Technical Newsletter

2005 *HVE* Forum - Hangin' In The Grove

While it may seem a long way off, February 2005 is just around the corner! It's time to make a note on your calendar and start thinking about travel arrangements to join your colleagues at the 2005 *HVE* Forum.

For the 2005 *HVE* Forum, we've changed the location, the time of year and, most importantly, the workshops! Attendees of previous *HVE* Forums will find that new information and the latest tips and techniques have been added to the regular workshops, along with a new series of workshops offered for advanced users.

If you have never been to a *HVE* Forum before, you should come and see why the *HVE* Forum is such a successful event year after year. The 2005 *HVE* Forum offers workshops for beginning, intermediate and advanced users, in both hands-on and lecture style formats. In addition, the *HVE* White Paper session, User's Group meetings, and hosted social hours offer a great opportunity to network with other *HVE* users.

All of the 2005 *HVE* Forum activities will take place at the Mayfair House Hotel, an all-suites hotel located in the heart of Coconut Grove, Florida. This is an ideal location, just 10 minutes from downtown Miami and 12 minutes from the Miami International Airport and South Beach. Within walking distance of the hotel is a large selection of restaurants, shopping and other activities.

Workshops and hotel rooms will be on a first-come, first-served basis, so register as soon as possible to ensure you get the choices you want. Workshop schedules, descriptions, and registration forms are available to view and download directly from the 2005 *HVE* Forum page on the EDC website.   There are links on the EDC website home page to go directly to the 2005 *HVE* Forum page, or enter this location into your browser: www.edccorp.com/service/hveforum.html.

If you have any questions about the 2005 *HVE* Forum, would like assistance with selecting your workshops, or would like to submit an abstract for the *HVE* White Paper session, please contact EDC Customer Service, or simply visit the 2005 *HVE* Forum page on the EDC website. See you in Florida in February!

*M*ARK THIS DATE ON YOUR CALENDAR . . .

2005 HVE FORUM
FEBRUARY 21 - 25, 2005
Coconut Grove (Miami), Florida

Technical Session

This Technical Session is a report on the use of *DyMESH* by *HVE* users. EDC has learned a lot after the introduction of *DyMESH* in May. A majority of *DyMESH* users are having success. However, some are experiencing problems that need to be addressed. The goal of this Technical Session is to help *DyMESH* users address those problems.

The single biggest problem experienced during a *DyMESH* simulation is one that results in a message, *MaxNabor Too Small*. This fatal error message occurs at the start of the run. It occurs because *DyMESH* has a limit of 40 polygons that may share a single vertex (see Figure 1). These polygons are referred to as "neighbor surfaces; hence the term *MaxNabor*. The problem is sometimes caused by excessively fine tessellation. If you have turned on the Vehicle Mesh, *Tessellation* option and set the *Max Side Length* to a small value, say 5 inches or less, try increasing the value to 20 inches and re-executing. The problem may also be caused by a mesh that has excessive detail. *DyMESH* simulations using the Telephone Pole Fixed Barrier and the Dodge Ram Pickup from the EDC database both result in this problem. Unfortunately, there is no solution to this problem in Version 5.0. However, in the next release, the value of *MaxNabor* has been increased to 60 from 40; the increased limit should eliminate the problem in virtually all cases.
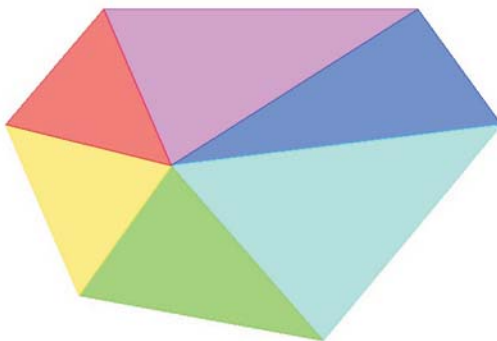

Figure 1 – The above surface has six neighboring polygons that share a single vertex.

All of the pole geometries in the *HVE* databases include polygons with extremely large aspect ratios. These geometries need to be tessellated because the length of a side polygon is actually equal to the length of the pole (i.e., 30 ft!). Because the pole might have no vertices in the region of interaction with a colliding vehicle, the vehicle may simply drive through it.

However, tessellating the pole may also result in a *MaxNabor Too Small* message (see above). The next release includes pole geometries that have been updated for use by *DyMESH*.

Occasionally, one vehicle slides up and over the top of the other vehicle during a *DyMESH* collision simulation. Usually this is caused by a larger (or taller) vehicle impacting a smaller vehicle. A high closing speed exacerbates the problem. The solution to this problem is to choose the *Force to x-y Plane* option (see *DyMESH* Options dialog). This option removes the z-component of the collision force. Note that roll and pitch moments still occur as expected whenever the collision force is applied at an elevation above or below the vehicle CG.

DyMESH assumes that meshes are *watertight*. A watertight mesh is one in which each neighboring polygon shares its vertices. For example, the mesh shown on the left in Figure 2 is watertight, while the mesh on the right in Figure 2 is not watertight. Note what happens when the vertex in the non-watertight mesh is displaced: the mesh opens up, resulting in a hole (see Figure 3). This hole represents a region through which a vertex on the other vehicle may pass. If that occurs, the vertex will not find contact with any surface, so it will remain undeformed (see Figure 4). The Technical Staff at EDC calls this a *rogue vertex* (because it misbehaves!). A collision simulation that results in spikes in the damage region is a sign that the mesh on the other vehicle is not watertight.

As one highly creative *DyMESH* user announced at the 2004 *HVE* Forum, *DyMESH* may be used to simulate vehicle rollovers during which the vehicle body interacts with the terrain. All you need to do is implant a vehicle in the earth. The vehicle, of course, just happens to have a body mesh shaped like the terrain. Testing reveals that this works well. A possible problem: The mesh must be watertight. Thus, a simple surface is not sufficient. You will need to create a box with the CG near the center. The surface on one side of this box simulates the terrain. You will then need to implant this box in the environment such that the terrain surface mates smoothly with the rest of the environment terrain.

The next release of *HVE* includes a new option that eliminates the need for a watertight mesh. (If the mesh is watertight, *DyMESH* will execute more quickly.) The following *HVE* release will support *DyMESH* environments directly.

If the vehicles in a *DyMESH* simulation pass right through each other, there are two possible reasons. First and foremost, you must turn on *DyMESH*! (See
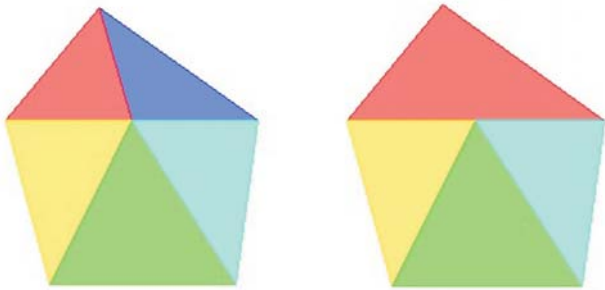
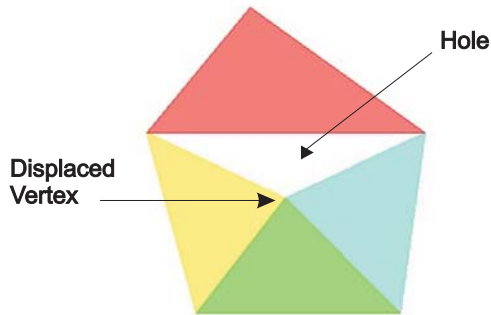Figure 2 - Watertight mesh (left) and non-watertight mesh (right).

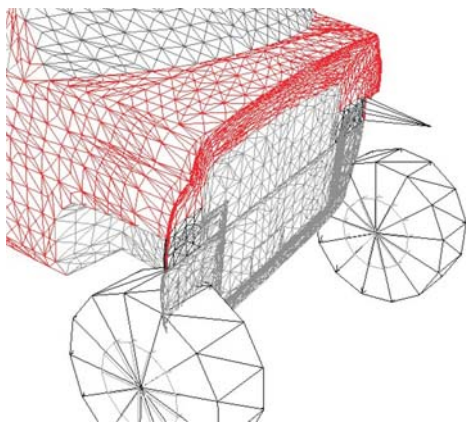Figure 3 - Displacing the vertex in a non-watertight mesh opens up a hole in the mesh.

Figure 4 - Rogue vertex resulting from collision with a barrier having a non-watertight mesh.

DyMESH Options dialog.) The second possibility is that one of the vehicles is very coarsely tessellated (e.g., a Generic Vehicle). In this case, choose the *Tessellation* option from the Set-up, Vehicle Mesh dialog. Setting the *Maximum Side Length* to 10 to 20 inches normally works well. Note that finer tessellation results in longer run times. There is no benefit to be gained from excessively fine tessellation.
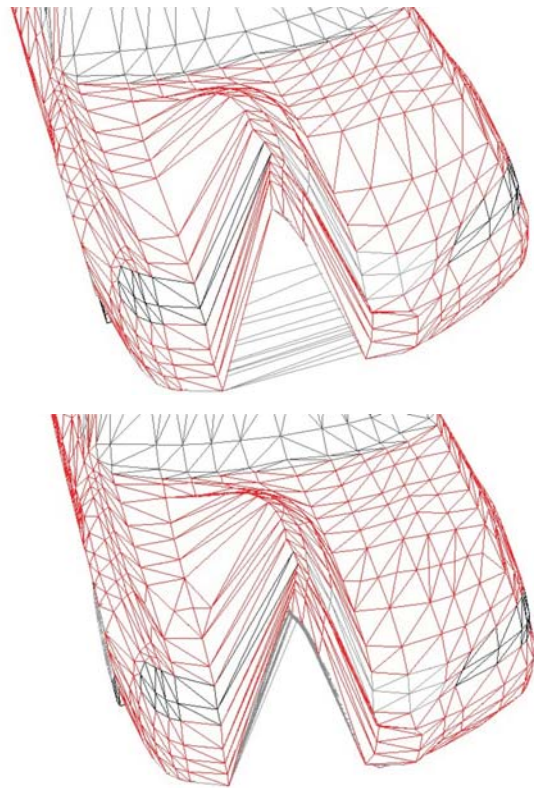

Figure 5 - The upper *DyMESH* simulation resulted in an undeformed vehicle bottom due to large polygons comprising the vehicle's bottom surface. The lower simulation shows the same simulation after using the *Tessellation* option (*Max Side Length* was set to 10 inches).

The bottom of a vehicle may not get deformed during a *DyMESH* collision (see Figure 5). This lack of deformation results from the manner in which the geometry was created. The vehicle bottom is comprised of very large polygons. Thus, there are no vertices in the vicinity of the deformation. Without vertices, deformation cannot be simulated. The solution is to use the *Tessellation* option described earlier.

Interior components (i.e., the dash, seats, etc.) are included by *DyMESH*. However, these components may affect *DyMESH* force calculations because the individual components may not be watertight. The next release of *DyMESH* includes an option that allows you to include or remove these components from *DyMESH* calculations.

Watch out for excessive tessellation. A *Max Side Length* of 10 inches is actually rather small (the next release uses a default of 20 inches). You might be surprised to learn that the Generic Class 4 Trailer has 11,266 vertices when tessellated using a 10 inch *Max Side Length*, and 2,818 vertices when using a

20 inch *Max Side Length*. Similarly, we have had users set up *DyMESH* runs with custom vehicle geometries having upwards of 100,000 vertices. Again, run times increase dramatically, and there is no improvement in the results.

Finally, *DyMESH* produces three fatal messages that result from a general algorithm failure. These are

> ➢ Restitution Direction = 000 for an inside vertex
> ➢ Way too many intersections for IsInside
> ➢ Poly != PolyNum in Master Mesh.

These fatal errors should not occur. We are pleased to say we have not had any reports of these errors occurring in the field. However, EDC would like to learn if you do encounter any of these messages.

EDC is anxious to see *HVE* users achieve success with *DyMESH*. It goes without saying that we are happy to assist you in any way possible to help ensure that success. Please let us know how we can help!

DyMESH User Notes

When using *DyMESH*, you're doing 3-D collision simulation. This is technically a very difficult task, so don't expect it to be easy. Here are a few important points to keep in mind:

• *DyMESH* is not going to work on every crash scenario, so spend a moment evaluating the scenario before plunging directly into a *DyMESH* analysis.

• Induced damage is not included. No damage will be displayed unless one or more vertices on a vehicle were actually in contact with the other vehicle.

• In *DyMESH* Version 1.0, only meshes of vehicles (Passenger Car, Fixed Barrier, etc.) are recognized for collisions. Also, note that the wheels and tires of a vehicle are not recognized as part of a vehicle mesh and will not be involved in interactions with other meshes.

• The mesh quality is a factor. Poorly tessellated meshes do not work well, resulting in potentially ugly damage profiles. Examples of poorly tessellated meshes are meshes with randomly directed surface normals, large polygons (say > 20 inches) and unshared vertices (unshared vertices result in non-watertight meshes – meaning cracks may open up and inter-vehicle contact may be missed).

• Generic Vehicles' meshes need to be tessellated before using in *DyMESH* events.

• In *DyMESH* Version 1.0, each vehicle in the event may only experience a collision with one other vehicle. (e.g. Vehicle A may hit only Vehicle B) However, any number of vehicles may be in the event and experience a collision with one other vehicle (e.g. Vehicle A hit Vehicle B, Vehicle C hit Vehicle D, etc.)

• Be patient. *HVE* is **resting** in between output time intervals while *DyMESH* is executing, so quickly punching a bunch of buttons on the Toolbar during a run may result in unexpected behavior.

• Computer horsepower means everything to *DyMESH*. On a 3.2GHz P4 computer, a typical run takes from 1-1/2 minutes to 15 minutes, depending on the length of the collision phase. Collisions with sustained contact all the way to rest may take as long as an hour.

• Every time you run a *DyMESH* event, a little more memory is used up. So, after a few executions of a *DyMESH* event, you may see your computer slow down. Having lots of memory helps delay the problem. Saving your work, exiting and restarting *HVE* is the best solution.

Upcoming Enhancements to *HVE* and *HVE-2D*

Reference to the next update of *HVE* was made several times in the Technical Session of this newsletter. In fact, development of Version 5.10 of *HVE* and *HVE-2D* is currently in the final stages. It is anticipated that field testing and validation of the update will be completed within the next month, and the update will be available to all supported users well before the end of the year.

Users will find several enhancements available in the next release, including:

• Direct support for Hyper-Thread Technology. Users will no longer have to disable Hyper-Threading on their Pentium 4 processors in order to create or to complete a simulation run.

• Enhanced Steer Axis Geometry. The wheels will steer about an axis defined by caster and inclination angles. Steering offset (also called *scrub radius*) will also be modeled. These changes enable the simulation of the self-steering and brake-induced steering moment characteristics that exist in all modern vehicles.

• Additional Tire Model options for SIMON, including Radial Spring, Soft Soil and Sidewall Impact models.

More details will be available in the next newsletter.

Using the New *HVE* Camera Setup Dialog

One of the many new features available in *HVE* Version 5 is a redesigned Camera Setup dialog. Using the new dialog, the user can create multiple named views and also assign the view to track a fixed point or a moving object. These abilities allow the user to quickly generate camera views that present excellent visualization of their simulation runs, without the need for complicated camera car paths or other efforts.

The new dialog and several screenshots from a simulation event using the settings displayed in the dialog are shown on this page. The camera is assigned to a fixed position attached to the environment model and pivots to track the motion of the Honda Accord. as it travels through the intersection. Additionally, the camera could have been assigned to a fixed position relative to the Ford Expedition while still tracking the motion of the Honda Accord.
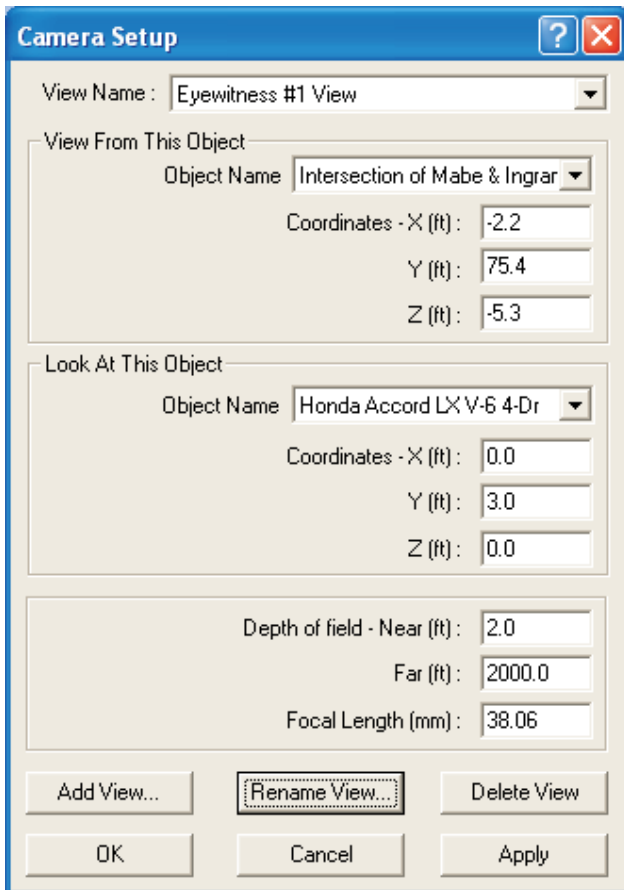

Figure 6 - *HVE* Camera Setup dialog displaying the *View From This Object* and *Look At This Object* settings for the named camera view "Eyewitness #1 View".
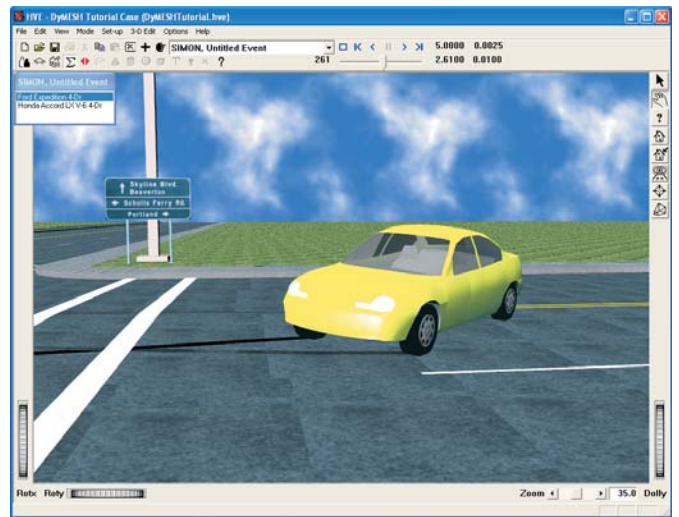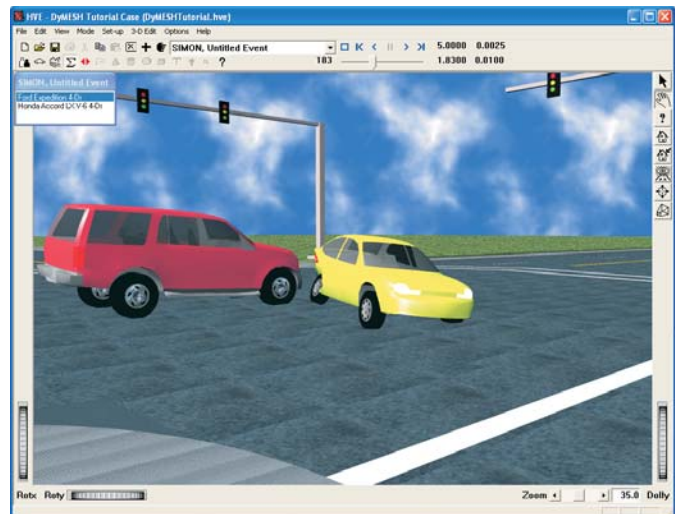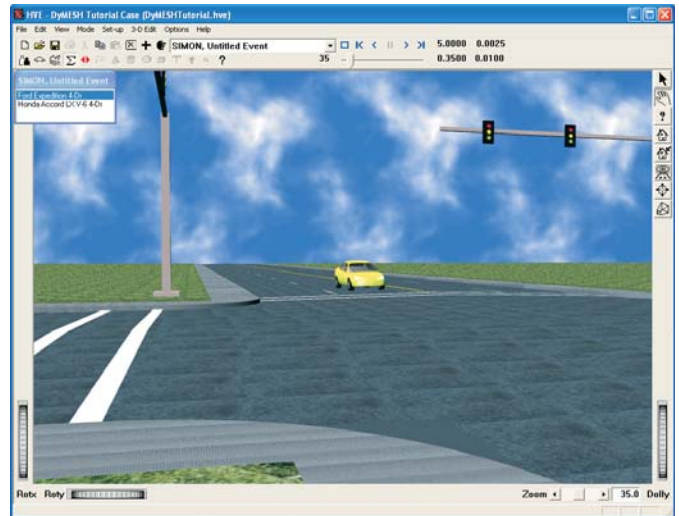
Figure 7 - Series of screenshots displaying the results of the Camera Setup settings. The camera view tracks the Honda Accord during the *DyMESH* Tutorial event.

Files for Version 5.00

Since the release of the Version 5.00 update, EDC has received two important "remedies" for potential problems in the operation of *HVE* and *HVE-2D*. These solutions have been provided by the vendors of the licensing and 3-D graphics tool kits used by the *HVE* source code. Both solutions only improve the operation of the user interface and do not have any effect on the results of reconstruction or simulation events. These solutions are specific to Version 5.00 only, as future updates will incorporate these solutions along with additional enhancements and features.

To help users understand and address these potential problems, we created a set of questions and answers and posted them on the Support F.A.Q. page on our website, as well as including them in this newsletter :

Q: I am using Version 5.00 and it seems to take about 30 seconds from the time I click to launch the application until I see the program window appear on the screen. In previous versions, it took about 4 seconds. Why is this happening with Version 5.00 and how can I fix it?

A: This delay is due to the reading and verification of a valid license file when using an EDKEY. This delay can be reduced to between 3 to 9 seconds by replacing the lsapiw32.dll file found in your *HVE* or *HVE-2D* program folder with an updated version. This updated file is available in the Version 5.00 Patch zip file.

Q: In Version 5.00, I am not able to see .jpg or .tif images that I would like to use for textures on my environment models. I also see the HVE Error Console telling me that the .jpg or .tif files used in previous environment models I created cannot be found. How can I fix this?

A: You need to add five additional files to your *HVE* or *HVE-2D* main program folder. These files need to be in the same folder as hve.exe in order to provide for the use of .jpg and .tif textures. These files are available in the Version 5.00 Patch zip file.

These questions and answers can be found on the Support F.A.Q. page on our website, along with a link to download the zip file. You may also download the file directly by typing the following address into your web browser:

www.edccorp.com/support/downloads/Hve500PatchFiles.zip

Note: The above column was first published in the Summer 2004 newsletter.

Tutorials and Examples Available on EDC Website

Visitors to the Products section of the EDC website will now find links to Tutorials, Examples and Simulation Movies pages available in the left hand column. In fact, the home page of the website includes a direct link to the Tutorials page.

The Tutorials page provides a brief description of each physics program, along with a link to download a copy of the Chapter 5 - Tutorial section from the Physics Manual. The Examples page was previously located in the Support section of the website, but has been relocated to the Products section to provide visitors with a greater understanding of the application of *HVE* and *HVE-2D* to their real-world issues.

You may find it helpful to use these pages to present your capabilities to your clients or to learn more about a physics programs capabilities. You may also be considering upgrading from *HVE-2D* to *HVE*, and these tutorials can help you decide which physics programs to add to your system.

To view these pages, go to www.edccorp.com and follow the links for Products or Tutorials.
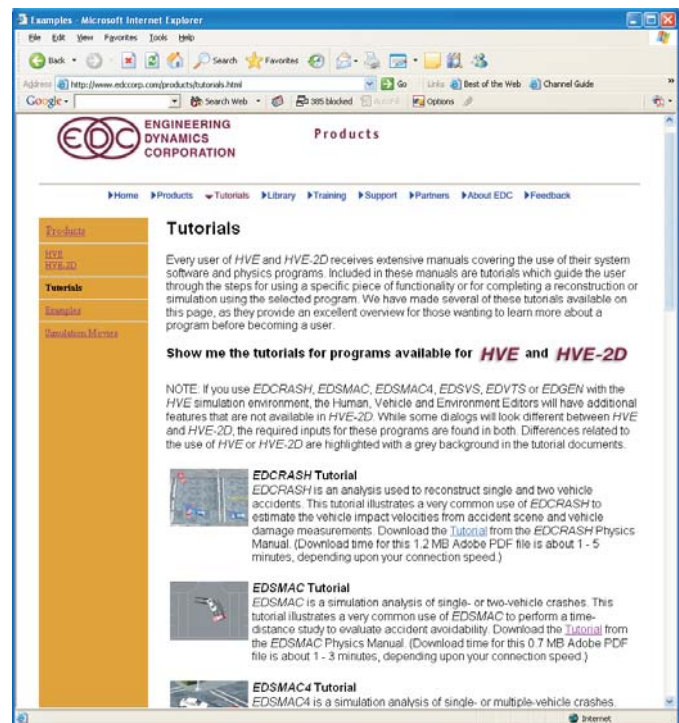

Figure 8 - Screenshot showing several of the listings for physics programs on the new Tutorials page of the EDC website.

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

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

Q: I was reviewing the Damage Data report from my EDSMAC4 simulation and noticed that the time for the Peak Acceleration is at a slightly different time than shown in my Variable Output Report. My Variable Output Report is displaying results at a 0.0333 second interval. How do I change the time interval in the Variable Output Report in the Playback Editor?

A: To change the time interval used throughout the Playback Editor, select Options, Playback from the main menu. This will access the Playback Time Interval dialog and allow you to change the value. By default, the interval is set to 0.0333 seconds, which corresponds to 30 frames per second of trajectory simulation output used for recording movies in the Playback Window. Once you have changed the time interval to the desired value, you can close the dialog. You may find that you need to change from the Playback Editor to a different Editor and then return to the Playback Editor to refresh the displayed reports and viewers.

Q: I am trying to review the work of another user. I have received their case file on a CD and am trying to open the case directly from within my HVE (or HVE-2D). I receive an error message that won't allow me to open the case? I'm told the file is good, so what is going wrong?

A: It is not always possible to open a case file that is located on a CD. However, you can open any case file that is available on your harddrive or a connected network location harddrive. To avoid any problems with opening case files, the best solution is to always copy the case file from the CD to your harddrive before attempting to open the file.

Q: I've imported a DXF environment model and applied colors and textures and friction attributes. I'd like to save it as an environment model that I can use in future cases. How can I do that?

A: When you import DXF files into the Environment Editor, a translator converts the format from DXF to Inventor (.iv) which then is displayed in the viewer. At this point, the file is an environment model only within your case file. Let's say that you use the 3D Editor and you change colors, add textures and assign friction factors to different surfaces. You close the 3D Editor

and view the model in the Environment Editor. It still is an environment model only within your case file. To save the current environment as a *HVE* File (.h3d) that can be directly selected and opened as an environment in future cases, you need to select the Object Information button on the toolbar to display the Environment Information dialog. Then press the Save As button to bring up a dialog that will allow you to name and save the current environment as an environment for use in future cases.

Q: I've seen how to turn the Auto Backup feature"On" and "Off" by selecting Options, Preferences from the main menu, but where is the Backup file saved? What is the proper way to restore it?

A: Auto Backup creates a file named Autosave.tmp located in the Temp folder of the *HVE* directory. Although this is a copy of your current case file, you cannot select this file to open as you normally would for a case file. This file is only used if you experienced a fatal crash before properly saving and exiting the program during your last use. When you restart after a crash, you will see a dialog stating "A temporary recovery case file was found. Would you like to recover this case?" If you choose "Yes", then the backup file is opened as the current case. If you choose "No", then the backup file is discarded. This Auto Backup feature was only put in as a safety measure in case of unexpected crashes to do graphics driver conflicts or other operating system crashes. It is not an Auto Save feature that saves your current work to your current case file.

User Hints and Tips

Have you wanted to add a few more details to your environment drawing or model, but didn't want to leave *HVE* and go back to the original model in your CAD program? Try using the Highway Furnishings Library available in the 3-D Editor. The library contains objects such as trees, poles, signs and even roadway marking that might be applicable to your scene. You can even create objects in the 3D Editor and save them into the library for later use.

F.A.Q.'s on EDC Website

The EDC website provides a special section dedicated to Technical Support, including answers to F.A.Q.'s from this and previous Newsletters. We encourage you to visit this page to search for answers to your questions before contacting Technical Support for assistance. Go to www.edccorp.com and follow the link to Support.

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 17 -21, 2005

Miami, FL . . . . November 2005

EDC Reconstruction

Los Angeles, CA . . . . .January 2006

Miami, FL . . . . November 8 - 12, 2004

Theoretical & Applied Vehicle Dynamics

TBA. . . . . Fall, 2004

2005 *HVE* FORUM

Miami, FL. . . . . .February 21 - 25, 2005

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 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 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) is offering the COMPTAR and MATAR courses once again. These courses are designed to provide law enforcement officers with a better understanding of using *EDCRASH* and *EDSMAC* for accident reconstruction. For more information or to register for these courses, you will need to visit the NUCPS website at www.northwestern.edu/nucps or by contacting the NUCPS office at 847-491-5476.