicle-fixed z coordinate; thus, 0.0 is the CG elevation.

- Click on the *Impulse No.* listbox and choose 1.

The *DamageStudio* viewer and Damage Profile information are updated to display the damage results existing at the end of impulse number 1.

NOTE: Explicitly selecting an impulse number is a quick way to display the results for a particular impulse. This method is much faster and easier than using the Playback Controller to scroll through time, especially when there are multiple impulses.

Summary

This tutorial illustrates a step-by-step procedure for using *EDSMAC4* to simulate a barrier crash test, and using *DamageStudio* to view the results. The combination of *EDSMAC4*'s CollisionData output report and HVE's *DamageStudio* window provides a powerful means of analyzing and displaying the results of any *EDSMAC4* collision simulation, whether it be a simple barrier impact, a 2-car collision, an intersection collision with secondary impact, or a complex, multi-vehicle crash involving cars and even articulated vehicles.

Rate This Tech Session

Please go to www.edccorp.com/TechSessionRating to tell us if you liked this Technical Session and to suggest other topics you'd like to see in future technical sessions in the EDC Technical Newsletter. Thank you!

EDSMAC4 v7.21 Patch Download Available

As mentioned in the Technical Session of this newsletter, *EDSMAC4* users are advised to download and install an updated *EDSMAC4* for their Version 8.20 software installations. The *EDSMAC4* v7.21 Patch addresses the following issues and improvements:

- Important corrections to the CollisionData routine (For a detailed discussion of this corrections, see the *EDSMAC4-DamageStudio-Memo* PDF document included with the download.)
- Enhanced Environment Data output report
- Corrections to the HVE Driver Model
- Corrections to the Driver Data and Vehicle Data output reports

This patch is available to download directly in the Support Downloads section of the EDC website, located at www.edccorp.com/support/downloads.html. Installation involves extracting updated *EDSMAC4.exe* and *EDSMAC4.rsc* files to the correct folder locations in your installation. **NOTE:** You need to also receive an updated license file in order to run this updated version of *EDSMAC4*.

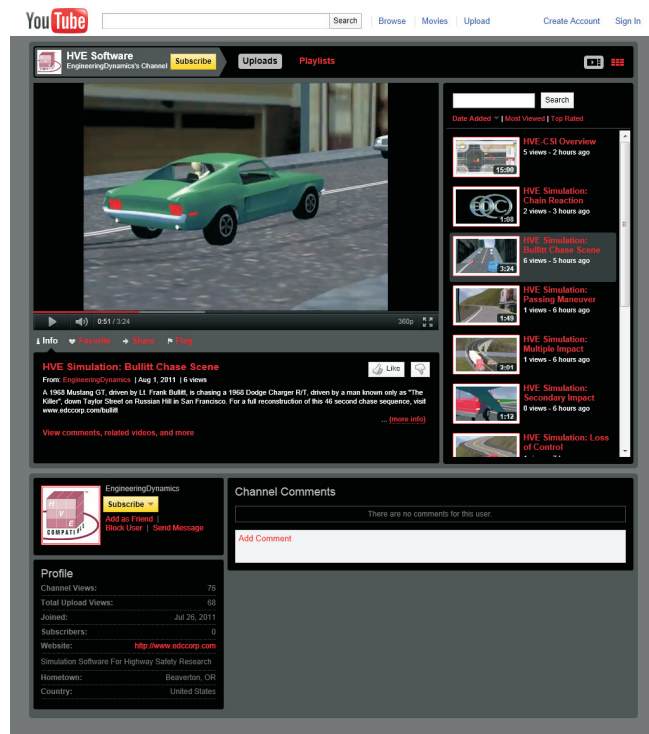
If you have any questions or would like assistance with installing this *EDSMAC4* v7.21 Patch, please contact EDC Technical Support at support@edccorp.com or by calling 888.768.6216.

EDC and HVE Users YouTube Channels

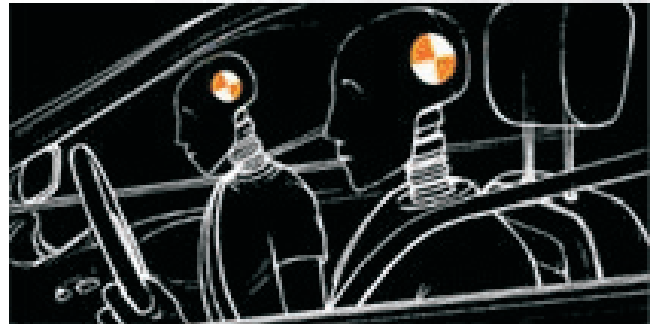
EDC invites you to view the new *HVE* Software YouTube Channel displaying simulations and other videos used by EDC for demonstration and promotion of *HVE*, *HVE-2D* and *HVE-CSI* over the years. Visit www.youtube.com/user/EngineeringDynamics for a variety of examples, walk-thrus and other videos that may be helpful to you for improving or presenting your own work to clients.

EDC has also helped launch a new YouTube Channel displaying simulation movies created by *HVE*, *HVE-2D* and *HVE-CSI* users from around the world! The *HVE* Users Channel is today's version of the *HVE* Simulations Festival, started over 10 years ago at the *HVE* Forum to help users to promote their capabilities and services. EDC invites all users to view and participate at www.youtube.com/user/HVEusers.

Movies displayed are either uploaded directly to the channel, or linked via "Favorites" from other channels hosted by users. EDC is available to help users upload movies and create descriptions and active links back to their own company websites. All user's are encouraged to submit or recommend movies to be displayed on this channel.



MADYMO



madymo®

MADYMO Occupant Simulation for STARS

Earlier this year, EDC and TASS, the provider of MADYMO occupant crash simulation software, entered into a distribution partnership. Specifically for the accident reconstruction industry, TASS launched a new software package called STARS (Software for Traffic Accident Reconstruction Simulation) that bundles the capabilities of *HVE-CSI*, MADYMO and PreScan together in an entry level package. STARS provides reconstructionists with basic vehicle crash reconstruction capabilities using *HVE-CSI*, occupant simulation capabilities using MADYMO-for-STARS, and accident animation using PreScan-for-STARS.

Collision pulses from crash simulations in *HVE-CSI* are exported from the Variable Output table and imported into MADYMO-for-STARS for occupant simulation studies. This means that collision pulses from the current version of *HVE* can also be imported into MADYMO-for-STARS. Because of this ability, the MADYMO and PreScan parts of the STARS package are now available to users of the current version of *HVE*. These users can purchase the [MADYMO pack](#) directly from TASS for only 1,000 Euro, using a special discount code that identifies them as a user with a current version of *HVE*.

For more information, or to receive your discount code to purchase STARS or the MADYMO pack directly from TASS, please visit www.stars-software.com or contact info@stars-software.com.

HVE and HVE-2D F.A.Q.

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

Q. I really appreciate the detailed information provided in the new Collision Data format Damage Data report for EDSMAC4 in my Version 8.20 software, but how do I change back to the Traditional format that I am used to working with for the past years?

A. To toggle back and forth between the new Collision Data and standard Traditional formats, you need to first be in the Event Editor and then use the Calculation Options dialog to change the setting in the bottom portion of the dialog. To access the Calculation Options dialog for your event, select *Options, Calculation Options* on the main menu. When you reset and run your event, the Damage Data report information will be generated in the format you selected.

Q. I can't seem to display the entire environment model in my viewer when I dolly the camera out. If I'm close in, I can see the model fill the viewer. But as I move away, the model appears to start being cut with a vertical plane and I see the default blue sky background instead. How can I make my entire model/drawing display in the viewer as I dolly out?

A. What is happening is simply that the default camera settings have near and far clipping planes which help large complex models to be displayed efficiently on your computer. These clipping planes tell the viewer the distance range for objects that can be displayed. By default, objects closer than 2 feet or farther than 2000 feet from the camera will not be displayed. A quick way to override the default settings so that it will show the complete model is to place your mouse cursor over the scene and right-click. In the menu that appears, choose *Preferences* and then check *Auto clip planes*. Now when you dolly out, you will always see your environment drawing/model displayed in the viewer.

Q. I'm trying to add an environment, but when I press the Add Environment button on the toolbar, I get an error dialog with the message "Parameter is incorrect" and the Environment Information dialog does not appear. It worked last time, so what can I do to fix this issue?

A. Your Environment Location database that provides the *Current Location, Latitude, Longitude* and *GMT* information displayed at the top of the Environment Information dialog has become corrupt. You need to

replace it with the original one supplied with your current installation. You can either reinstall your software, or simply visit the Support, Downloads section of the EDC website to download a replacement *EnvLocation.ldb* file.

Q. In EDSMAC4, I know that I can assign the initial velocity of the vehicle with a 180 degree slip angle to make it travel backwards at a set speed at the start of the event. Is it possible to accelerate the vehicle backwards in EDSMAC4?

A. No. In EDSMAC4, the inputs for the Driver Controls Throttle table only provide a forward acceleration to the vehicle. To accelerate backwards, as if the vehicle is in reverse and the driver steps on the accelerator pedal, you will have to use *SIMON*. *SIMON* utilizes a complete drivetrain model which allows you to shift the transmission into reverse gear and apply the throttle pedal, which in turn results in the acceleration of the vehicle in reverse.

Q. I've upgraded from my old Windows XP computer to a new Windows 7 model, and now I find that I can't open the HVE Application Help like I used to be able to. Actually this happens with some of my other software programs too. Any suggestions?

A. Your answer comes straight from Microsoft on this one --- This situation "On a computer that is running Windows Vista, Windows 7, Windows Server 2008, or Windows Server 2008 R2, you may be unable to use the Help feature in some programs." is addressed in the following support article from the Microsoft website - <http://support.microsoft.com/kb/917607>

The above link allows you to download and install the legacy WinHlp32.exe application that matches your Windows operating system. Once you have completed the installation, you will be able to select Help, Help Topics in HVE and view the content as expected.

Because the Help file only provides very basic user interface information, you should look to the PDF version of User and Physics Manuals for detailed operation and application information. These are easily found from your Windows Desktop menu by selecting Start, All Programs, HVE (or HVE-2D or HVE-CSI) and then Manuals.

**Visit the Support section of
www.edccorp.com for the latest
Downloads and answers to F.A.Q.s**

EDC Training Courses

EDC Reconstruction & EDC Simulations

EDC offers excellent one-week courses on the use of the *EDCRASH* reconstruction program or the use of simulation programs, such as *EDSMAC*, *EDSMAC4*, *EDSVS* and *EDVTS*. The **EDC Reconstruction** and the **EDC Simulations** courses are designed to fully investigate the inner workings of the physics programs. Lectures are full of helpful hints gained from years of experience. During the course, students will use the physics programs to complete several workshops highlighting the capabilities of each program discussed in the course.

All users of *HVE* and *HVE-2D* agree that these courses are extremely beneficial and challenging. It's the fastest way to learn what you really need to know – how to effectively use the physics programs and get the right results. *Note: These courses focus on the physics programs, not on the user interface. For courses on using HVE, HVE-2D or HVE-CSI, check out the HVE Forum.*

Vehicle Dynamics

The **Theoretical & Applied Vehicle Dynamics** course extends the scope of a general vehicle dynamics discussion by including several direct applications using the *SIMON* vehicle dynamics simulation program within *HVE* and providing a solid theoretical background for such simulations. The course is focused towards engineers and safety researchers with an interest in an understanding of vehicle dynamics and automotive chassis systems development.

Engineering Dynamics Corporation Training Course Schedule

EDC Simulations

Los Angeles, CA January 2013
Miami, FL November 2013

EDC Reconstruction

Los Angeles, CA January 2014
Miami, FL November 9 - 13, 2012

Theoretical & Applied Vehicle Dynamics

Upon Request

2012 HVE FORUM

New Orleans, LA Feb 27 - Mar 2, 2012

HVE Forum

The **HVE Forum** offers workshops designed to help *HVE*, *HVE-2D* and *HVE-CSI* users improve their modeling and application skills. By participating in workshops, attendees learn new techniques and also how to use the latest advancements in the software. The *HVE Forum* is also a great opportunity to meet other users and expand your network of resources.

Course Registration

To register for a course, download a registration form from the Training page at edccorp.com or contact EDC Customer Service at 503.644.4500 or by email to training@edccorp.com. All courses are eligible for Continuing Education Units and ACTAR credits.

HVE Training Partners

HVE, *HVE-2D* and *HVE-CSI* users looking to improve their skills, but unable to attend one of EDC's regularly scheduled courses, can contact an *HVE* Training Partner for assistance. *HVE* Training Partners are experienced *HVE* and *HVE-2D* users who offer introductory and custom training courses on the use of *HVE*, *HVE-2D*, *HVE-CSI* and compatible physics programs.

HVE Discussion Groups

Websites hosted by experienced *HVE* Users offer information about using *HVE* as well as moderated online discussions with other users. Be sure to visit:

Yahoo - tech.groups.yahoo.com/group/HVErecon - Discussion group hosted by Beck Forensics, Inc.

AccidentReconOnline.com - Online training courses and also the DiscoverHVE video tutorials and discussion group hosted by Wes Grimes of Collision Engineering Associates.

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