



# Technical Newsletter

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## Here's the Latest "Now Available" News!

It's been a busy summer here at EDC! Here's some "Now Available" news for *HVE*, *HVE-2D* and the newest member of the *HVE* family, *HVE-CSI*:

### ***HVE, HVE-2D & HVE-CSI Version 8.0***

Version 8.0 is now available! This latest release offers users exciting new features, such as the *HVE* Clutch Model, along with numerous enhancements to the Vehicle, Environment, Event and Playback Editors. Click on the **Version 8 - July 30, 2010** link at the top of the [www.edccorp.com](http://www.edccorp.com) for more information.

### **Program Selection Guide**

A new Program Selection Guide designed to help you select between *HVE*, *HVE-2D* and *HVE-CSI*, and also the physics programs to use for your reconstructions, is now available. Click on the **Program Selection Guide** link at the top of the [www.edccorp.com](http://www.edccorp.com).

Three tables provide an *Application* comparison (as shown below), a *System Features* comparison and also a comparison of the rich feature set and capabilities of each physics program. Helpful links take you to more information about the selected feature or capability.

Application Comparison of ***HVE, HVE-2D*** and ***HVE-CSI***

EXAMPLE APPLICATIONS	<b><i>HVE</i></b>	<b><i>HVE-2D</i></b>	<b><i>HVE-CSI</i></b>
Speed Determination/Skid-to-Stop	Yes	Yes	Yes
Time-Distance Study	Yes	Yes	Yes
Basic Vehicle Handling (Steering, Throttle, Brakes)	Yes	Yes	Yes
Basic Intersection Crash	Yes	Yes	Yes
Basic Offset Head-on Crash	Yes	Yes	Yes
Basic Rear-end Crash	Yes	Yes	Yes
Crush Energy Analysis	Yes	Yes	Yes
Collision Force Analysis	Yes	Yes	Yes
Multiple Friction Zones and Split-Friction Surfaces	Yes	Yes	
Collision Simulation with Fixed and Moving Barriers	Yes	Yes	
Multi-vehicle Freeway Pile-up	Yes	Yes	
Hydroplaning Simulation	Yes	Yes	
Tire Blow-out Simulation	Yes	Yes	
Wheel Displacement Due to Collision	Yes	Yes	
Tractor-Trailer Handling (Steering, Throttle, Brakes)	Yes	Yes	
3-D Collision (Over-ride/Under-ride)	Yes		
Rollover Simulation	Yes		
Airborne Vehicle Simulation	Yes		
ABS Braking Simulation	Yes		
Powertrain (Engine, Transmission, Clutch)	Yes		
Sloped or Irregular Terrain Effects	Yes		
Tire Interaction with Curbs, Potholes and Soft Soil	Yes		
Occupant and Pedestrian Kinematics	Yes		
	<b><i>HVE</i></b>	<b><i>HVE-2D</i></b>	<b><i>HVE-CSI</i></b>

### **2011 *HVE* Forum**

The 2011 *HVE* Forum offers a wide selection of workshops designed for beginning, intermediate and advanced users of *HVE*, *HVE-2D*, and *HVE-CSI*, along with User's Groups, the *HVE* White Paper session and interactive social hours at the end of each day. Workshop schedules, descriptions, registration forms and details about the hotel and discounted room rates are now available to download from the EDC website. Visit [www.edccorp.com/2011HVEForum](http://www.edccorp.com/2011HVEForum) or contact EDC Customer Service and register today.

**Spring Training 2011 HVE Forum**

February 21-25, 2011  
Chaparral Suites  
Scottsdale, AZ

**WORKSHOPS**

- NEW** Advanced *HVE* Using Damage Studio
- NEW** Advanced *HVE-2D*: ED5MAC Case Studies
- NEW** Environment Building for the Professional Graphic Artist
- NEW** Introduction to *HVE-CSI*
  - Introduction to ED5MAC, ED5MAC, ED5SAC, ED5TS
  - Creating and Enhancing Environments Using the 3-D Editor
  - DyNA3D 3-D Collision Model Overview and Applications
  - Tractor-Trailer and Commercial Vehicle Simulation
  - Advanced Multi-vehicle Simulation Using SIMOW
  - Importing 3-D Environments from Total Stations
  - Theoretical and Applied Vehicle Dynamics
  - Simulating Cars, Potholes and Soft Soils
  - Multi-Vehicle Collision Using ED5MAC
  - Building Vehicles for *HVE* and *HVE-2D*
  - Brake System and ABS Simulation
  - Simulating Blow-outs and Rollovers
  - Details of the *HVE* Vehicle Model
- NEW** *HVE, HVE-2D and HVE-CSI* User's Groups
- Recording Simulation Movies
- NEW** Powerful Tips and Techniques
- NEW** *HVE* White Paper Session

**ANIMATION**

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## Technical Session

This Technical Session introduces a new tool available in the HVE Playback Editor, called *Damage Studio*®. Our technical session is a continuation of the technical session in our previous Newsletter.

*Damage Studio* is a graphical analysis tool that allows the user to visualize collision data, and to correlate collision damage with the kinetics (force magnitude and direction), delta-V, acceleration and other important collision parameters. *Damage Studio* is an option that replaces the Damage Profiles output report. A typical HVE *Damage Studio* window is shown in Figure 1.

There are many uses for the kind of detailed collision information provided by *Damage Studio*. One example is the ability to directly compare simulated crush dimensions with a measured damage profile. This technique can also be used to fine-tune stiffness coefficients from staged collision data.

*Damage Studio* can also be used to identify the magnitude and direction of individual impulses, peak

collision forces and delta-Vs for vehicles undergoing multiple impacts, even if the impacts are simultaneous.

A *Damage Studio* window includes a 3-D viewer and two groups of supporting information:

- Viewer Options
- Damage Profile

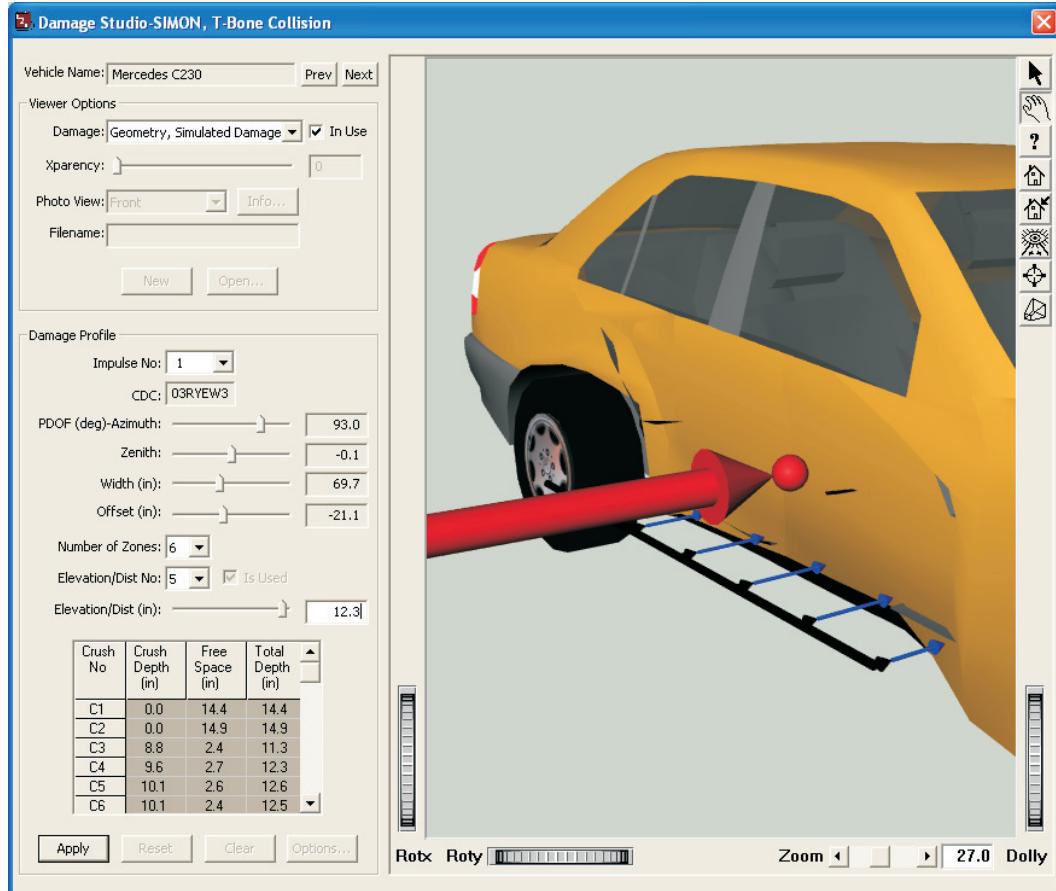
These two new features differentiate *Damage Studio* from HVE's existing Damage Profile output report window.

### Viewer Options

The Viewer Options group determines what is displayed in the 3-D viewer. The five options are:

- Geometry, Simulated Damage
- Geometry, Undamaged
- Geometry, from File
- Damage Photograph
- Damage, User-entered

The current Viewer Option is selected from a dropdown list. Our Technical Session focuses on the *Geometry, Simulated Damage* option.



When the *Geometry, Simulated Damage* option is selected, the 3-D viewer displays the vehicle damage calculated by the simulation. It is similar to the Damage Profiles output report window currently found in the Playback Editor. As the simulation is played, the damage profile dynamically updates, showing the current damage profile. Unlike the Damage Profiles window, *DamageStudio* also displays the PDOF, impulse center and color-coded crush vectors showing free space and actual crush depth.

## Damage Profile

The Damage Profile group is enabled when the currently selected Viewer Option is *Geometry, Simulated Damage* or *Damage, User-entered*.

For simulated vehicle damage, the Damage Profile group displays the current impulse number (up to 10 individual impulses per vehicle may be displayed), along with the following results for the current impulse:

**Collision Deformation Classification (CDC)** – This is a full implementation of SAE J224B. The first two characters are the clock direction of the PDOF; the 3<sup>rd</sup> character is the major contact surface (Front, Right, Back, Left, Top, Undercarriage); the 4<sup>th</sup> character is the specific location of damage on the major surface defined by the 3<sup>rd</sup> character; the 5<sup>th</sup> character is the damage elevation (for Front, Right, Back and Left damage) or damage width along the vehicle-fixed x axis (for Top and Undercarriage damage); the 6<sup>th</sup> character is the type of damage (Wide, Narrow, Sideswipe, Corner); the 7<sup>th</sup> character defines the maximum extent (depth) of crush.

**PDOF** – By definition, the PDOF is the direction of the impulse (and, therefore, the delta-V). Because HVE is 3-dimensional, the PDOF has both an azimuth angle (the traditional PDOF in the vehicle's x-y plane) and a zenith angle (the vertical component of the PDOF).

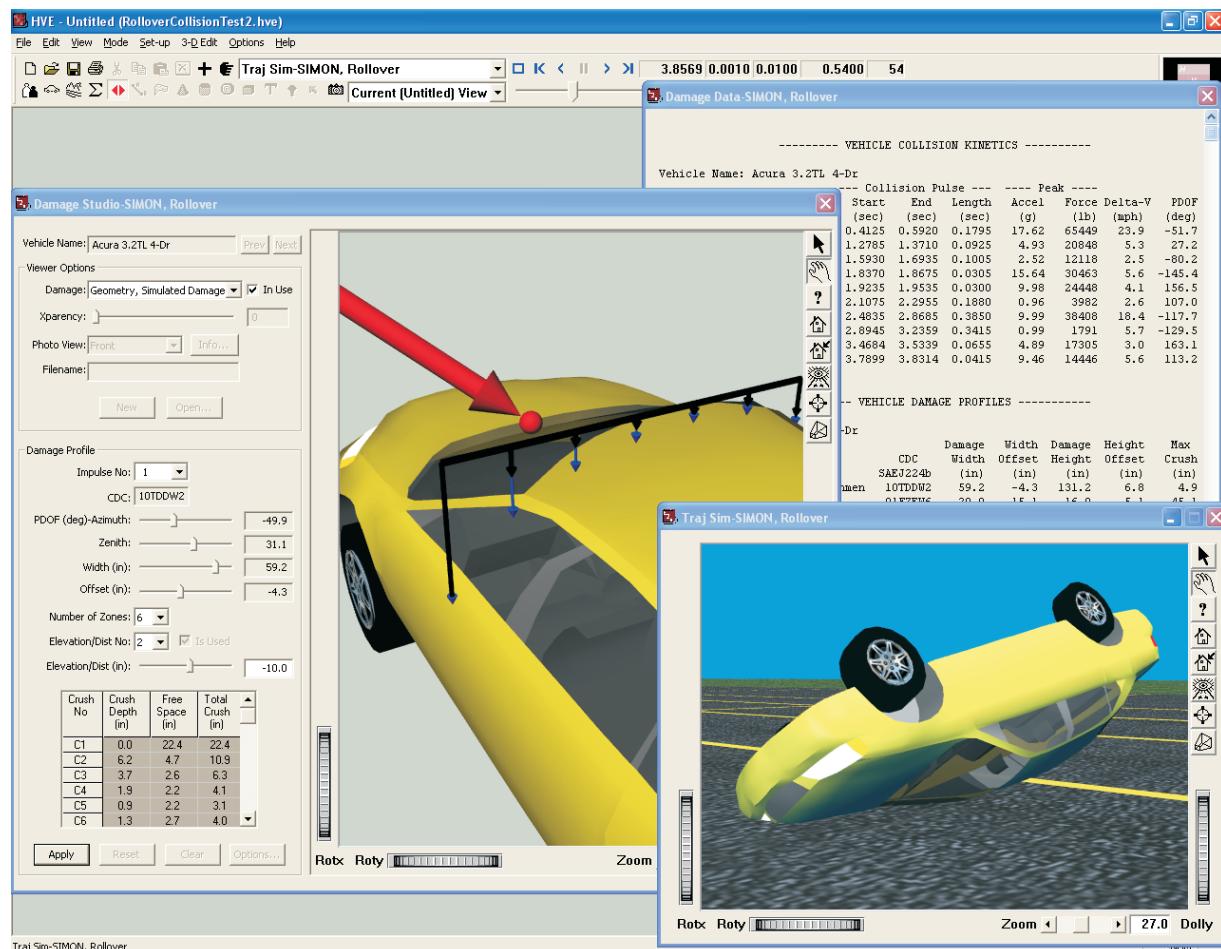


Figure 2 - Playback Editor displaying Damage Data, *DamageStudio* and Trajectory Simulation windows for our rollover simulation. The current simulation time is 0.540 seconds, the time at which the peak force occurs during Impulse No. 1.

**Width** – For side and end damage, this is the horizontal width of damage. For top and undercarriage damage, this is the width of damage in the y-direction.

**Offset** – For side and end damage, this is the horizontal distance from the CG to the center of the damage width. For top and undercarriage damage, this is the lateral distance from the CG to the center of the damage width.

**Elevation/Distance** – For side and end damage, this is the vertical elevation at up to five locations (above/below the CG) for the crush depths displayed in the crush table. For top and undercarriage damage, this is the x-distance from the CG at up to five locations for the crush depths displayed in the crush table.

**Crush Table** – These are the actual crush depth for physically observable damage, the free space and the total crush depth (sum of actual crush depth and free space). Up to 10 crush depths may be entered (five is the default).

The 3-D viewer displays the current impulse center and PDOF vector, as well as a set of color-coded arrows (vectors) that illustrate the crush depth and free space for each selected elevation/distance.

## Using DamageStudio

The following example illustrates the use of *DamageStudio* for analyzing a rollover collision. We have set up and executed a rollover simulation for a 2001 Acura 3.2TL. The vehicle rolls several times, resulting in 10 individual impulses at various locations on the vehicle.

After executing our SIMON rollover event, we open a Damage Data output report and *DamageStudio* and Trajectory Simulation windows in the Playback Editor, as shown in Figure 2. We also set the playback output interval to a small size, 0.01 seconds (remember, we're talking about impulses that last only about 100 milliseconds, or so).

The CollisionData results for this rollover are displayed in SIMON's Damage Data report (see Figure 3). From our previous Newsletter, we learned that CollisionData is a new HVE routine that calculates and provides a significant amount of detailed numeric data describing a collision.

CollisionData results include:

**Kinetics** – Collision impulse information, including the start, end and time duration of each impulse, as well as the peak force, acceleration, delta-V and PDOF associated with the impulse.

**Damage Profiles** – Damage profile information, including the CDC, damage width and width offset, and damage height and height offset (that's right, we're talking 3-dimensional damage profiles!), and maximum crush depth.

**Crush Tables** – Detailed crush depth information, including elevation and crush depths for five locations.

Damage Data-SIMON, Untitled Event								
----- VEHICLE COLLISION KINETICS -----								
Vehicle Name: Acura 3.2TL 4-Dr								
--- Collision Pulse ---								
Imp	No	Collision With	Start (sec)	End (sec)	Length (sec)	Accel (g)	Force (lb)	Delta-V (mph)
1	Untitled Environment	0.4125	0.5920	0.1795	17.62	65449	23.9	-51.7
2		1.2785	1.3710	0.0925	4.93	20848	5.3	27.2
3		1.5930	1.6935	0.1005	2.52	12118	2.5	-80.2
4		1.8370	1.8675	0.0305	15.64	30463	5.6	-145.4
5		1.9235	1.9535	0.0300	9.98	24448	4.1	156.5
6		2.1075	2.2955	0.1880	0.96	3982	2.6	107.0
7		2.4835	2.8665	0.3850	9.99	38408	18.4	-117.7
8		2.8945	3.2359	0.3415	0.99	1791	5.7	-129.5
9		3.4684	3.5339	0.0655	4.89	17305	3.0	163.1
10		3.7899	3.8314	0.0415	9.46	14446	5.6	113.2
----- VEHICLE DAMAGE PROFILES -----								
Vehicle Name: Acura 3.2TL 4-Dr								
Imp	No	Collision With	CDC	Damage Width (in)	Width Offset (in)	Damage Height (in)	Height Offset (in)	Max Crush (in)
1	Untitled Environment	SAEJ224b	10TDDW2	59.2	-4.3	131.2	6.8	4.9
2			01FZEW6	29.9	15.1	16.0	5.1	45.1
3			09FLENS	13.3	-26.1	9.7	8.5	35.9
4			07UBLNO	13.5	-27.1	59.6	-81.8	4.6
5			05UBRWO	19.7	23.0	27.0	-97.6	7.6
6			04UFRNO	6.6	31.8	20.8	55.9	5.3
7			08FDAWS	47.4	-10.7	37.1	-11.2	40.8
8			06TBLN2	5.6	-29.5	10.6	-105.6	3.4
9			05UBZWO	41.2	11.0	12.6	-107.2	8.4
10			04UZRNO	7.7	29.4	48.4	43.5	4.8
----- VEHICLE CRUSH DEPTH TABLES -----								
Vehicle Name: Acura 3.2TL 4-Dr								
Imp	No	Collision With	Elevation (in)	C1 (in)	C2 (in)	C3 (in)	C4 (in)	C5 (in)
1	Untitled Environment	-58.8	4.9	0.0	0.0	0.1	0.2	
		-26.0	2.7	4.2	2.2	2.2	1.4	
		6.8	3.2	3.4	0.0	0.0	0.0	
		39.6	-26.3	2.3	0.0	0.0	0.0	
		72.4	0.0	2.9	3.8	0.8	-35.1	
		-2.9	3.7	1.5	0.0	0.3	2.5	
		1.1	0.0	0.4	2.0	3.1	3.2	
		5.1	0.3	3.1	4.0	5.1	4.4	
		9.1	0.5	2.6	3.7	4.8	10.2	
		11.9	0.1	1.5	3.1	4.2	45.1	
		3.6	35.0	16.9	11.5	6.5	2.4	
		6.1	35.9	11.8	8.7	5.6	2.5	
		8.5	35.4	9.9	8.0	4.5	1.6	
		10.9	34.9	9.4	6.9	3.5	0.9	
		11.9	34.7	9.5	6.5	3.0	0.6	
		-111.6	0.0	0.0	0.0	1.5	0.7	
		-96.7	0.0	4.6	3.9	3.8	3.8	
		-81.8	0.2	0.1	0.0	0.0	0.0	
		-66.9	0.0	0.0	0.0	0.0	0.0	
		-52.0	0.3	0.4	0.4	0.3	0.3	

Figure 3 - SIMON's Damage Data output report showing CollisionData results for the sample rollover event.

As you would expect, when implemented in SIMON, the CollisionData results are fully 3-dimensional, and include roof and undercarriage damage as well as side/end damage at various elevations.

Just to focus briefly on one useful application, the CollisionData results can be used to provide detailed roof crush measurements for our rollover crash. The *DamageStudio* window for the SIMON simulation is displayed in Figure 4. The Viewer Option is *Geometry, Simulated Damage*; the Damage Profile group initially shows the Impulse No. as *Auto*.

The Trajectory Simulation window gives excellent context to the rollover event, showing the vehicle contacting the ground at the moment the CollisionData results for each impulse are displayed in the *DamageStudio* window.

Now play the simulation. Watch as the first roof collision occurs. As the vehicle comes down on its roof, the

Impulse No. changes from *Auto* to 1, and the CDC and related damage information for the first impulse are displayed in *DamageStudio*'s Damage Profile group. The current crush vectors and PDOF are displayed in the 3-D viewer. Press *Pause*. Figure 2 shows the Trajectory Simulation and *DamageStudio* windows at precisely this moment.

Press *Play*. The simulation continues. After the first impulse is complete, the Impulse No. changes back to *Auto*. When the second impulse begins, the Impulse No. changes to 2 and the damage information associated with the second impulse is displayed (see Figure 5). Allow the simulation to run to completion. As the simulation progresses, *DamageStudio* displays the current impulse information for each successive impulse.

Let's say our main interest is the impulse that caused a majority of the roof crush above the driver's head; this is

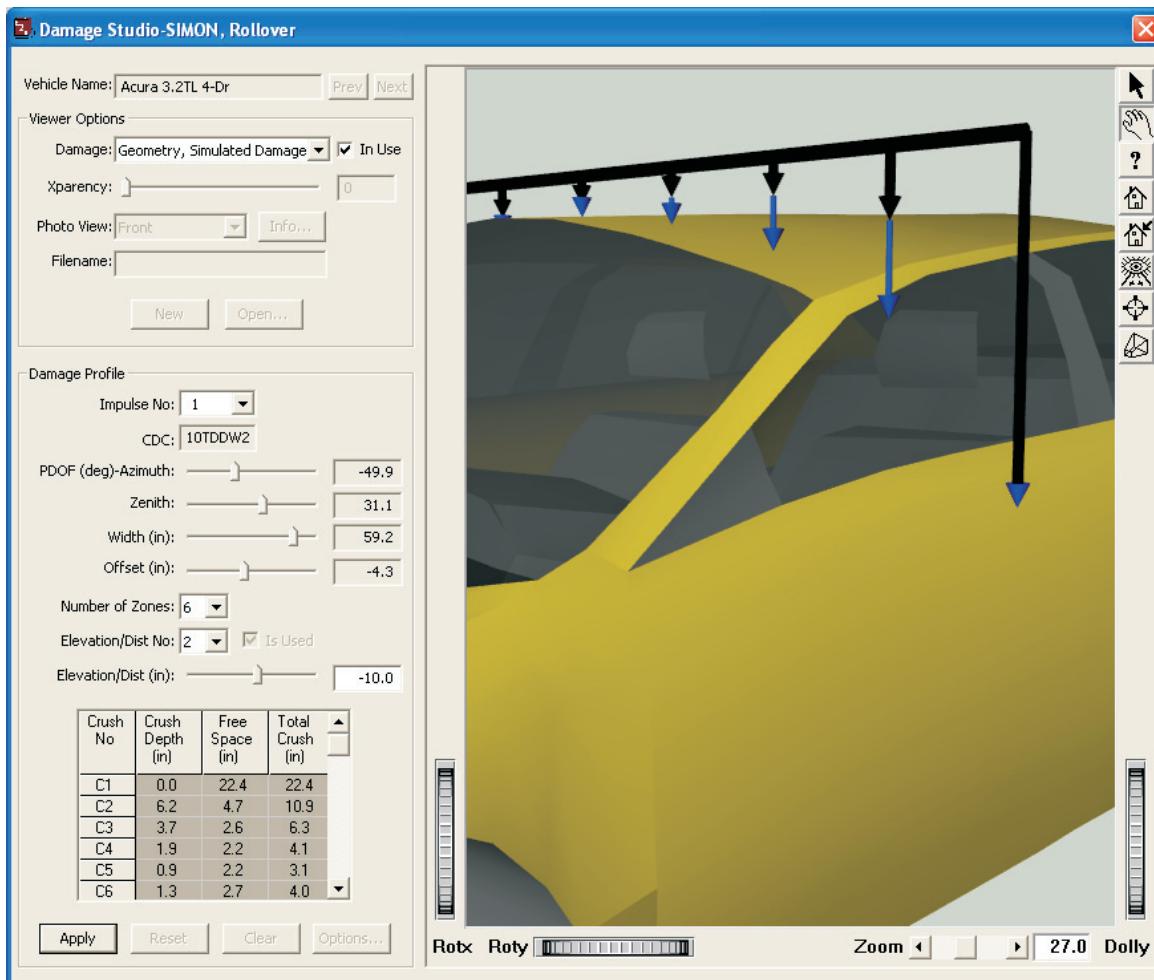


Figure 4 - *DamageStudio* showing the crush depths near the top of the A-pillar. This is the area that sustained the maximum roof crush, and also happens to be above the driver's head.

the first impulse. We can focus directly on the first impulse by clicking on *DamageStudio's* Impulse No. dropdown list and choosing Impulse No. 1. The current simulation time moves to the end of the first impulse. We can now look at up to 10 crush depths at up to five individual locations along the entire length of the vehicle. However, we focus on those that involve the roof above the driver's head. Choose Elevation/Distance No. 2. You will see the crush table and the 3-D viewer update accordingly, showing the crush depths for the selected location. We can then fine-tune our investigation by directly entering the location at the top of the A-pillar (directly above the driver's head).

This is but one example of using *DamageStudio*. We leave it to the creative user to ponder all the other possible uses!

## What We Learned

This example was all about studying occupant injury exposure. The vehicle landed on its roof at  $t=0.540$  seconds, when its orientation was roll=211 deg, pitch=-13 deg, yaw=-89 deg. The peak acceleration was 17.6 g; the PDOF azimuth and zenith angles were -50 and +31 degrees, respectively. The peak roof force was 65,500 lb; the delta-V was 24 mph. The resulting roof crush in the vicinity above the driver's head was 4 to 6 inches.

## Other Viewer Options

The first release of *DamageStudio* focuses on the *Geometry, Simulated Damage* viewer option. Its implementation for HVE is complete. Other viewer options are well under way, as is the implementation for HVE-2D and EDSMAC4. The obvious difference for HVE-2D is that damage data and visualization are 2-dimensional.

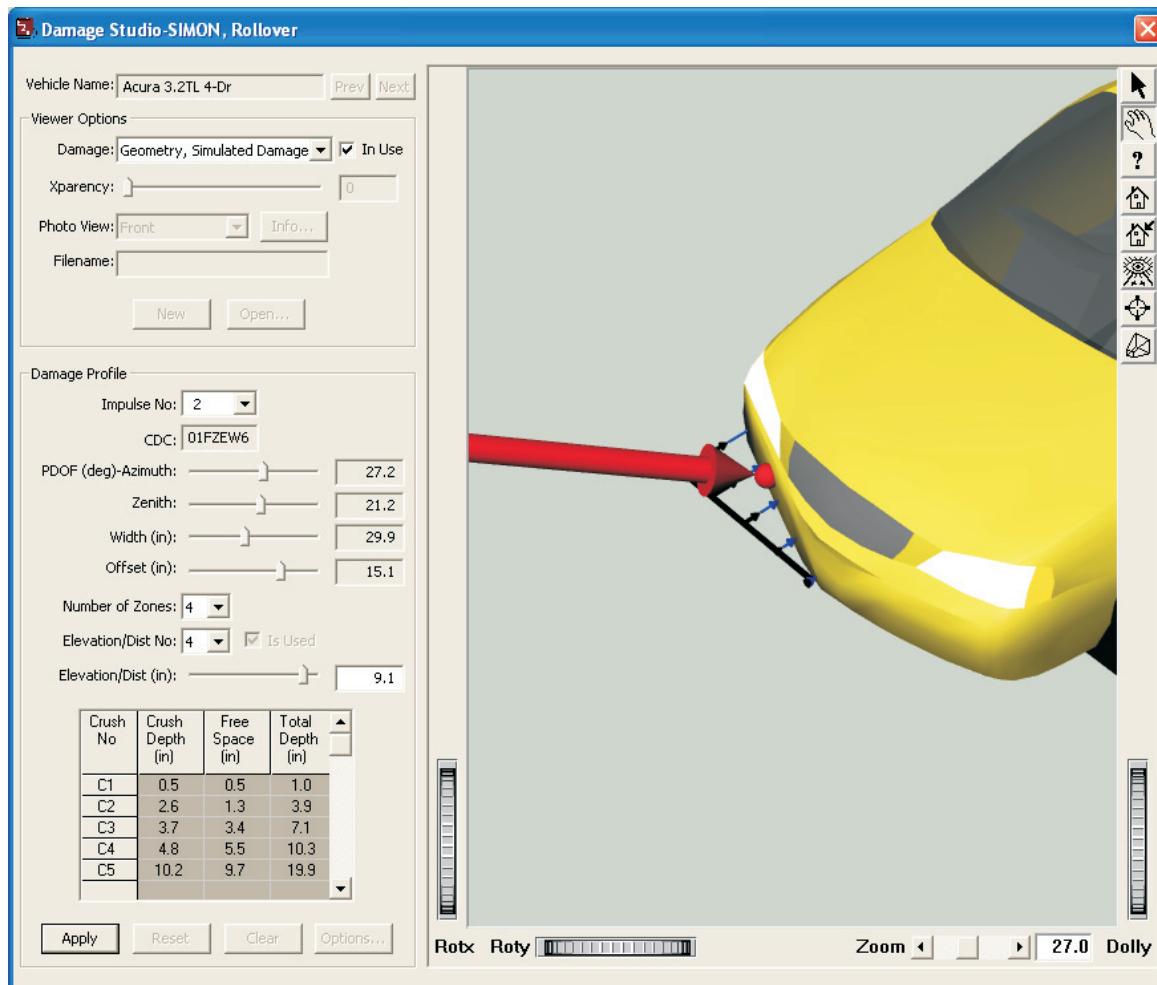


Figure 5 - *DamageStudio* showing information for the second impulse. This impulse occurred at the right corner of the front bumper. Close inspection of the crush arrows reveals color-coded vectors for free space and actual crush; the measurements are shown in the table.

The viewer options under development are:

**Geometry, Undamaged** – Selecting this option displays the original (undamaged) vehicle geometry for comparison with the damaged vehicle.

**Geometry, From File** – Selecting this option displays any 3-D model provided by the user. The user would typically select, using a file browser, a CAD model that was created from a scan or total station survey of the actual crash vehicle.

**Damage Photograph** – Selecting this option displays up to seven user-supplied vehicle damage photographs (six orthographic, one perspective). The user would typically select, using a file browser, one or more photographs that document the damage profile of the actual crash vehicle.

**Damage, User-entered** – Selecting this option displays a vehicle dimensions “shoe-box” and user-entered damage dimensions (an extended version of the Damage Profiles dialog currently used in the Event Editor for supplying damage dimensions for an EDCRASH event).

The above views may be superimposed, providing a direct visual comparison between simulated damage and actual damage displayed in a user's CAD file or photos, or actual damage dimensions.

## Summary

CollisionData, *Damage Studio* and Trajectory Simulation results can be used together to provide extremely detailed information about a collision. You can correlate collision forces and accelerations directly with crush information (in our sample case, roof crush) and occupant injury. You can determine the time of peak forces and accelerations and correlate those with vehicle orientation and occupant position within a vehicle. In multiple vehicle collisions (yes, they may be simultaneous), you can identify which collision produced the greatest force and associated crush.

We are very excited to be introducing *Damage Studio* in HVE's next release!

## Environment DXF Issues

Having difficulty importing DXF models of your environments into HVE or HVE-2D? Please contact EDC Technical Support for assistance. We can offer helpful tips and suggestions for preparing your file in your CAD program and for using a convertor program to help you successfully import your DXF model into your HVE and HVE-2D Environment Editor.

## 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. My Key Results windows are supposed to be displayed, but they are not visible on my screen. I have unchecked and checked Show Key Results, but they are still not displayed. They were displayed when I was working with a dual monitor configuration with my laptop at my desk, but not now on just my laptop screen alone. How do I get them to display once again?*

A. It sounds like you left the Key Results windows over on the other display, which is “pixel real estate” that is currently not displayed. One way to fix this condition is to plug back into your dual monitor configuration and move the Key Results windows back to the primary monitor. The other fix is to search for your *hve.ini* file on your computer (it's most likely at *c:\windows*). The *hve.ini* file contains information such as the names of recently opened case files and also the positions of Key Results windows on your displays. By deleting this file, it will reset the initial size and position of your HVE program window and also your Key Results windows.

*Q. I'm working in Version 8, and I just opened an existing case from Version 7.10. I'm in Playback looking for the Vehicle Data report, but it is not listed in the available Output Reports. I know it should be there, but it's not listed. What do I have to do to get it to appear?*

A. In Version 8, the addition of the new References report to the list of available outputs simply displaces the Vehicle Data report off the list for an existing case. To view the Vehicle Data report, you need to go back and reset and reexecute the event. When you return to Playback, you will see that the entire list of reports is available. The results of the event have not changed between 7.10 and 8.00, and the Vehicle Data report will now be available.

*Q. What is the suggested filename length for cases, textures, vehicle geometry files, etc.?*

A. Filenames must be less than 30 characters (including extension). Longer filenames are not handled properly, which causes unexpected behaviors.

*Visit the Support section of  
[www.edccorp.com](http://www.edccorp.com) for the latest  
Downloads and answers to F.A.Q.'s*

## EDC Training Courses

### EDC Reconstruction & EDC Simulations

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

Both new and long-time 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 24 - 28, 2011  
Miami, FL ..... November 7 - 11, 2011

#### EDC Reconstruction

Los Angeles, CA ..... January 2012  
Miami, FL ..... November 8-12, 2010

#### Theoretical & Applied Vehicle Dynamics Upon Request

#### 2011 HVE FORUM

Scottsdale, AZ ..... February 21 - 25, 2011

### 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](http://edccorp.com) or contact EDC Customer Service at 503.644.4500 or by email to [training@edccorp.com](mailto: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:

[tech.groups.yahoo.com/group/HVErecon](http://tech.groups.yahoo.com/group/HVErecon) - Discussion group hosted by Roman Beck of Casteel, Beck & Associates.

[DiscoverHVE.com](http://DiscoverHVE.com) - Online training and discussion group hosted by Wes Grimes of Collision Engineering Associates

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*EDCRASH*, *EDSMAC*, *EDSMAC4*, *EDSVS*, *EDVTS*, *EDHIS*, *EDVSM*, *EDVDS*, *EDGEN*, *EDVDB*, *HVE*, *HVE-2D*, *HVE-CSI*, *HVE Brake Designer* and *GetSurfaceInfo()* are trademarks of Engineering Dynamics Corporation. All Rights Reserved.

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