SPRING 2013 ENGINEERING DYNAMICS CORPORATION

Technical Newsletter

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

Download Your Update to Version 9.12

HVE and *HVE-2D* users are encouraged to download their patch update to Version 9.12 by visiting the Support Downloads section of the EDC website. Version 9.12 provides the following improvements:

Enhancements

The Video Creator now produces video using 32 bits per pixel, an increase from the previous 16 bits per pixel. The result is higher definition color mapping and improved rendering of scenes with fog. (Note: This effectively doubles the size of the resulting video file.)

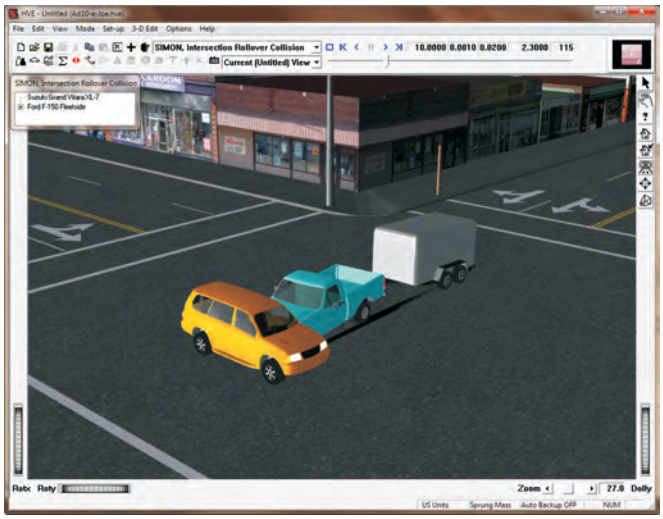
Two changes have been made to provide for a more realistic appearance of the event at the time, date and location set in the Environment Information dialog:

- The vehicles color (material) attributes have been modified to improve vehicle rendering.
- The lighting for a scene now comes directly from the current sun position. Previously, the viewer was flooded with additional lighting from an extra light source positioned behind your view, which is now turned off by default.

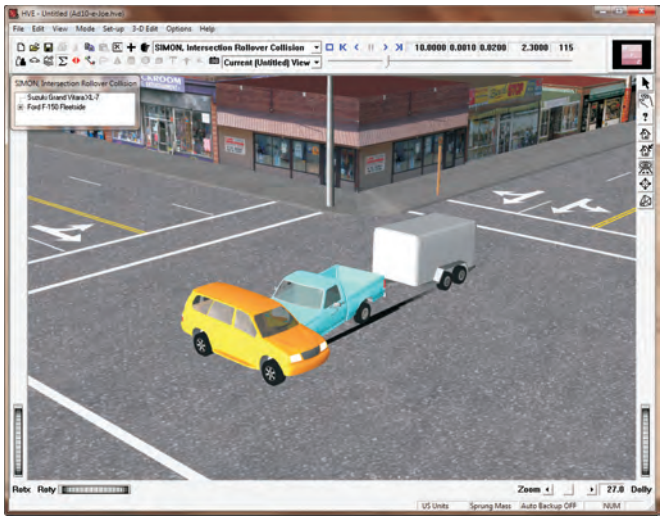
Bug Fixes

This update addresses the following issues found in Version 9.10 and/or Version 9.11:

- Saving a large case file over a network sometimes caused a crash or a corrupt file.
- Vehicle data were not properly saved into user.db or the Version 9.10 or Version 9.11 case file database.
- Vehicle Handling Properties dialog used an incorrect value for vehicle roll stiffness.
- Positioning a human occupant would result in a crash if the Dimension Basis was set to Total Mass.
- The Event Set-up, Wheel Damage, Time Duration field may have been incorrectly disabled.
- The Video Creator did not properly manage multiple events which included a trailer separation.
- If the Aerial Image option was used in Version 9.11, the image was displayed upside down.



Screenshot showing the rendering improvements provided by Version 9.12. The Environment Information dialog indicates the crash occurred at 1635 on 09/21/2010 in Bannockburn, Illinois. Note the contrast between the dark and light sides of the vehicles and buildings in the scene due to the position of the sun as the only light source for the time, date and location indicated.



Screenshot of the same event shown in Version 9.10. Note how the whole scene is flooded with extra light.

Further information about enhancements and bug fixes contained in this update is provided in the Release Notes accompanying the patch download.

Technical Session

This Technical Session describes the procedure for combining multiple events using *HVE*'s Video Creator. As we'll see, this feature can result in significant time and cost savings when creating a crash sequence that includes more than one collision or other time-intensive simulation technique.

The Basic Premise

Let's assume you are simulating an event that includes a curb-tripped rollover, followed by a collision. As is always the case for simulation analysis, you start at the beginning of the event and work forward in time. Because of the curb-tripped rollover, you set up a *SIMON* event using the *Radial Spring Tire-terrain Model* with the *Sidewall Impact* option. Those of you familiar with this tool know it is computationally very intensive; it takes time to execute such a simulation.

After you have completed the curb-tripped rollover phase, you allow the vehicles to continue on to the impact phase. This part of the task requires some trial-and-error to get the impact configuration just right. If you start the simulation at the beginning, you must wait during each simulation while the curb-tripped rollover phase executes before you reach the current point of interest, the impact configuration.

But watching the same pre-impact portion of the simulation over and over is a waste of time! Wouldn't it be great if you could simply start the simulation of the impact after the completion of the curb-tripped rollover? This is precisely what the Video Creator allows you to do!

General Procedure

The general steps for combining events using the Video Creator are as follows:

- Set up and execute the first phase of the crash sequence. At the end of the first phase, note the simulation time, as well as the position and velocity of each vehicle.
- Terminate the first event.
- Set up the second event of the crash sequence. Use the positions and velocities noted at the end of the first phase as the initial conditions for the second phase.
- Execute the second event.
- Repeat the above process as many times as you like, using the positions and velocities at the end of the current event as the initial conditions for the following event.

There is one limitation to this procedure: The vehicles should be at or near equilibrium at the start of each event. For example, you are likely to encounter a variety of issues (both physics model-related as well as results-related) if you try to start a simulation in the middle of a collision.

An Example

We will use as an example the simulation of a collision in a curve between an SUV and a passenger car towing a utility trailer. In our example, the trailer swings out into the oncoming lane and is struck by the SUV. The collision overloads the connection and causes the trailer to separate. The trailer is hurled off the road and down an embankment, rolling over several times. We'll use *SIMON* with *DyMESH* to simulate this sequence. Those of you who follow the Technical Session religiously will note that this is a continuation of our Fall 2012 Technical Session which described how to simulate trailer separations.

The first event begins with the vehicles at their initial positions and velocities. We used the *HVE Driver Model* for both vehicles to assign the steering, throttle and brake inputs. We used *DyMESH* to simulate the impact and edited the tow vehicle's Breakaway Force to cause the trailer to separate. We also used the *DyMESH Wheel Impact Model* because a majority of the collision force went into the trailer wheel (the trailer sheetmetal is actually quite flimsy). We terminated the simulation at the end of the collision phase, noting the positions and velocities at that time, 2.62 seconds.

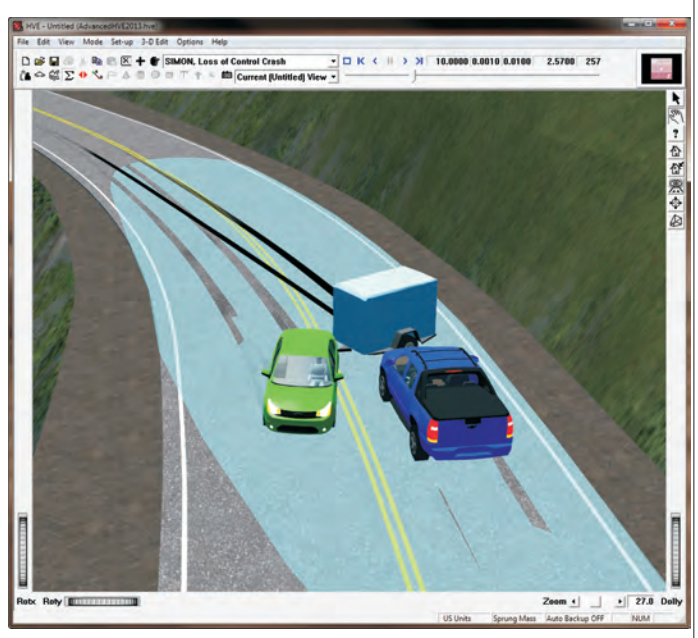


Figure 1 - First event, from initial positions through impact.

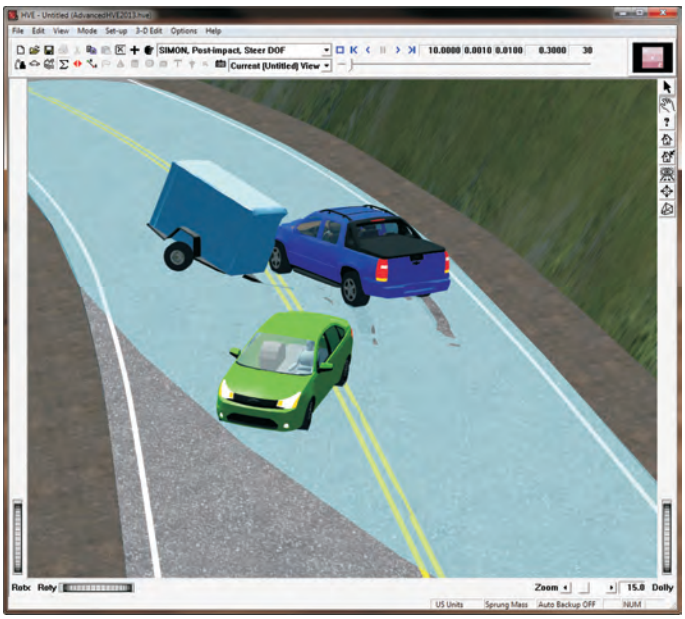


Figure 2 - Second event, from separation through rest.

We created a second event, using as the initial conditions, the positions and velocities from the first simulation. Because the trailer separated and rolled over, interacting with the terrain as it tumbled down the embankment, we used *DyMESH* with the Include Environment option.

Here is the big payoff: If you tried to simulate this event using a single simulation, you would need to have the *Include Environment* option turned on for the entire event. That initial 2.62 seconds (during which the trailer never comes into contact with the environment) would take several hours. Given the need to perform several post-impact simulations to achieve the desired goal, attempting to simulate this event in a single simulation would be completely impractical!

Video Creator

Now let's use the Video Creator to stitch these two events together. This is a very simple task:

- Go to the Playback Editor.
- Add Trajectory Simulations for the two events.

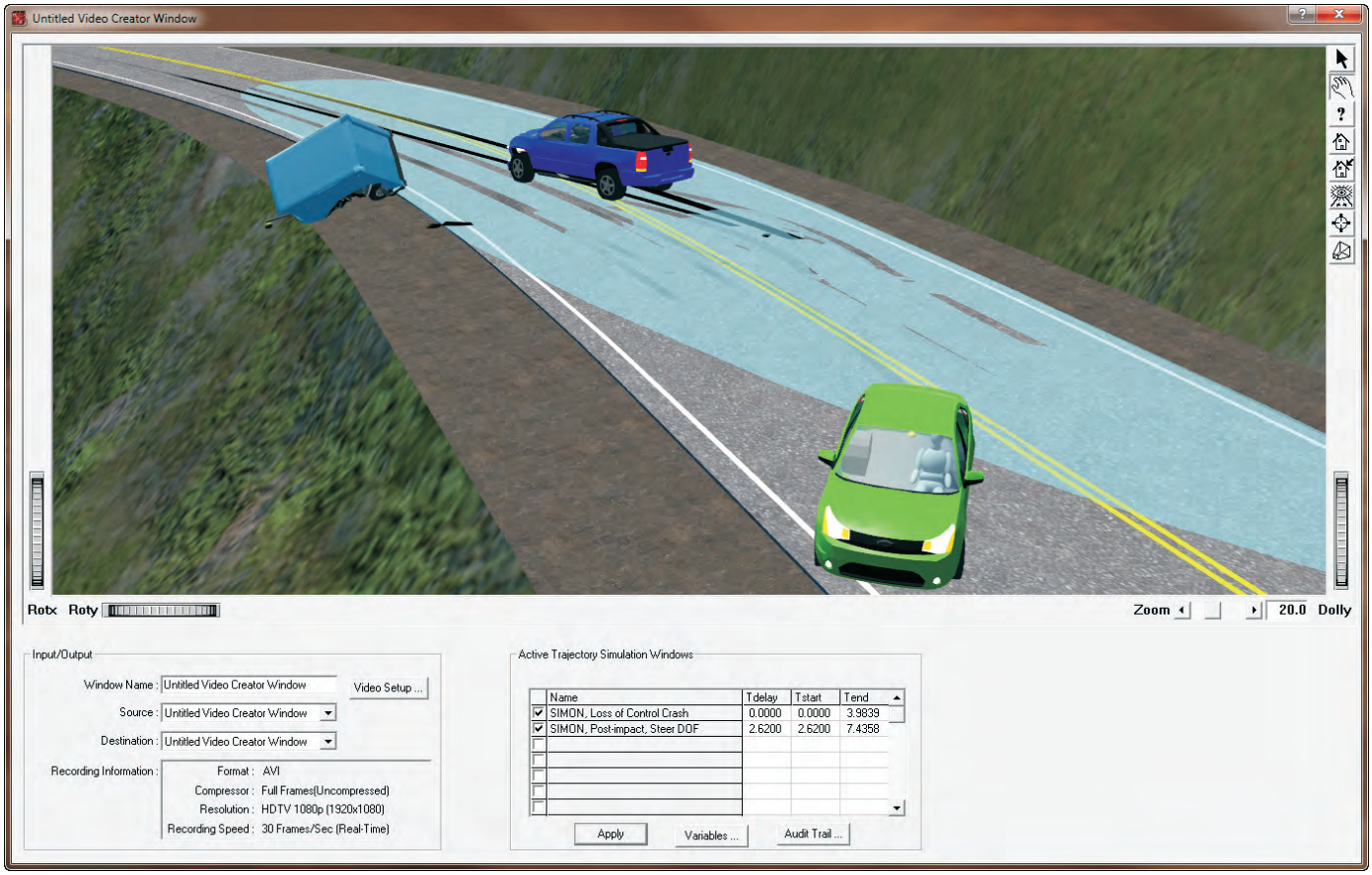
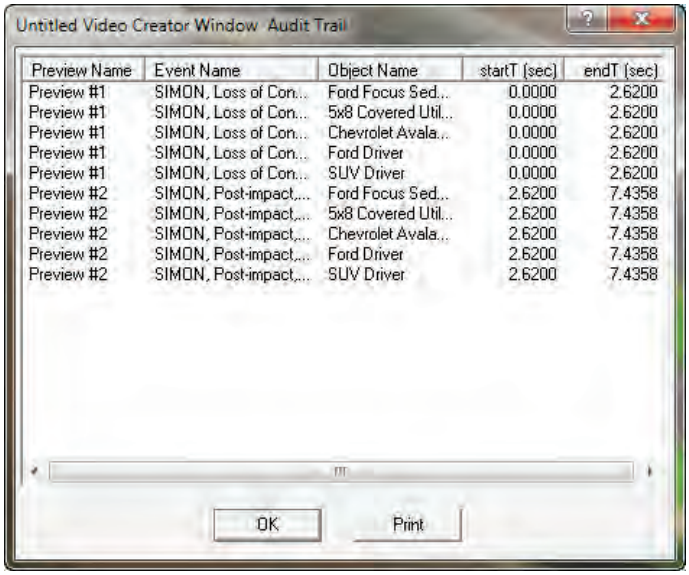


Figure 3 - Video Creator Window showing the sequence after trailer separation.



Preview Name	Event Name	Object Name	startT (sec)	endT (sec)
Preview #1	SIMON, Loss of Con...	Ford Focus Sed...	0.0000	2.6200
Preview #1	SIMON, Loss of Con...	5x8 Covered Util...	0.0000	2.6200
Preview #1	SIMON, Loss of Con...	Chevrolet Avala...	0.0000	2.6200
Preview #1	SIMON, Loss of Con...	Ford Driver	0.0000	2.6200
Preview #1	SIMON, Loss of Con...	SUV Driver	0.0000	2.6200
Preview #2	SIMON, Post-impact,...	Ford Focus Sed...	2.6200	7.4358
Preview #2	SIMON, Post-impact,...	5x8 Covered Util...	2.6200	7.4358
Preview #2	SIMON, Post-impact,...	Chevrolet Avala...	2.6200	7.4358
Preview #2	SIMON, Post-impact,...	Ford Driver	2.6200	7.4358
Preview #2	SIMON, Post-impact,...	SUV Driver	2.6200	7.4358

Figure 4 - Audit Trail, showing which event controls the motion of each vehicle during the combined sequence of events.

- Add the Video Creator window. The crash scene is displayed in the viewer; the *Active Trajectory Simulations* table is displayed below the viewer.
- Set the Tme Delay for the second event to 2.62 seconds (see Figure 3).
- Play the events.

The Video Creator displays the vehicles as they approach each other and collide. Watch as the trailer separates from the tow vehicle and tumble down the hill.

- Set up the camera(s) to your liking and replay the sequence until the view is as desired.

At this point, there is only one thing left to do:

- Set the *Destination* to *Video*, choose the video format, an optional video compressor, set the recording speed (real time or slow motion), and record your video.

Audit Trail

It seems so simple, but the logic required to control the motion of each vehicle in a multi-vehicle sequence controlled by several different simulations is quite sophisticated. The *Audit Trail* is a table that documents which event controls each vehicle during the entire sequence displayed in the video creator. The *Audit Trail* is displayed by clicking a button in the Video Creator window (see Figures 3 and 4).

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!

2014 *HVE* Forum
February 24 - 28, 2014
St Petersburg, FL

Start making plans to attend the 2014 *HVE* Forum, set for February 24 - 28, 2014, at the Hilton St. Petersburg Bayfront in St. Petersburg, Florida. The 2014 *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 training workshops are available, designed for beginning, intermediate and advanced users.

In addition, the Forum offers User's Group meetings, the *HVE* White Paper Session and interactive networking social hours at the end of each day. Another great benefit is pre-approval for 20 - 35 ACTAR continuing education credits depending upon your workshop selection over a 3 or 5 day period.

Check out this perfect location that has been arranged for the 2014 *HVE* Forum:

Hilton St. Petersburg Bayfront
333 1st St South
St. Petersburg, FL 333701

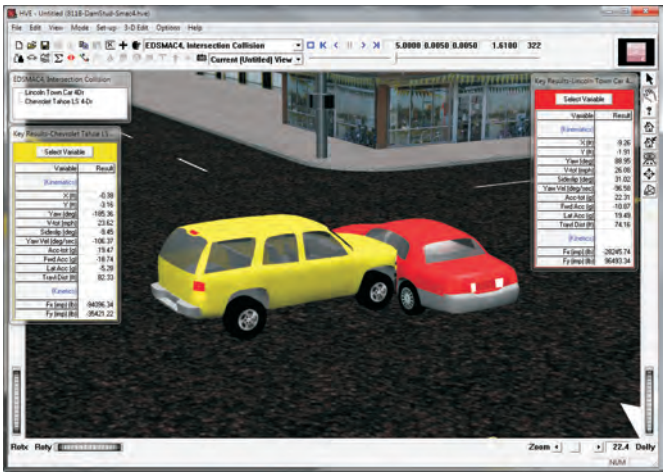
Workshop schedules, descriptions and registration forms will be available to download from the 2014 *HVE* Forum pages at www.edccorp.com/2014HVEForum.

Call For Papers
HVE White Paper Session
2014 *HVE* Forum

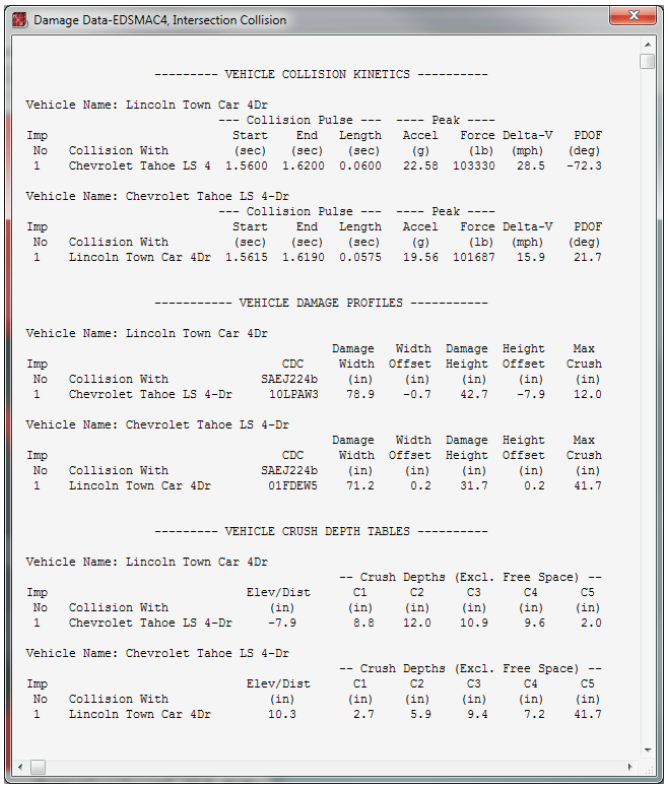
All users interested in presenting a technical paper in the "*HVE* White Paper" session at the 2014 *HVE* Forum are invited to submit an abstract for consideration. *HVE* White Paper topics include *HVE* Case Studies, any application of *HVE* showcasing its capabilities, and innovative tips and techniques using *HVE*. Please submit your abstracts to EDC by September 1, 2013.

DamageStudio Improves Your Crash Analysis

DamageStudio allows you to correlate collision damage with the kinetics, delta-V, acceleration and other important collision parameters from your *EDSMAC4* and *SIMON/DyMESH* collision simulations. The following images from an *EDSMAC4* intersection collision between a passenger car and SUV provide an excellent example of the information provided by the Damage Data report and *DamageStudio*:



EDSMAC4 simulation displaying the SUV and car at their maximum engagement during the crash.



Damage Data-EDSMAC4, Intersection Collision

--------- VEHICLE COLLISION KINETICS ----------

Vehicle Name: Lincoln Town Car 4Dr

Imp No	Collision With	Collision Pulse Start (sec)	Collision Pulse End (sec)	Collision Pulse Length (sec)	Peak Accel (g)	Peak Force (lb)	Peak Delta-V (mph)	PDOF (deg)
1	Chevrolet Tahoe LS 4	1.5600	1.6200	0.0600	22.58	103330	28.5	-72.3

Vehicle Name: Chevrolet Tahoe LS 4-Dr

Imp No	Collision With	Collision Pulse Start (sec)	Collision Pulse End (sec)	Collision Pulse Length (sec)	Peak Accel (g)	Peak Force (lb)	Peak Delta-V (mph)	PDOF (deg)
1	Lincoln Town Car 4Dr	1.5615	1.6190	0.0575	19.56	101687	15.9	21.7

---------- VEHICLE DAMAGE PROFILES ----------

Vehicle Name: Lincoln Town Car 4Dr

Imp No	Collision With	CDC	Damage Width (in)	Width Offset (in)	Damage Height (in)	Height Offset (in)	Max Crush (in)
1	Chevrolet Tahoe LS 4-Dr	SAEJ224b 10LPAW3	78.9	-0.7	42.7	-7.9	12.0

Vehicle Name: Chevrolet Tahoe LS 4-Dr

Imp No	Collision With	CDC	Damage Width (in)	Width Offset (in)	Damage Height (in)	Height Offset (in)	Max Crush (in)
1	Lincoln Town Car 4Dr	SAEJ224b 01FDEW5	71.2	0.2	31.7	0.2	41.7

--------- VEHICLE CRUSH DEPTH TABLES ----------

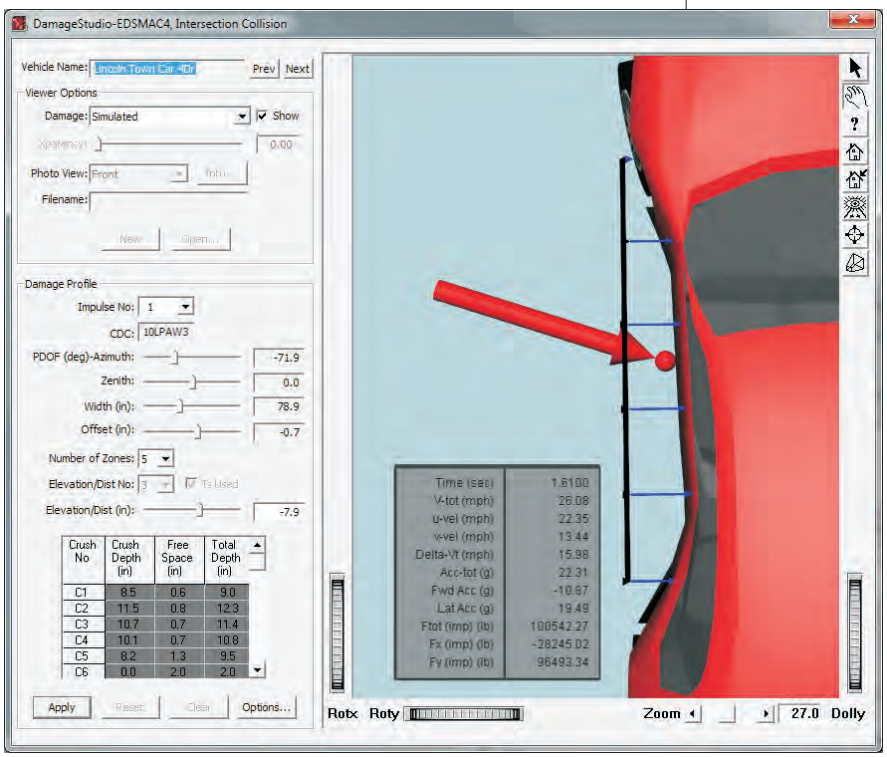
Vehicle Name: Lincoln Town Car 4Dr

Imp No	Collision With	Elev/Dist (in)	Crush Depths (Excl. Free Space) C1 (in)	C2 (in)	C3 (in)	C4 (in)	C5 (in)
1	Chevrolet Tahoe LS 4-Dr	-7.9	8.8	12.0	10.9	9.6	2.0

Vehicle Name: Chevrolet Tahoe LS 4-Dr

Imp No	Collision With	Elev/Dist (in)	Crush Depths (Excl. Free Space) C1 (in)	C2 (in)	C3 (in)	C4 (in)	C5 (in)
1	Lincoln Town Car 4Dr	10.3	2.7	5.9	9.4	7.2	41.7

EDSMAC4 Damage Data report displaying the Collision Data format utilized by *DamageStudio*. The report is divided into three sections, providing details on Vehicle Collision Kinetics, Vehicle Damage Profiles and Vehicle Crush Depth Tables.



DamageStudio displaying the current simulation time Collision Data for the passenger car.

Note the PDOF, impulse center, color-coded crush vectors and Key Results are displayed directly in the *DamageStudio* viewer. Additionally, the current impulse number, along with the Collision Deformation Classification (CDC), PDOF, Width, Offset, Elevation/Distance and Crush Table results for the current impulse are displayed next to the viewer.

By displaying the information in this detailed manner, *DamageStudio* helps you understand, present and explain the results of your analysis of a real-world crash.

Select The Right Physics For Your Crash Analysis

A Comparison Guide of the simulation and reconstruction physics programs for *HVE*, *HVE-2D* and *HVE-CSI* is available in the Products section of the EDC website. The guide helps you select the physics program that provides the capabilities you need to address the real-world questions and issues of your crash analysis. A visual identifier showing which programs may be used in *HVE*, *HVE-2D* or *HVE-CSI* is found at the top and bottom of the guide. The left hand column lists features and also the technologies that may be available to use in each program

Comparison of *HVE*, *HVE-2D* and *HVE-CSI* Compatible Programs†

	Programs Available for *HVE*								
	Programs Available for *HVE-2D*								
	HVE-CSI								
Program Name	*EDCRASH*	*EDSMAC*	*EDSMAC4*	*EDSVS*	*EDVTS*	*EDGEN*	*EDVSM*	*EDVDS*	*SIMON*
Type of Program	Reconstruction	Simulation	Simulation	Simulation	Simulation	Simulation	Simulation	Simulation	Simulation
2-D/3-D	2-D‡	2-D‡	2-D‡	2-D‡	2-D‡	2-D/3-D	3-D	3-D	3-D
Degrees of Freedom	3/Vehicle	3/Vehicle	3/Vehicle	3	4	6	16	19/Tow Vehicle 22/Full Trailer	21/Tow Vehicle 36/Full Trailer
Number of Vehicles	1 or 2	1 or 2	Unlimited	1	2	1	1	1 to 4	Unlimited
Type of Vehicles	Barrier or Any 2-Axled	Any 2-Axled	All Types	Any 2- or 3-Axled	Any 2- or 3-Axled	Any	Any 2-Axled	3-Axled Tow Vehicle/ 4-Axled Full Trailer	Barrier or Any 3-Axled/ 6-Axled Full Trailer
Collision Model	Damage and Momentum	2-D Rho Vectors	2-D Rho Vectors	No	No	N/A	No	No	*DyMESH* (3-D Mesh)
Articulation Allowed	No	No	Yes	No	Yes	N/A	No	Yes	Yes
Number of Trailers	N/A	N/A	Unlimited	N/A	1	N/A	N/A	1 to 3	Unlimited
Suspension Model	No	No	Roll Couple Distribution	Roll Couple Distribution	Roll Couple Distribution	N/A	Independent or Solid Axle	Solid Axle	Independent or Solid Axle
Tandem Axles	No	No	Yes	Yes	Yes	N/A	No	Yes	Yes
Max No. Drive Axles	2	2	3	2	3	N/A	1	3	3
Dual Tires	No	No	Yes	Yes	Yes	N/A	Yes	Yes	Yes
Rollover	No	No	No	No	No	Yes	Yes	Yes	Yes
Aerodynamic Drag	No	No	No	No	No	N/A	Yes	No	Yes
HVE Brake Designer	No	No	No	No	No	N/A	Yes	Yes	Yes
HVE Tire Blow-out Model	No	No	Yes	No	No	N/A	Yes	No	Yes
Anti-lock Braking Model	No	No	No	Simple	Simple	N/A	No	No	*HVE* ABS Simulation Model
Automatic Transmission Model	No	No	No	No	No	N/A	No	No	Yes
HVE Driver Path Follower	No	No	Yes	No	No	N/A	Yes	Yes	Yes
HVE Driver Speed Follower	No	No	No	No	No	N/A	No	No	Yes
Steer Degree-of-Freedom	No	No	Yes	No	No	N/A	Yes	No	Yes
Enhanced Tire-Terrain Models	No	No	No	No	No	N/A	No	No	Yes
HVE Hydroplaning Model	No	No	Yes	No	No	N/A	No	No	Yes
DamageStudio Analysis Tool	No	No	Yes	No	No	N/A	No	No	Yes
HVE Electronic Stability Systems Model	No	No	No	No	No	N/A	No	No	Yes
Program Name	*EDCRASH*	*EDSMAC*	*EDSMAC4*	*EDSVS*	*EDVTS*	*EDGEN*	*EDVSM*	*EDVDS*	*SIMON*
	HVE-CSI								
	Programs Available for *HVE-2D*								
	Programs Available for *HVE*								

Study Occupant Injury Mechanisms Using *GATB*

Visit the updated Featured *HVE* Applications section of the EDC website to explore the latest scenario involving a collision simulation and the study of the motion of occupants seated in the rear of one of the vehicles. This scenario illustrates a classic example of the evaluation of potential occupant injury mechanisms in a side impact collision between a pickup and an SUV.

A menu-driven reconstruction provides a detailed description of the scenario as well as the issues and answers provided directly using *HVE* simulation technologies, such as the *SIMON* 3-D Vehicle Dynamics Simulation Model, *DyMESH* 3-D Collision Model and the *GATB* Occupant/Pedestrian Simulation Model. You'll also discover screenshots of the human, vehicle and environment models, simulation set-up details, output results and high-definition simulation movies.

You can also directly view this scenario by going to www.edccorp.com/rearoccupant. Follow the links to view ten other Featured *HVE* Applications as well.

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've updated to Version 9.12, and I notice that the terrain model and my vehicles appear 'richer' in color. In some cases I also see that the view appears to have less illumination, such that one side of the car is bright and the other side appears to be in shadow. What has changed in Version 9.12?

A. Since Version 9.10, there have been changes made to the vehicle's color attributes, and the lighting of the scene now comes directly from the current sun position. These two changes provide for a more realistic appearance of the event at the time, date and location you specified in the Environment Information dialog. Previously, the viewer was flooded with additional lighting from an extra light source positioned behind your view, which is now turned off by default. If you want to turn the extra lighting back on for some reason, you can position your cursor in the viewer and right-click. On the pop-up menu, select Headlight and the additional lighting will be turned back on.

Q. I am trying to run a SIMON/DyMESH event involving a rollover. I quickly imported a line drawing to use as a guide for matching my simulation to my scene evidence. I set-up the vehicle into the correct initial positions, assigned velocities and driver controls and was sure to set DyMESH options to Include Environment. However, when I try to run the event, I get the message "Bad or Incompatible Vehicle Data: Check Dimensions." Why am I getting this message and what do I need to do to address it?

A. It sounds like you are trying to work with an environment model that doesn't include any surfaces. You have imported a line drawing and are thinking that the usual Z=0 plane will be acceptable for the vehicle body vs. terrain interaction, which you asked for by choosing to "Include Environment" in the *DyMESH* options. However, *DyMESH* works by modeling the interaction of the surface geometry of the vehicle with the surface geometry of the terrain model, and your terrain model information only includes the line drawing elements, not surfaces. You can either go back to your original CAD model and add surfaces, or you can quickly go to the 3-D Editor in *HVE* and add a very large surface under your line drawing. This now provides a surface for the vehicle exterior to interact with during the rollover and you will be able to run your simulations as expected.

Q. I can't get the selected output variables to display in the Video Creator window. I have them turned on and selected as I normally do, but don't see them. Help!

A. It sounds like you adjusted the Camera properties for the Near Clipping Plane to a distance just beyond where the Key Results display is positioned in the Video Creator. That display is an object which you can move around the viewer to the position best suited for your simulation movie. As an object, it requires the viewer clipping plane to be set close enough to prevent the variable display from being 'clipped' from the camera view. If you change the near clipping plane back closer to the camera, you will find that the results will be displayed as expected.

Q. I am trying to run a very detailed SIMON/DyMESH collision event, but the program stops responding about halfway through, with a message indicating "Out of Memory". What can I do to get past this?

A. *HVE* is currently a 32-bit application which has a limitation of about 2 GB for the active storage of the event data output. The best workarounds are to slightly increase the Output Time Interval, shorten the event Maximum Time, reduce the polygon mesh density of the vehicles or terrain, or turn off the high resolution Radial Spring Tire Model. Try to limit the amount of data you are handling/recording during the event and your event will run to completion.

Q. When I try to install HVE, the process is stalling just before it starts copying files to the computer. I've installed the same CD on other computers in my office, but for some reason it will not continue on this particular computer. Why?

A. We have recently received a couple of reports about this behavior and the recommended solution is to start your computer in Safe Mode (press and hold F8 as your computer starts) and then perform the installation. It seems that even though you manually turn off firewall and anti-virus programs on your computer in regular mode, they can still block a copying process of files. Safe mode forces your anti-virus to behave 'properly', thereby allowing you complete the installation. Once the program is installed it should not be a problem for installing future updates.

Visit the Support section of www.edccorp.com for answers in the Knowledge Base and also the latest Downloads

EDC Training Courses

EDC Reconstruction & 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.*

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.

Engineering Dynamics Corporation
Training Course Schedule

EDC Simulations

Los Angeles, CA . . . . . January 2015
Miami, FL . . . . . November 11 - 15, 2013

EDC Reconstruction

Los Angeles, CA . . . . . January 20 - 24, 2014
Miami, FL . . . . . November 2014

Theoretical & Applied Vehicle Dynamics

Upon Request

2014 *HVE* FORUM

St. Petersburg, FL . . . . . February 24 - 28, 2014

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.

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:

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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