SUMMER 2012 ENGINEERING DYNAMICS CORPORATION

Technical Newsletter

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

Ongoing Developments From EDC

EDC Celebrates 30 Years

This year marks 30 years of contributions by Engineering Dynamics Corporation towards the advancement of the vehicle safety industry. By now you've noticed the "30 Years" seal adorning the home page of the EDC website, weekly E-News broadcasts and EDC Reconstruction course flyers. We look forward to continuing to offer users highly-validated robust tools, as well as unparalleled customer support and training.

Version 9.10 - Coming Soon

The final development efforts for Version 9.10 are underway, and after field testing and final validation are completed, this update is expected to be available starting in October. New features include:

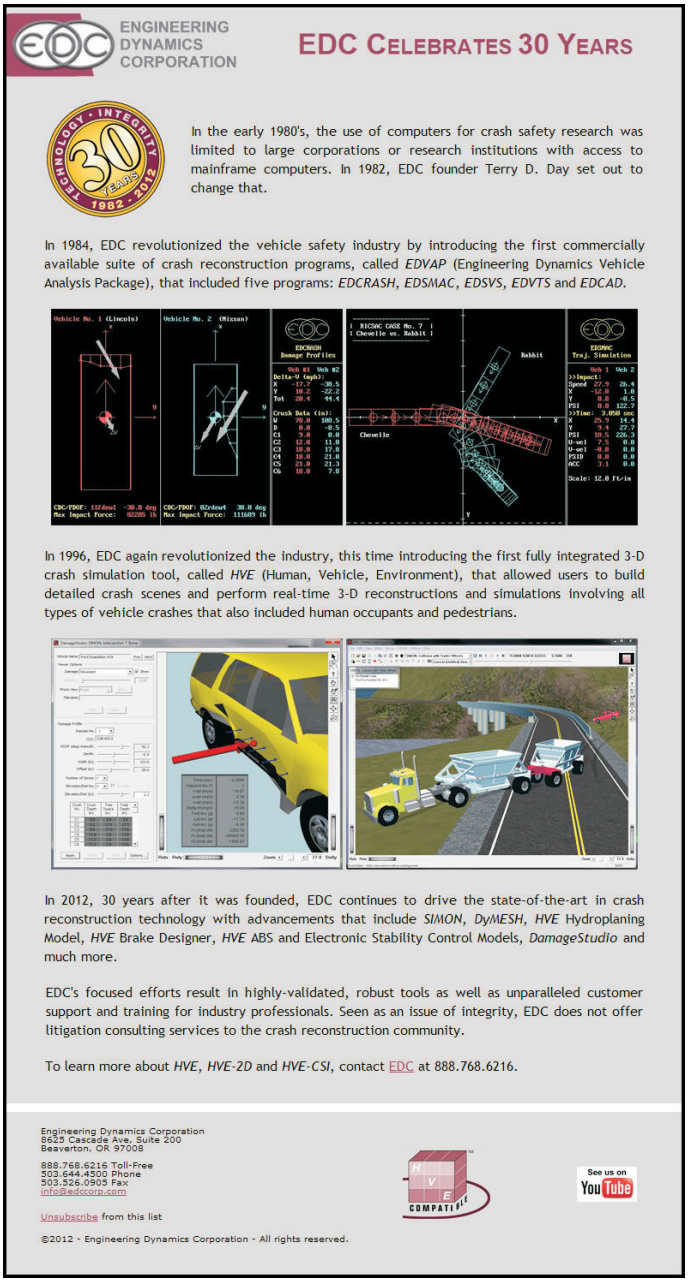
- ***SIMON* Trailer Separation -** Simulation of trailer disconnection resulting from mechanical failure or collision forces/moments will be possible. The robust handling of the separate vehicles post-separation allows for detailed study of free-rolling trajectory, roll-over or even collision with other objects.

- **Key Results In Video Creator -** The Video Creator viewer will include a Key Results window that displays time-domain results which are recorded directly in your simulation movie. The available Key Results include all the standard results (e.g., time, positions, velocities, accelerations, forces...).

- **DXF Support in *HVE-CSI* -** Users can choose between Aerial Photo or Terrain as environment models used in *HVE-CSI*. If Terrain is selected, an AutoCAD DXF format line drawing or 2-D surfaced model can be imported directly into the Environment Editor. This capability allows for quick placement of vehicles over scene evidence in *EDCRASH* reconstructions by switching to wireframe mode.

- **3rd Party Vehicle Database License Manager -** License mangement of vehicles selected from a 3rd party database provider, such as those available from Vehiclemetrics, will be supported.

More information about these and other enhancements available in *HVE*, *HVE-2D* and *HVE-CSI* Version 9.10 can be found online at www.edccorp.com/Version910.



E-News announcement of the 30th anniversary of EDC, found by clicking on the 30 Years logo on the EDC website. The layout includes screenshots from EDVAP introduced in 1984 and also the current HVE software displaying the latest DamageStudio and DyMESH Wheel Impact Simulation capabilities. My how things have changed!

Technical Session

This Technical Session provides an updated tutorial on the *HVE* Driver Model. Earlier tutorials in May, 1999, and Summer, 2004, provided a detailed technical backgrounder and a user tutorial, respectively. This tutorial extends the previous work by including the Speed Follower option, which was introduced with *HVE* Version 7.00 in August, 2009. The visualization of the attempted path, introduced with *HVE* Version 9.00, is also included.

HVE Driver Model

The *HVE* Driver Model* predicts the driver inputs (steering, braking and throttle) required to cause a vehicle to follow an attempted path. The *HVE* Driver Model is a useful tool because it provides a quick and efficient method for determining if and how a vehicle's driver can successfully negotiate an attempted maneuver. The most important results are the steer table, throttle table and brake table that were used to negotiate the path. These results may be found in the Driver output group in the Key Results (Event Editor) and Variable Output Table (Playback Editor).

Note that the vehicle may not be able to follow the user-entered path because of vehicle performance limitations. For example, if the user describes a circular path with a constant radius of 100 feet and an initial velocity of 75 mph, the vehicle will quickly deviate from the defined path, typically with significant understeer, because it is incapable of pulling a lateral acceleration of 3.76 g.

On close inspection, the *HVE* Driver Model has four components:

- **The vehicle –** Any vehicle with driver controls (a steering system, a braking system and a drivetrain) may be used.
- **The attempted path –** The attempted path is supplied during event set-up.
- **The driver –** The parameters describing the driver are also supplied during event set-up.
- **The results –** The results of the attempted maneuver are displayed visually in the viewer during event execution and/or replay. The numeric results are displayed in the Key Results window (see Kinematics for the vehicle path and Driver for driver steering, braking and throttle, as well as deviation from the attempted path).

* Day, T.D., Metz, L.D., "The Simulation of Driver Inputs Using a Vehicle Driver Model," SAE Paper No. 2000-01-1313, Society of Automotive Engineers, Warrendale, PA, 2000

Example

An excellent application for the *HVE* Driver Model, including the Speed Follower option, is the Bullitt chase scene down Taylor Street in San Francisco. The use of traditional, open-loop driver tables would require numerous iterations of the steering (to keep the vehicle on a straight line), braking (to keep the speed approximately constant on both the 25 percent downgrade and the level intersections) and throttle (to accelerate westbound after turning left onto Filbert Street).

Our tutorial begins in the event editor after the vehicles and the environment have been added to our case. To create our *SIMON* simulation, perform the following steps:

- Select the *1968 Ford Mustang Fastback*.
- Select the *SIMON* calculation method.
- Press *OK*.

The environment is displayed (see Figure 1), and we're now looking straight down at the top of Russian Hill (the intersection of Vallejo and Taylor).

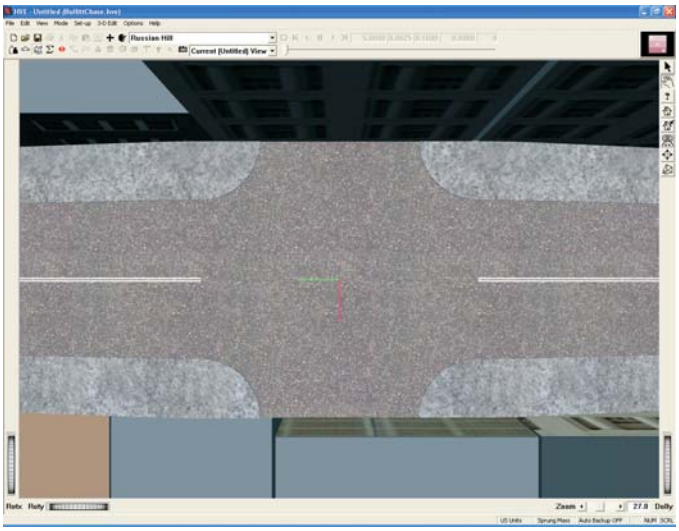


Figure 1 - Looking straight down at the earth-fixed origin at the top of Russian Hill.

Now, we're ready to set up the simulation:

- Choose *Set-up, Position/Velocity*. The initial position of the Mustang is now displayed at the X,Y origin at the top of Russian Hill. (AutoPosition ensures the vehicle is sitting on the terrain at the correct elevation.) Move the vehicle to the middle of the northbound (downhill) lane, X = 5 ft, Y = 0 ft, Yaw = -90 deg. Click the *Velocity is Assigned* checkbox and enter 35 mph.

The *HVE* Driver Model requires the user to create an attempted path. This is done using target positions. To enter the target positions that define the attempted path:

- Click on the Position/Velocity dialog's *Path Location* listbox and choose *Begin Perception.* (Because our calculation method, *SIMON*, is a simulation-type program, the path location name is simply a label.) A second instance of the Mustang is now displayed at the origin. Move it down the hill about a half block short of our turn onto Filbert, X = 5 ft, Y = -850 ft, yaw = -90 deg. This will be where the Mustang starts slowing for the turn. Click the *Velocity is Assigned* checkbox and enter 35 mph.
- Click on the *Path Location* listbox and choose the next path position, named *Begin Braking* (again, the path location name is not relevant). Another vehicle instance appears at the origin. Move it to Filbert, where it begins to enter the intersection, X= -3 ft, Y= -990 ft and Yaw = -110 deg (you'll note that Frank is cutting the corner). Click the *Velocity is Assigned* checkbox and enter 15 mph. The reduced speed will cause the speed follower will increase the braking level and slow the vehicle.
- Click on the *Path Location* listbox and choose the next path position, named *Impact*. Another vehicle instance is placed at the origin. Move it to Filbert, where it is leaving the intersection having negotiated the left turn and begins heading westbound, X = -50 ft, Y = -1040 ft and Yaw = -180 deg. Click the *Velocity is Assigned* checkbox and enter 15 mph.
- Click on the *Path Location* listbox and choose the next path position, named *Separation*. Another vehicle instance is placed at the origin. Move it to Filbert, 100 feet west of the previous position, X = -150 ft, Y = -1040 ft and Yaw = -180 deg. Click the *Velocity is Assigned* checkbox and enter 50 mph. A quick calculation will show that we've just asked the vehicle to accelerate at 1.63 g, causing full throttle application and resulting tire marks.
- Click on the *Path Location* listbox and choose the final path position, named *Point On Curve*. Another vehicle instance is placed at the origin. Move it to Filbert, 500 feet west of the previous position, X = -650 ft, Y = -1040 ft and Yaw = 180 deg. Click the *Velocity is Assigned* checkbox and enter 50 mph. This final path position is important: When the driver preview point passes this position, the driver model turns off and steering, braking and throttle return to zero. Therefore, we want to place this final position way down the road, beyond the range of our path following needs.

Table 1 - Summary of target positions defining the attempted path

X (ft)	Y (ft)	Yaw (deg)	Vtotal (mph)
5	0	-90	35
5	-850	-90	35
-3	-990	-110	15
-50	-1040	-180	15
-150	-1040	-180	50
-650	-1040	-180	50

We have now defined the path using (in addition to our initial position) five target positions. Table 1 summarizes the six path positions. Figure 2 shows the scene with the target path positions displayed.

The next step is to activate the *HVE* Driver Model:

- Choose *Set-up, Driver Controls*, and select the *HVE Driver* tab. The *HVE* Driver Model pages are displayed.
- Click on the *Use Path Follower* checkbox to activate the *HVE* Driver Model.
- Select the *Speed* tab and click the *Use Speed Follower* checkbox to activate the Speed Follower option (this option applies the braking and throttle required to maintain the speed assigned in the Position/Velocity dialogs at each path location; see Figure 3).
- Press *OK*.

Because the event lasts longer than 5 seconds, let's increase the *Maximul Simulation Time*:

- Choose *Options, Simulation Controls,* and increase *Maximum Time* to 30 seconds, followed by *OK*.

We are now ready to execute the simulation:

- Press *Play* (the blue arrow in the Execution Controller).

The Mustang heads down Taylor Street at 35 mph. To confirm what's going on, pause the simulation and add some Key Results to our Key Results window:

- Click *Pause*.
- Click on the *Options* menu and confirm that Show Key Results is active. If it is not, click on *Show Key Results*.
- Click *Select Variables* in the Key Results window. The Variable Selection dialog is displayed.
- Click *Clear All Selections* to remove any unwanted variables from the window.

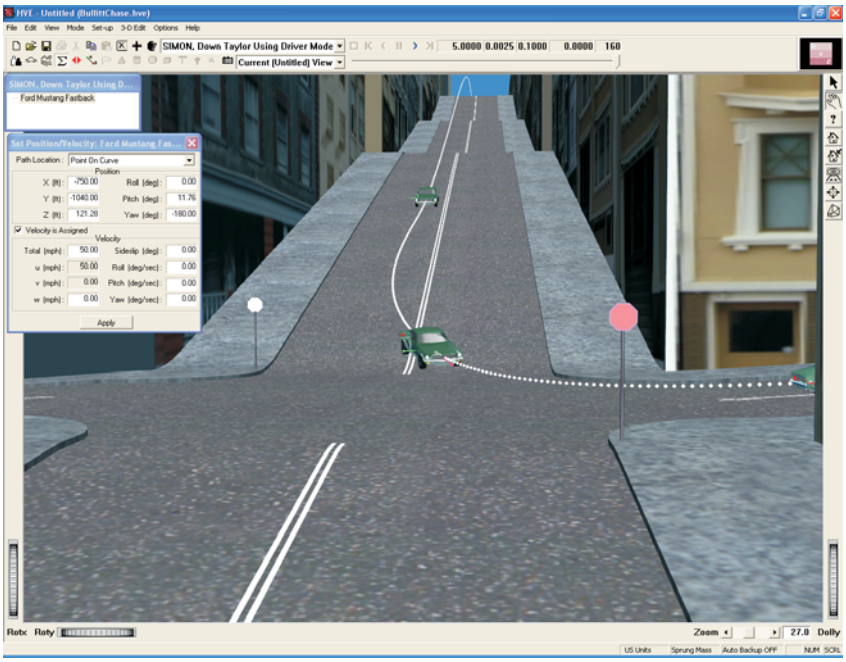


Figure 2 - View from Filbert looking up Taylor Street at the attempted path (dotted line) defined by the target vehicle positions.

Summary

To review the results, let's go to the Playback Editor and look at a Variable Output table:

- Click the *Playback Editor* icon in the toolbar to go to the Playback Editor.
- Add a Variable Output table. If your user preference is set, the results displayed in your Key Results window are automatically displayed in the Variable Output table (see Options, Preferences, Copy Key Results to Variable Output checkbox). Otherwise, add the Kinematics Speedometer and Driver Steer Ang, Brake Pedal and Throttle Posn. The speed and simulated driver steering, braking and throttle required tocomplete the maneuver are shown in Figure 4.

To view the actual movie footage of this portion of the chase scene, and a significalty more detailed simulation, go to edccorp.com, Featured Simulations and choose the Bullitt Chase Scene.

- Choose the *Kinematics* output group and select *Speedometer* so we can monitor the speed as the vehicle travels down the hill.
- Choose the *Driver* output group and select *Steer Ang, Brake Pedal* and *Throttle Posn* to monitor the driver inputs as the vehicle travels down the hill.

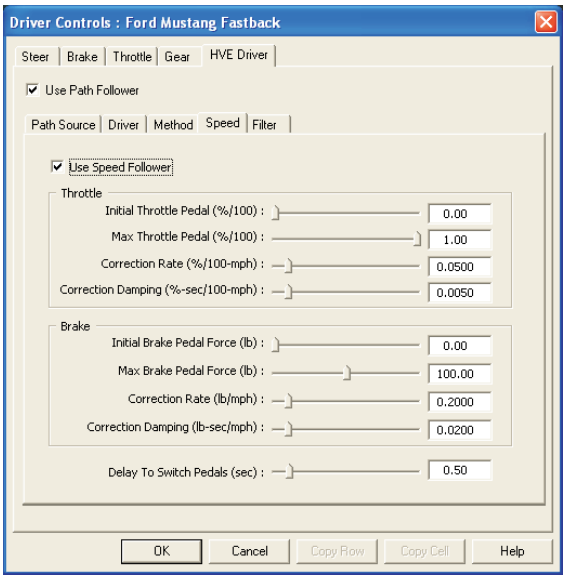


Figure 3 - Driver Controls, *HVE* Driver Model dialog, Speed page, allowing the user to activate the Speed Follower option.

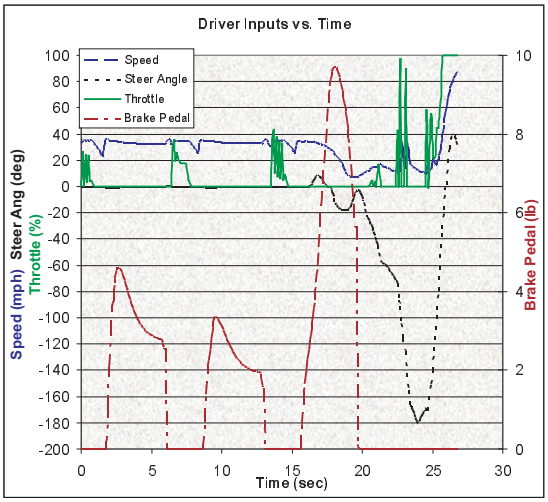


Figure 4 - *HVE* Driver Model results for Frank Bullitt driving his Mustang down Taylor Street in San Francisco.

Rate This Tech Session

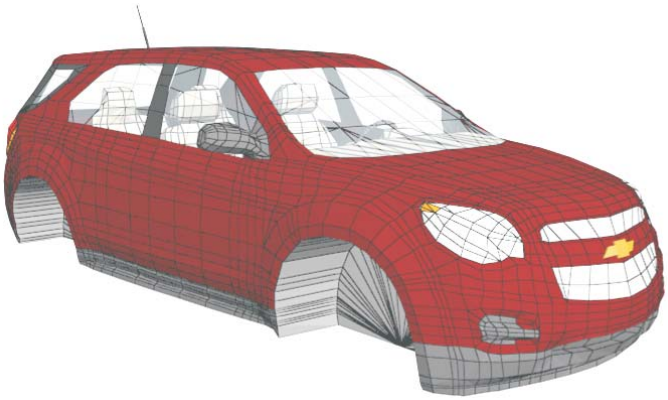
Please go to www.edccorp.com/TechSessionRating to tell us if you liked this Technical Session and to suggest other topics you'd like to see in future technical sessions in the EDC Technical Newsletter. Thank you!

Vehiclemetrics Launches *HVE* Vehicle Database

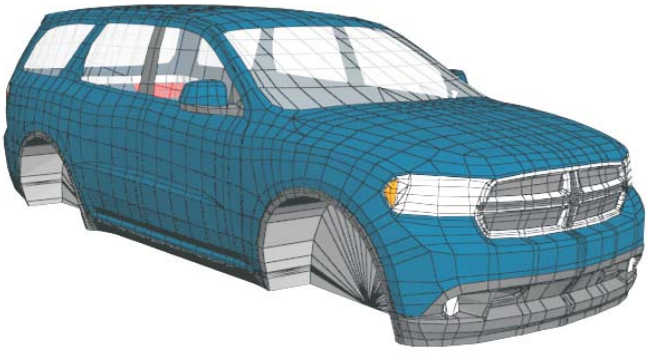
Vehiclemetrics has released their new *HVE*-compatible vehicle database. The background and development effort behind this new source of ready-to-use vehicles was first introduced during the *HVE* White Paper Session at the 2012 *HVE* Forum in HVE-WP-2012-2, "An Introduction to the Vehiclemetrics *HVE* Vehicle Database," by *HVE* users Ron Jadischke and Joe McCarthy of Vehiclemetrics/McCarthy Engineering.

Vehicles selected from the Vehiclemetrics database will appear and function similar to existing *HVE* vehicles. The geometry is created from multiple laser scans with an *HVE* specific mesh density, consisting of a semi-uniform grid spacing of polygons for more uniform crush computations and visualizations. The physically measured mechanical data included in most of the models includes the following features:

- Measured parameters for three-dimensional suspension movement, braking and steering.
- Measured wheel center (spring) rate.
- Calculated wheel damping rate based upon vibration testing.
- Measured auxiliary roll stiffness.
- Measured vehicle mass data and center of gravity data.



2010 - 2012 Chevrolet Equinox geometry displayed with wireframe overlay showing polygon mesh density.



2011 - 2012 Dodge Durango geometry displayed with wireframe overlay showing polygon mesh density.

The database is designed to be plug-and-play in a current *HVE* installation. A user selects vehicles from the Vehiclemetrics database as they would for a Generic Vehicle or Custom Vehicle from the *EDVDB-3D* vehicle database. Licensing of the database is controlled by the *HVE* license manager, so along with their Vehiclemetrics database, the user will receive a updated license file for *HVE* (see below).

This initial release of the database includes geometry and mechanical data for 70 current model vehicles typically available for sale in North America. Vehiclemetrics anticipates adding 100 to 150 vehicles per year to the database.

Vehiclemetrics is offering a free sample vehicle from the database to allow *HVE* users to experience the quality of the geometry and data parameters firsthand. Additionally, Vehiclemetrics is offering discounts on purchases of this initial database release. Information regarding the purchase of the database, individual vehicles or custom orders is available at www.vehiclemetrics.com, or by calling Vehiclemetrics at 1-855-966-3357 (toll-free).

HVE Version 9.01 Update

An interim update of *HVE* has been released to support license management for the Vehiclemetrics database. This update only contains changes to the license verification process executed when vehicles are added to the *HVE* Vehicle Editor. The Version 9.01 update consists of replacement hve.exe and language.rsc files, and the user will also receive and install an updated license file. This update will only be issued in conjunction with the user receiving their database installation files from Vehiclemetrics.

2013 *HVE* Forum

March 11 - 15, 2013

Westin Gaslamp Quarter • San Diego

Make plans now to attend the 2013 *HVE* Forum, from March 11 - 15, 2013, at the Westin Gaslamp Quarter in San Diego, California. The 2013 *HVE* Forum is where you will learn how to use the latest features and capabilities of *HVE*, *HVE-2D* and *HVE-CSI*. An excellent selection of workshops is available, designed for beginning, intermediate and advanced users. In addition, the Forum has User's Group meetings, the *HVE* White Paper session and interactive networking social hours at the end of each day. Check out this perfect location:

Westin Gaslamp Quarter - San Diego
910 Broadway Circle, San Diego, CA 92101
www.westingaslamp.com

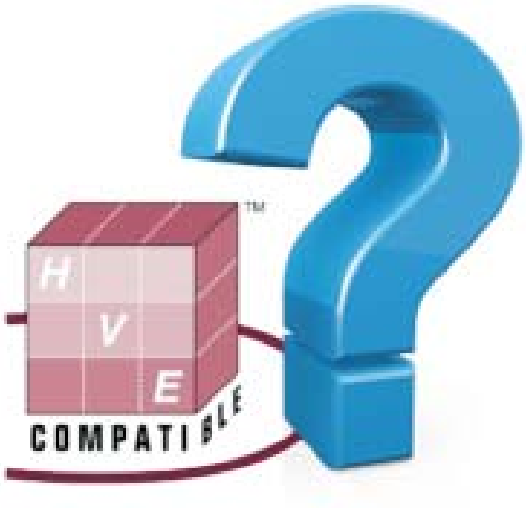
Workshop schedules, descriptions and registration forms will be available to download from the 2013 *HVE* Forum pages at www.edccorp.com/2013HVEForum.

EDSMAC4 7.31 Update

An update to *EDSMAC4* is now available for download from the Support, Downloads section of the EDC website. The *EDSMAC4* Version 7.31 update addresses the following issue*:*

- If the Damage Data Format option was set to Collision Data, the Crush Depth Table in the Damage Data report used a stale elevation index, potentially resulting in an incorrect set of crush depths. This problem routine has been corrected.

NOTE: This update is only applicable to users with *HVE* & *HVE-2D* Version 9.00 installations. After installing the replacement *EDSMAC4* file, the user must also install an updated license file. To receive your updated license file, please contact EDC Technical Support.



HVE FAQ Knowledge Base Continues to Grow

All users are invited to explore the *HVE* FAQ Knowledge Base and check out the latest additions to this powerful user support resource. This system provides immediate, 24/7 assistance for questions related to installation, operation and application of *HVE*, *HVE-2D* and *HVE-CSI*. Users can browse through questions and answers from multiple categories, or go directly to their issue using integrated Search and Advanced Search tools on each page.

The *HVE* FAQ Knowledge Base can found by browsing to the Support section of the EDC website, or by going directly to www.edccorp.com/FAQ.

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. In the video created from my simulation, the environment aerial image appears as a scrambled checkerboard. Why?

A. If the aerial image on your environment looks fine in the Environment and Event Editors, and it looks fine in the Traj Sim and Video Creator windows in the Playback Editor, but appears scrambled in the final recorded video, the issue is due to a behavior of the Windows video recording subsystem on your computer. The cause of your issue is that the location of your aerial image is not on your local drive, but actually on a drive across your network such as your server. If you place the image on your local drive and reapply it to your environment, it will appear as expected in all of the Editors and in your video.

Q. I see an option in the User Preferences called Dimension Basis. What is this for?

A. The Dimension Basis user preference was added in *HVE* Version 8.10 (Dec 2010). Its purpose is to allow the user to assign certain vehicle-fixed dimensions (CG to Front Axle, etc.) according to either the sprung mass CG or the total mass CG. There is a difference in sprung and total mass CG location, and while the difference is rather small for most passenger vehicles, it can be significant for on-highway trucks wherein the unsprung masses (wheels and tires) represent a larger fraction of the total vehicle weight.

When executing a 3-D simulation, the equations of motion require all vehicle-fixed coordinates (e.g., wheel locations, connection locations) to be relative to the sprung mass CG. Therefore, *HVE* has always displayed and stored these coordinate data relative to the sprung mass CG. When *HVE* is executing a 2-D simulation, the equations of motion require all vehicle-fixed coordinates to be relative to the total mass CG (technically, the reason is that the unsprung masses are included in the total vehicle mass for a 2-D simulation). Prior to Version 8.10, it was assumed that the difference was small and could be ignored. However, as mentioned above, for heavy trucks the difference could be significant. So we introduced the ability to switch between total mass and sprung mass dimensions. Each dialog in *HVE*'s Vehicle Editor that displays coordinate data automatically switches from sprung mass basis to total mass basis when that preference is selected. (In Version 9.00, the current setting is displayed in *HVE*'s status bar at the bottom of the screen.)

Here is the takeaway: You can use either preference in the Vehicle Editor. While executing an event, a 3-D simulation (e.g., *SIMON*) will always use the sprung mass dimensions (as it should). However, 2-dimensional *HVE*-compatible programs (e.g., *EDSMAC4*) are designed to allow either the sprung mass or total mass CG location (as determined by the current user preference) in order to maintain compatiblity with earlier versions of *HVE*. So, while executing a 2-D event, you *should* use the Total Mass preference. The Dimension Basis that was used while executing a 2-D event is displayed in the Program Data output report.

Q. In the Vehicle Editor, if I change the wheel locations or move the CG, the result isn't what I expect. What am I doing wrong?

A. Probably nothing. If the Dimension Basis is set to Total Mass, there is a known problem with these two dialogs. The problem is more obvious when working with heavy trucks because the unsprung masses (wheels and axles) represent a greater fraction of the total vehicle weight (when compared to passenger cars, for example). The solution for moving the CG or editing wheel locations is to set the Dimension Basis to Sprung Mass until the problem is fixed (in the next release). You can use the Handling Properties dialog (click on the CG and choose Handling…) to confirm the total weight on the front and rear suspensions.

Q. My barrier collision simulation terminates with the vehicle still engaged with the barrier. Why?

A. It sounds like your vehicle's velocity has reached the Linear Velocity termination condition set in the Event's Simulation Controls dialog. The default termination velocity is set at 2 mph, so when your vehicle drops below that speed, the event terminates and the vehicle does not rebound from barrier. However a simple change to the termination conditions will allow the simulation to continue. On the menu, select Options, Simulation Controls and then set the value for Linear Velocity to 0 mph, thereby overriding the velocity termination condition. Reset and run the event and you will now see your vehicle fully engage the barrier and rebound as expected.

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 and the *EDSMAC*, *EDSMAC4*, *EDSVS* and *EDVTS* simulation programs. 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 14 - 18, 2013
Miami, FL . . . . . November 2013

EDC Reconstruction

Los Angeles, CA . . . . . January 2014
Miami, FL . . . . . November 5 - 9, 2012

Theoretical & Applied Vehicle Dynamics

Upon Request

2013 *HVE* FORUM

San Diego, CA . . . . . March 11 - 15, 2013

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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