FALL 2009 ENGINEERING DYNAMICS CORPORATION

Technical Newsletter

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

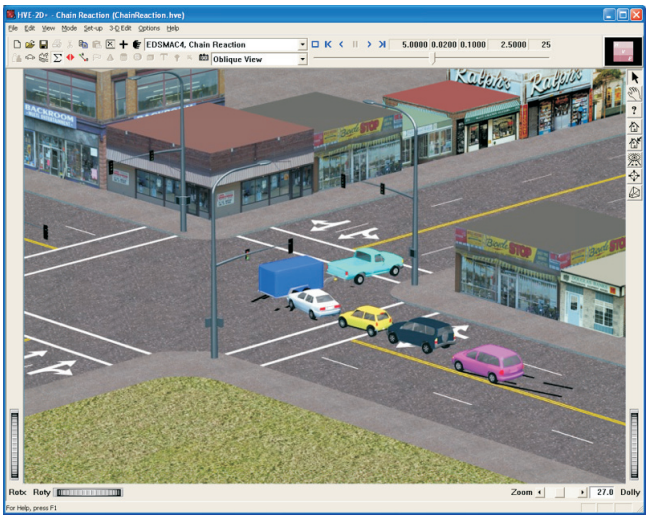
HVE & *HVE-2D* Version 7.1 - December 2009

Version 7.1 - Fourth Update for 2009!

Yes, you heard it right! The next version of *HVE* & *HVE-2D* will be released December 2009. Version 7.1 offers users several new and exciting features and capabilities, including:

3-D Viewer Option For *HVE-2D* Users

HVE-2D users now have the option to upgrade to *HVE-2D+*. This option converts the regular *HVE-2D* viewers to those used by *HVE*, allowing the user to position the camera anywhere and look everywhere in a 3-D world. This also allows *HVE-2D+* users to easily work with ground level views and target-following cameras, such as those used for displaying the driver's view of an impending crash.



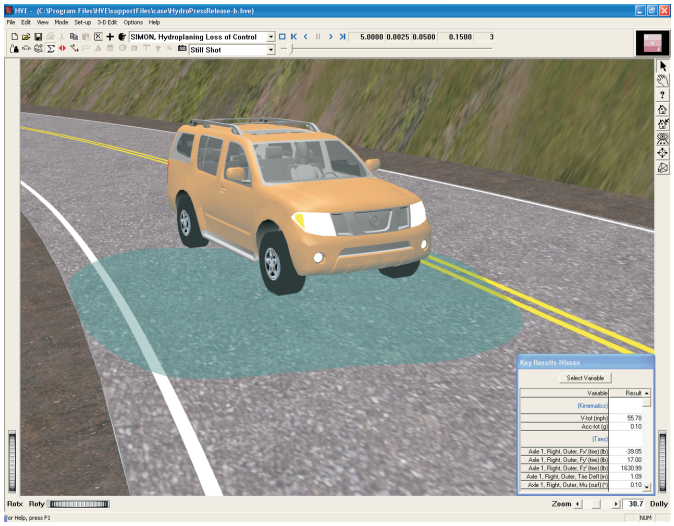
The new 3-D viewers option allows the camera to be easily positioned anywhere, such as providing an oblique view of the EDSMAC4 chain reaction collision simulation shown above.

Using Aerial or Google Earth Images

Users can now quickly work with aerial photos or Google Earth maps as their environment models. The enhanced Environment Information dialog allows the user to enter the dimensions of their image and then automatically builds a scaled surface with their selected photographic image applied as a texture. It's that easy!

HVE Hydroplaning Model

For the first time the history of vehicle simulation, a hydroplaning model has been integrated into a vehicle dynamics model so the effect on vehicle handling behavior may be directly observed! The *HVE* Hydroplaning Model has been implemented for both *SIMON* and *EDSMAC4*. The new *HVE* Hydroplaning Model allows the user to select from several industry standard methods, such as NASA (Borne) and Gallaway. The Technical Session of this Newsletter discusses the background and also provides an overview of how to use this exciting new capability.



In this SIMON simulation studying the effects of hydroplaning on vehicle handling, a Nissan Pathfinder is traveling at 55 mph around a slight curve with a downhill grade. The new HVE Hydroplaning Model in Version 7.1 is used to calculate the reduction of tire-roadway friction at each wheel location as the Nissan passes through an area of standing water.

New Vehicles Added to *EDVDB*

The EDC Vehicle Database now includes the Audi A4 (2005 - 2009 model years) , the Audi TT (2000 - 2006) and the Jeep Liberty (2002 - 2008).

These are just a few of the enhancements available in Version 7.1. More information will be posted on the EDC website as it becomes available.

Technical Session

This edition of the Technical Session describes the new *HVE* Hydroplaning Model. The Hydroplaning Model was introduced in *HVE* and *HVE-2D* Version 7 and is now implemented in *EDSMAC4* and *SIMON* updates available with *HVE* Version 7.1 (see page 1 for more information about *HVE* and *HVE-2D* Version 7.1).

The *HVE* Hydroplaning Model uses three components within *HVE*: The Vehicle Editor, the Environment Editor and the Event Editor.

Vehicle Editor

The *HVE* Vehicle Editor's Tire Physical Properties dialog (see Figure 1) now includes three new parameters:

- **Tread Width** - The width of the tread surface in contact with the terrain. The default value is provided automatically, according to tire type and nominal width.
- **Tread Depth** - The depth of the tread surface. The default value assumes the tire is in new condition and is provided automatically, according to tire type.
- **Nominal Pressure** - The tire inflation pressure. Again, the default is provided for you, and is assigned according to tire type.

In *HVE-2D*, the above default values are not editable.

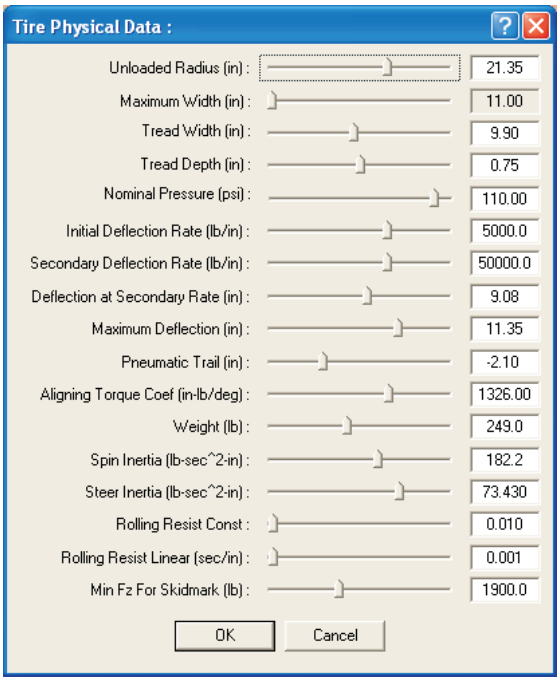


Figure 1 - The Tire Physical Data dialog now includes tread and inflation properties used by the *HVE* Hydroplaning Model.

Environment Editor

The current environment can have (and *should have!)* a terrain. Every surface (actually, *every polygon*) in the terrain has physical attributes. These attributes include:

- **Type** – User-defined surface type; may be of type *Road, Friction Zone, Curb* or *Water*
- **Friction Multiplier** – User-defined multiplier for tire-terrain friction properties
- **Micro-texture** – User-defined descriptor for the depth of pavement asperities

When the surface is of type *Water*, two additional attributes are made available:

- **Method** – Method for calculating water depth; may be *Static* (user-entered) or *Dynamic*
- **Water Depth** – User-defined water depth when the user chooses the *Static* method

These surface attributes are defined for each surface using the Object Attributes dialog; see Figure 2. (Micro-texture is assigned using the Surface Material dialog.)

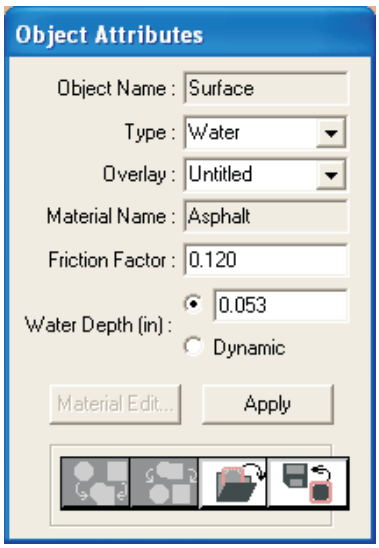


Figure 2 - The Environment Editor's Object Attributes dialog is used for assigning the type of surface, friction factor and water depth used by the *HVE* Hydroplaning Model.

To create a water surface to drive through, perform the following simple steps:

- Add a Surface Object for the road. By default, it will be of type *Road*.
- Add a Surface Object for the water region. Change its type from *Road* to *Water.*
- Enter the surface *Water Depth* and *Friction Factor*.

That's it for the Environment Editor.

Event Editor

To create a hydroplaning simulation, start by performing the usual steps:

- Select one or more vehicles
- Select the *EDSMAC4* or *SIMON* simulation model

Next, set up the event:

- Assign the Initial Position and Velocity for each vehicle
- Assign any Driver Controls (steering, braking, throttle, gear selection) for each vehicle
- Assign any other desired set-up options (Payloads, Accelerometers, etc.)

Now we choose the Hydroplaning Model:

- Choose *Calculation Options* from the Options menu.

The Calculation Options dialog for the current event is displayed (our example uses a *SIMON* simulation; see Figure 3). You will note the addition of a new Hydroplaning Model group to the dialog.

- Choose the desired model (*NASA*, *NASA-TTI* or *Gallaway*; the *Blythe-Day* model is not yet available).

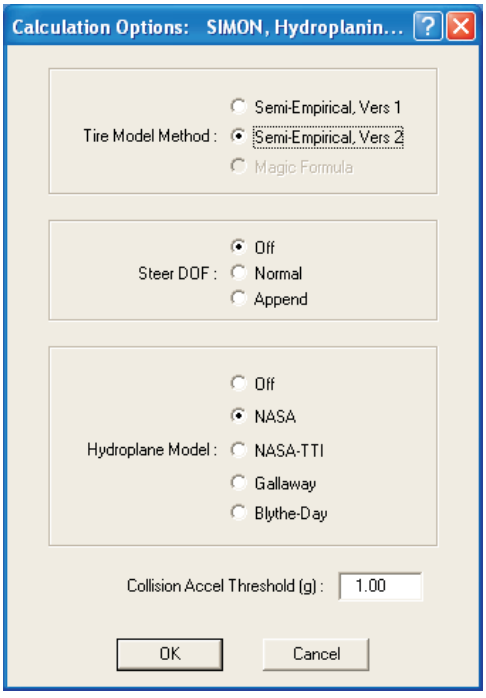


Figure 3 - *SIMON* Calculation Options dialog, used to select the desired hydroplaning model.

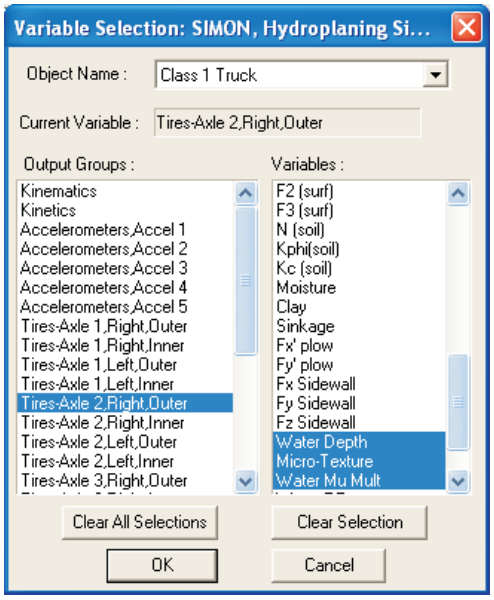


Figure 4 - Variable Selection dialog showing the selected hydroplaning results.

Of course, you would like to monitor the hydroplaning state during the simulation. In the Key Results window for any vehicle, select the *Tire* Output group, and then perform the following steps:

- Choose an *Axle Location* and *Side* for the tire.
- From the list of available outputs, choose *Mu (surf)*.
- Scroll down the variables list until you find the hydroplaning variables for the selected tire.
- Choose *Water Depth*, *Micro-Texture* and *Water Mu Mult* (see Figure 4), then press *OK*.

The output results for the selected tire(s) are now displayed in the Key Results window.

- Execute the simulation.

You will notice the current tire-terrain friction multiplier, as well as the surface attributes, for the wet region of the road. You will also notice the tire-terrain friction multiplier change as the vehicle speed exceeds the threshold for hydroplaning. If you added steering,

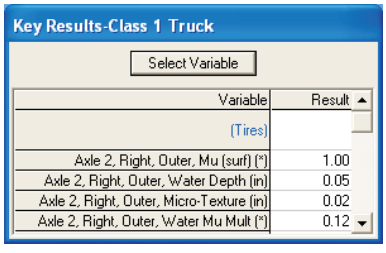


Figure 5 - Key Results window showing current values for hydroplaning parameters.

braking or throttle, take a look at the acceleration; it changes as well. You can observe directly the change in vehicle handling behavior as the speed increases. This is the major breakthrough: For the first time, a hydroplaning model has been integrated into a vehicle dynamics model so the effect on vehicle handling behavior may be directly observed!

How It Works

While executing, all *HVE* simulations use a sophisticated technique, called `GetSurfaceInfo()`, to obtain the current terrain elevation, surface normal and friction multiplier for the polygon (surface) beneath each tire as the vehicle travels along. In Version 7, `GetSurfaceInfo()` was extended: It now looks first for surfaces of type *Water*. If a *Water* surface is found, the water depth and surface micro-texture are obtained as well. `GetSurfaceInfo()` then proceeds to look at all the remaining non-water polygons to find the terrain elevation, surface normal and friction multiplier for the *Road* surface beneath the tire (these last three attributes are ignored for the Water surface).

The *HVE* Hydroplaning Model calculates the threshold velocity for hydroplaning. If the current tire velocity is less than the threshold velocity, the Hydroplaning Model returns the friction multiplier associated with the road surface; if the current tire velocity is higher, it returns the friction multiplier associated with the water surface.

It's actually pretty simple!

The Models

Three hydroplaning models have been implemented in *HVE* thus far:

- **NASA** – This is a direct implementation of the industry standard Borne equation. Hydroplaning velocity is strictly a function of tire inflation pressure.
- **NASA-TTI** – This is a direct implementation of an extended version of the Borne equation. Hydroplaning velocity is a function of tire inflation pressure as well as the tire contact patch length-to-width ratio.
- **Gallaway** – This is a direct implementation of the method developed by Gallaway at TTI. This model uses tire inflation pressure, tread depth, longitudinal slip, pavement micro-texture and water depth to calculate hydroplaning velocity.

A fourth model, called *Blythe-Day*, is under development. It is an empirical model based on flat-bed tire test data. *Blythe-Day* uses a table look-up to calculate the current tire-terrain multiplier according to the current speed, water depth and tread depth. Stay tuned!

For an excellent reference on the subject of hydroplaning, see Gallaway, et. al., *Pavement and Geometric Design Criteria for Minimizing Hydroplaning - Final Report,* FHWA-RD-79-31, Texas A & M University, College Station, TX, 1979.

HVE Admissibility List Available in the Technical Reference Library

To provide easy access to publications that support the use and application of *HVE* and *HVE-2D*, EDC has made the majority of the publications in the Library of the EDC website available to download for free. Visitors will also find the Library is divided into five sections as follows:

- Technical Reference Library
- Technical Newsletters
- *HVE* White Papers
- Validation
- Developer Resources

Several publications have recently been added to the 3000 section of the Technical Reference Library, which contains publications related to the admissibility of computer simulations in court:

3025 - "How To Introduce and Exclude Computer Evidence," Hagans, Fred.

3026 - "Admissibility of a Computer Simulation" Lehr, Louis A.

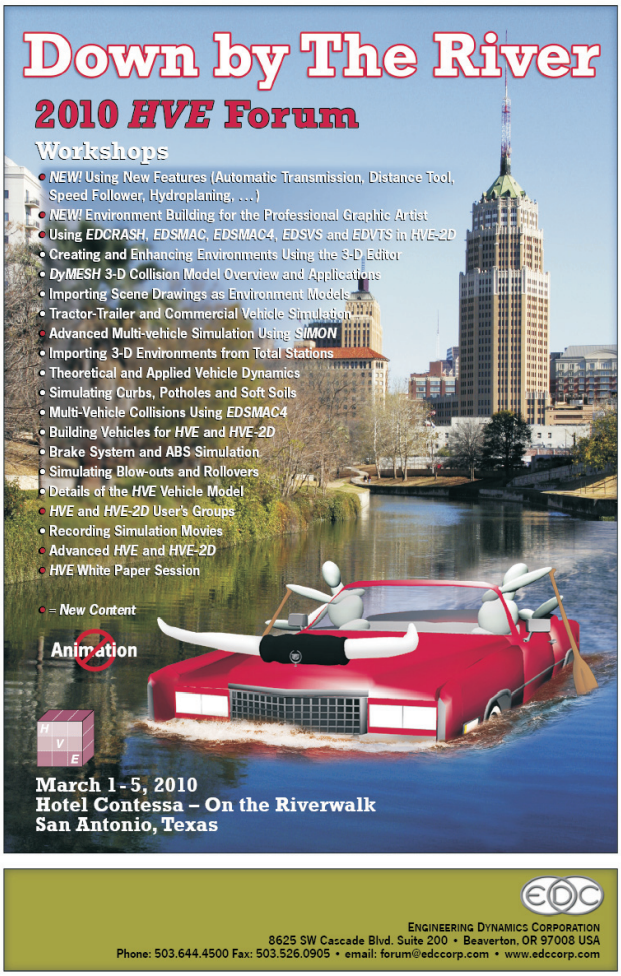
3027 - "Computer Technology in Civil Litigation," Kohlman, Richard J. & Lathrop, Mitchell L.

3028 - "Crash Testing: Actual and Computer Simulated to Undermine Plaintiffs Case and Prove Your Defense," Watson, Richard B.

3029 - "*HVE* Admissibility List". Court case details provided voluntarily by users of *HVE* and *HVE-2D*.

We encourage users to refer to these documents and also to recommend other documents they have found helpful in support of defending their work. EDC will continue to add documents to this section of the Technical Reference Library for the benefit of all users of *HVE* and *HVE-2D*.

One document in particular, 3029 - *HVE Admissibility List*, has been extensively used to inform the court that *HVE* simulations and reconstructions are readily accepted as evidence to support the opinions of expert users. The *HVE* Admissibility List is compiled from information provided by users of *HVE* and *HVE-2D*. We encourage all users to provide the details or their cases to EDC Customer Service to support the continued growth of the *HVE* Admissibility List.



Sign Up Now! Early Registration Discounts Are Still Available!

Sign up now to attend the 2010 *HVE* Forum and receive early registration discounts offered to attendees who sign up before the end of this year. This is your opportunity to learn how to use the latest features and capabilities of *HVE* and *HVE-2D*, including the Distance Tool and Vehicle Wizard, plus the *HVE* Automatic Transmission, *HVE* Driver - Speed Follower, and the new *HVE* Hydroplaning Models.

The 2010 *HVE* Forum will be held March 1 – 5, 2010, at the Hotel Contessa – On the Riverwalk in San Antonio, Texas. Workshop descriptions, details and registration forms, along with a link to a deeply discounted hotel rate, are available in the EDC website. Visit www.edccorp.com/2010HVEForum or call EDC Customer Service to sign up today!

New Workshop for 2010! Environment Building for the Professional Graphic Artist

This new workshop is designed to give your professional graphic artist insight into the basic workings of *HVE* and how to quickly build 3-D environment models for use in *HVE*. The course content will provide step-by-step instructions for building high quality 3-D environments that are easily imported into *HVE* for vehicles to drive on and interact with. The software program discussed and used in the construction of the models will be 3-D Studio MAX.

Specific course topics include:

- Working as a Team With The *HVE* User
- The Production Mindset You Must Have (For admissibility, foundation is everything!)
- The Basic Site Information You Need
- Additional Site Information To Add Detail and Accuracy for the *HVE* Simulation
- Environment Surveying Overview: Simple Total Station to Complex Professional Surveys
- Reference Photographs - Scene and Vehicles
- Cleaning up the Initial Survey Data
- Importing the Survey Data into MAX and Positioning the Base Model
- Identifying Essential Objects to Include in the Environment Model
- Adding Necessary, Additional Interactive Objects Other Than Road Surfaces
- Adding Visual Reference Elements to the Environment Model
- Using Texture Maps - What Works and What To Avoid
- Exporting the Model From MAX Into *HVE*
- Importing *HVE* Output Into MAX To Produce High-end Visual Presentations
- Practical Examples - Good, Bad and...Start Over

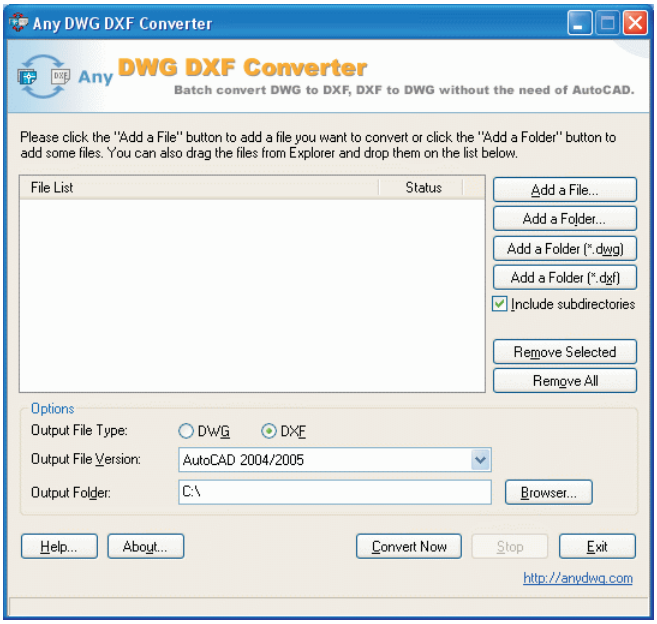
Professional graphic artists who attend this workshop will fully understand how to build environment models for *HVE* that provide for a smooth, accurate and admissible presentation to the court or mediator. All users should encourage their graphics partners to attend this workshop! It's in your best interest!

DXF Conversion Utilities

Users have provided EDC with numerous DXF file converter programs that they have found helpful when importing line drawings of scenes into *HVE-2D*. These programs convert AutoCAD (2005 and newer) and many other CAD program DXF files to a fully compatible AutoCAD R12 DXF format, which provides excellent translator support for arcs, splines and other line entities commonly used in their scene drawings.

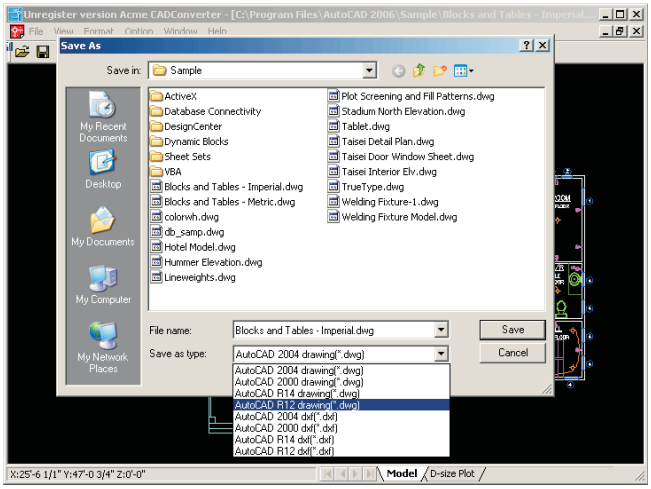
Any DWG DXF Converter

Available for $75 from www.anydwg.com



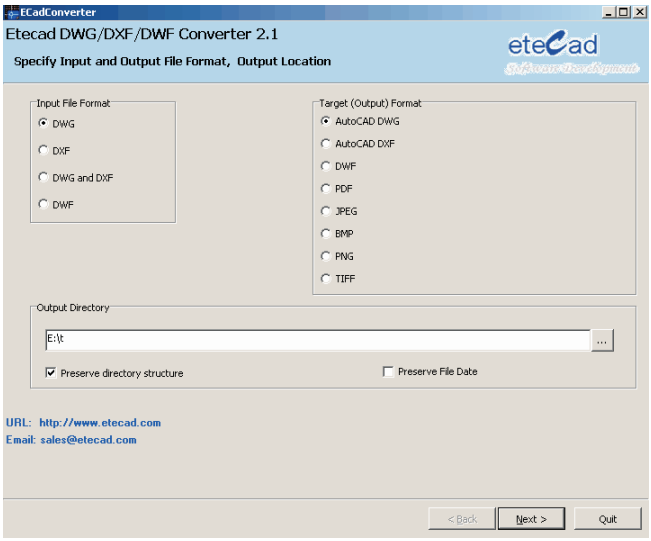
Acme CAD Converter

Available for $100 from www.freefirestudio.com



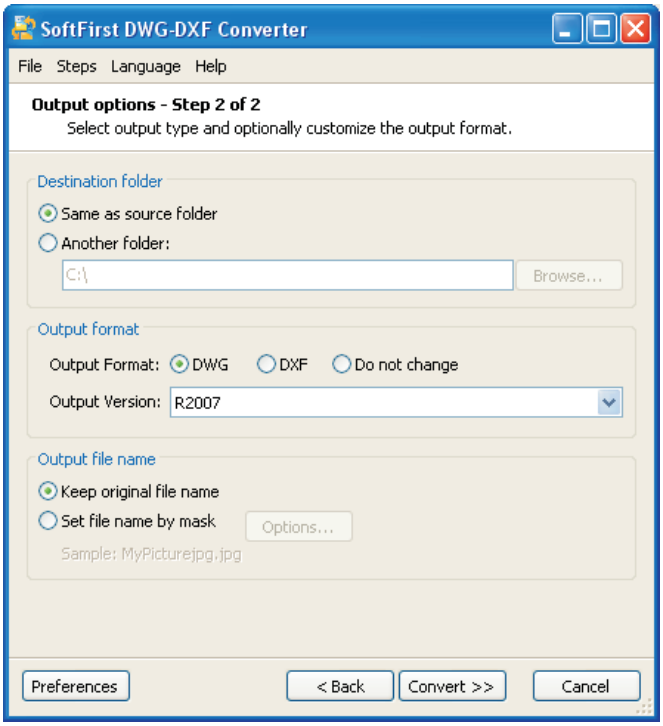
Etecad DWG/DXF/DWF Converter

Available for $89 as CAD software from www.cadopolis.com



SoftFirst DWG-DXF Converter

Available for $20-$30 from www.softfirst.com



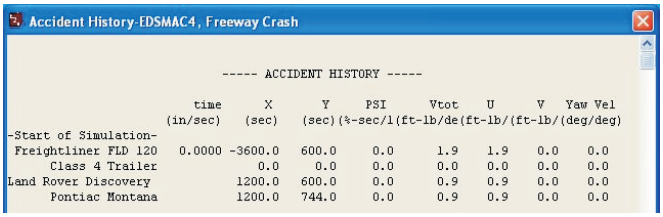
At the time of publication, these programs are available as trial versions to download from their respective websites. If you have been experiencing troubles with some of the lines drawn in your CAD program not coming into *HVE-2D*, we encourage you to try out one of these programs to resolve your issue.

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

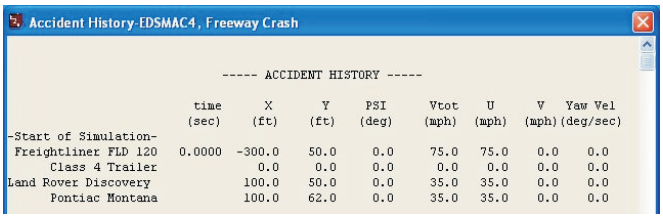
This section contains answers to frequently asked questions submitted to EDC Technical Support staff by *HVE* and *HVE-2D* users.

Q. In Version 7.00, I notice that when I open an old case and look at the Accident History output report in Playback, the units displayed at the top of each column and the corresponding numbers below are not correct. How do I fix this issue?

A. This issue was caused by the addition of new values to the units system file used by Version 7. Your results from older cases have not been corrupted, they are just simply not being displayed properly. This issue may exist for values shown in Key Results and other output reports. To fix this issue, simply go back to the Event Editor and re-execute your event. The results will then appear as expected in Key Results and other output reports as shown in the example below:



Accident History Report - Existing results in pre-Version 7.00 case shown in Version 7.00



Accident History Report - Results from re-run of pre-Version 7.00 case shown in Version 7.00

Q. Is there any way to make the wheels/tires invisible on a vehicle in HVE? My custom vehicle geometry that I have imported includes wheels and tires, so I would like to not display the wheels/tires provided by HVE.

A. No, there is no selection for making the wheels/tires of a *HVE* vehicle invisible. You can edit the Wheel Location to change the position in x and y directions. If you are using *HVE* (3D), then you can additionally change the z position and also modify the size of the displayed wheel and tire combination. Only the Fixed Barrier vehicle type does not have wheels/tires.

Q. Will HVE and HVE-2D work on the new Windows 7 Operating System?

A. *HVE* and *HVE-2D* are compatible with Windows XP and Vista operating systems, so there are not any expected problems with running on Windows 7. However, as with any new operating system, the support for hardware such as graphics cards and their drivers always seems to lag the initial release. If you experience unexpected behaviors such as random crashes when using *HVE* on Windows 7, we recommend that you attempt to update your graphics driver or set your Hardware Acceleration to "None".

Q. I am using a custom vehicle geometry file. It is properly displayed in the Vehicle Editor, but when I go to the Event Editor, the geometry has been replaced by a generic image. Additionally, when I run the event, the vehicle completely disappears! What's happening?

A. The Event Editor requires that the filename of the vehicle geometry be no longer than 30 characters, including the file extension (e.g. .h3d, .iv). Check the length of your filename and shorten it to less than 30 characters. Reapply the geometry to the vehicle in the Vehicle Editor and then reset and run your event.

Q. I've just started HVE and before the program opens, I see a message dialog telling me the "Application is Node Locked". Then I see another message telling me "License file not found. Running in Demo Mode." I have successfully used HVE on this computer before, so why am I getting these messages now?

A. The "Application is Node Locked" message is telling you that the license manager is expecting to match the code in your license file with the code on your EDKEY. You need to check that your EDKEY is plugged in and is being recognized by your computer. You can select Help, Tech Support from *HVE*'s main menu to display the code for the EDKEY seen by the license manager.

Q. Is there a way to display the departure angle of a vehicle at separation during a collision simulation?

A. Yes. Using the Key Results dialog, a vehicle's "Departure Angle" or "Course Angle" is shown as the kinematics variable Nu. Nu is the direction of the velocity vector of the vehicle relative to the X axis of the environment model. The value for Nu at the moment of separation is the Departure Angle.

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 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 Course Schedule

EDC Simulations

Los Angeles, CA . . . . . January 2011
Miami, FL . . . . . November 9 - 13, 2009

EDC Reconstruction

Los Angeles, CA . . . . . January 18-22, 2010
Miami, FL . . . . . November 8-12, 2010

Theoretical & Applied Vehicle Dynamics

Upon Request . . . . . TBA

2010 *HVE* FORUM

San Antonio, TX. . . . . March 1 - 5, 2010

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.

In-House 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 bringing this two-day on-site course to 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 Training pages on our website and download a registration form. All courses are eligible for Continuing Education Units and ACTAR credits. See you at our next course!

DiscoverHVE.com

Collision Engineering Associates has launched a website where subscribers can learn more about using *HVE* by viewing basic, intermediate and advanced video tutorials. Members can also participate in on-line discussion groups covering various topics such as tire side-wall impacts, video output, importing vehicles and scenes, using humans in *HVE*, and known issues or work-arounds. Visit www.DiscoverHVE.com or contact Collision Engineering Associates at 480.655.0399 for more information.

Engineering Dynamics Corporation
8625 SW Cascade Blvd, Suite 200
Beaverton, Oregon 97008 USA
Phone 503.644.4500 / FAX 503.526.0905
Email: info@edccorp.com
Website: www.edccorp.com

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