

Technical Newsletter

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HVE Version 11 to Debut in Austin

HVE Version 11 will be the star of the show at the *HVE* Forum during the week of March 2 - 6 in Austin, Texas.

See Page 5 for information about the 30+ individual workshops to be held at the 2015 *HVE* Forum!

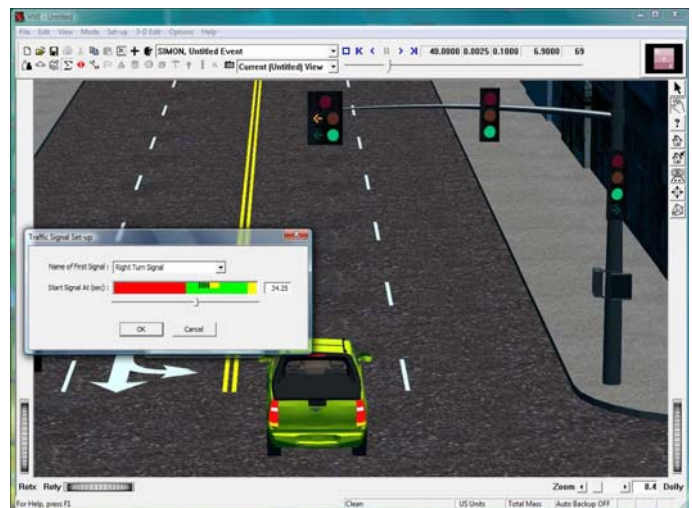
HVE Version 11 is loaded with new features and capabilities, such as:

New Robust DXF Translator • Thanks to a totally new DXF translator, *HVE* can now import crash site terrain models directly from a vast array of CAD programs and from terrains creating using total station surveys. The new translator was built directly on top of Autocad's DXF toolkit, thus ensuring the seamless importing of virtually any DXF file from Release 14 up to the present.

Dynamic Driver Table Length • Driver control tables for steering, braking and throttle may now have an unlimited number of entries, allowing users to copy data to the tables directly from EDR downloads.

Brake and Back-up Lights • Vehicle brake lights now come on any time the brake pedal is applied during a simulation event; the user no longer needs to explicitly activate them. The same is true for back-up lights; they come on when a vehicle's transmission is shifted into reverse gear.

***HVE* Driver Model Update** • The *HVE* Driver Model Speed Follower option has been updated. This option allows users to determine the throttle and braking necessary to follow a desired speed profile. Because the model is based on the vehicle's drivetrain and brake systems, as well as the available tire-terrain friction, the Speed Follower can also tell the user when an attempted maneuver is prohibited by the laws of physics.



Traffic Signals Simulation System • Users can now create virtually any type of traffic signal system, such as blinking lights and sequential systems (see above). The Traffic Signal Editor is used to create and edit the individual traffic signals. Each signal may include up to eight individual multi-function lights with solid lenses, solid or blinking directional arrows, and horizontal or vertical bars or crosses. The Traffic Signal Set-up dialog is used to time the sequence. The smartly designed sequential timing interface makes setting up the signals for an entire intersection quick and easy.

Copy Human/Vehicle • It is now possible with a single click to create an exact copy of any human or vehicle in the current *HVE* case file. This is really handy for what-if scenarios comparing results with similar humans and/or vehicles.

HVE Version 11 is scheduled for release on February 11th and will be shipped automatically to all users with a current Update/Support policy. If you would like to update your *HVE*, *HVE-2D* or *HVE-CSI* software, contact us today for a personalized quotation via email at sales@edccorp.com or phone 888.768.6216.

Technical Session

The previous (Fall 2014) Technical Session provided an overview and tutorial for the *DyMESH* Wheel Impact model. The example used in that tutorial described how the model works for a wheel attached to an independent suspension. Solid axle suspensions behave differently because the wheels on the right and left sides are connected by a rigid body. Thus, the movement of a wheel on one side affects the wheel on the other side.

This Technical Session builds on the previous one by describing how the *DyMESH* Wheel Impact model handles the wheels attached to a solid axle suspension.

If you haven't already done so, please review the Fall 2014 Technical Session before continuing.

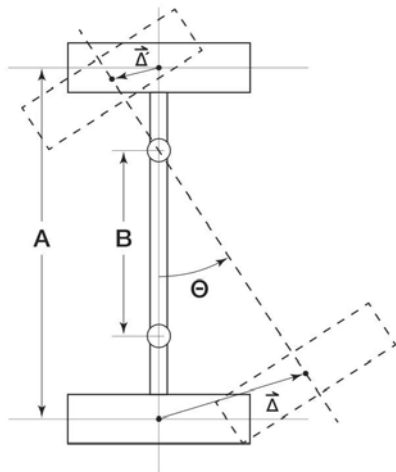


Figure 1 - *DyMESH* model for solid axle suspensions.

Figure 1 shows the basic model for *DyMESH* wheel impacts involving solid axle suspensions. As stated above, the position of the off-side wheel is affected because it is connected to the wheel in the struck side by a (rigid) solid axle. The mathematical model is as follows:

Given the *DyMESH*-calculated (displaced) wheel coordinates on the struck side, x_w, y_w , the vehicle-fixed angle of the solid axle is calculated:

$$x' = x_w - x_{w,original}$$

$$y' = |y_w| + \frac{B}{2}$$

and

$$\delta_{Axle} = \arctan\left(\frac{x'}{y'}\right) \times sign$$

where sign is positive (+) for a right-side wheel and negative (-) for a left-side wheel.

Given the original right side and left side wheel y-coordinates, $y_{original}$, the trackwidth, A, is:

$$A = y_{r,original} - y_{l,original}$$

and the displaced wheel coordinates, x'_w, y'_w , for the off-side wheel are:

$$x'_w = x_w - A \times \sin(\delta) \times sign$$

$$y'_w = y_w + A \times \cos(\delta) \times sign$$

Finally, the steer angles for each wheel are changed from their original (user-entered) values, δ_o ,

$$\delta = \delta_o + \delta_{Axle}$$

Tutorial

In this example we will simulate an under-ride collision between an SUV and the wheels of a semi-trailer. This is an all-to-common occurrence that is difficult (perhaps impossible) to properly analyze without the *DyMESH* Wheel Impact model. Let's get started.

- Start *HVE*.
- Go to the Vehicle Editor.
- Add a 2013 Subaru Forester SUV.
- Add a Peterbilt Model 379 truck tractor.
- Add a Generic Class 3 trailer. Name it *First Trailer*.
- Add a Generic Class 1 Fixed Drawbar dolly.
- Add a second Generic Class 3 trailer. Name it *Second Trailer*.

We have now added all the vehicles to our tutorial; let's add the environment.

- Go to the Environment Editor.
- Add an environment.
- In the Terrain page, open the Terrain file browser and choose *4-LaneFreeway.h3d* to add the terrain to the current environment.
- In the Sky page, open the Sky Image file browser and choose *Clouds1.jpg*.
- Click the *Use Sky Dome* checkbox to add a sky dome.
- Click OK.

The terrain and sky are now displayed in the Environment Editor. Let's set up our wheel impact event:

- Go to the Event Editor

- Add an event that includes the Subaru Forester, Peterbilt tractor, first trailer, fixed drawbar dolly and second trailer. Remember, the order is important: *HVE* will automatically connect the tow vehicle and trailers because of their compatible inter-vehicle connections.
- Select the *SIMON* calculation method.
- Enter an event name: *Trailer Under-ride Collision*.
- Click *OK* to add the event to our case.

The terrain is now displayed in the Event Editor. Because the event includes a collision, we need to activate *DyMESH*:

- From the Options menu, choose *DyMESH*. The *DyMESH* options dialog is displayed.
- Click the *Use DyMESH* checkbox to activate *DyMESH*. Set the *DyMESH* timesteps, 0.001 seconds for the integration timestep and 0.010 seconds for the output time interval. NOTE: We are using a small output time interval because the collision impulse has a very short duration.
- Click *OK*.

The next step is to set up each of the vehicles:

- Select the Subaru Forester in the Event Humans and Vehicles listbox (it's probably already selected).
- Choose *Set-up, Position/Velocity* to assign the Position/Velocity for the Subaru as follows: X = 46.9 ft, Y = 49.3 ft, $\Psi = 165.0$ deg, $V_{total} = 44$ mph.

Let's activate the *DyMESH* Wheel Impact model for the Subaru's left front wheel:

- Choose *Set-up, Wheels* and click the Damage tab to display the Wheel Damage page.
- Using the drop-down listboxes, choose *Axle 1, Left* to select the left front wheel.
- Click the *Wheel is Damaged* checkbox and the *Use DyMESH* checkbox to activate the *DyMESH* Wheel Impact model for the selected wheel. NOTE: The Wheel Impact model is not selected by default to reduce calculation time.
- Enter a value for *Peak Lock-up Torque* of 1.00 to simulate post-impact wheel lockup due to impact damage.
- Press *OK*

We're done setting up the Subaru; let's set up the Peterbilt and its trailers:

- Select the Peterbilt tractor in the Event Humans and Vehicle listbox.
- Choose *Set-up, Position/Velocity* to assign the Position/Velocity for the Peterbilt as follows: X = 0.7 ft, Y = 56.8 ft, $\Psi = 0.0$ deg, $V_{total} = 55$ mph.

Notice the trailers are correctly positioned along with the tractor. *HVE* does this for us automatically when the event is set up because the tractor and trailers have compatible inter-vehicle connections. We don't need to do anything further to position the trailers or assign them velocities.

Let's activate the *DyMESH* Wheel Impact model for the second trailer's left wheel:

- Click on the second trailer to select it (you can also select it from the Event Humans and Vehicles listbox). The trailer's manipulator is displayed, indicating it is selected.
- Choose *Set-up, Wheels* and click the Damage tab to display the Wheel Damage page.
- Using the dropdown listboxes, choose *Axle 1, Left* to select the second trailer's left wheel.
- Click the *Wheel is Damaged* checkbox and the *Use DyMESH* checkbox to activate the *DyMESH* Wheel Impact model for the selected wheel.
- Edit the selected wheel's Force and Moment displacement characteristics: Enter Max No-damage Force = 200,000 lb, Displacement Rate = 20,000 lb/in, Max Force = 10,000,000 lb. Continuing on to the moment characteristics, enter Max No-damage Moment = 10,000 in-lb, Moment Displacement Rate = 20,000 in-lb/deg, Max Moment = 4,000,000 in-lb. NOTE: Selecting these values requires trial and error. Always start with large values, and then reduce them until the wheel/axle displacement is as expected.
- Press *OK*.

Before executing the *SIMON* simulation, let's set up our Key Results windows to monitor some important variables:

- If the Key Results windows are not displayed, choose the *Options* menu and click the *Show Key Results* option. The Key Results windows are now displayed for each vehicle.
- In the Key Results window for the 2014 Subaru Forester, click *Select...* The Variable Selection dialog is displayed.
- Click *Clear All Selections* to de-select all the current variables.
- Choose the *Kinematics* output group and select the following Kinematics variables: *X, Y, Z, Roll, Pitch, Yaw, V Tot, Sideslip, Acc Tot, Fwd Acc, Lat Acc, Vert Acc*.
- Choose the *Kinetics* output group and select the following Kinetics variables: *Fx Imp, Fy Imp, Fz Imp*,
- Click *OK* to add the selected variables to the Subaru's Key Results window.

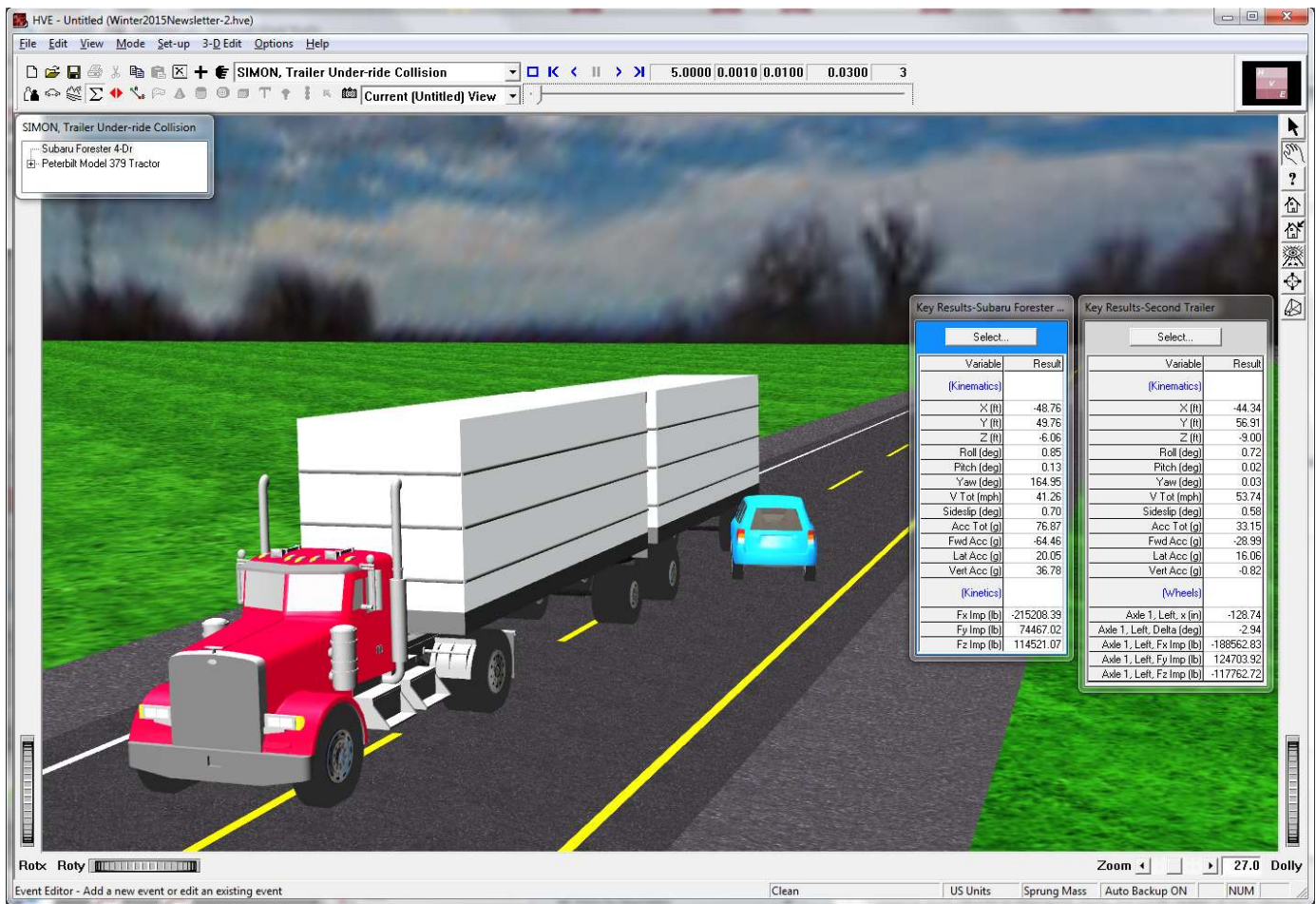


Figure 2 - SIMON simulation using the *DyMESH* Wheel Impact model. In this example, the SUV under-rides the second trailer and collides only with the trailer's left rear wheels.

Now, let's repeat the process for the second trailer:

- In the Key Results window for the the second trailer, click *Select...* The Variable Selection dialog is displayed.
- Click *Clear All Selections* to de-select all the current variables.
- Choose the *Kinematics* output group and select the following Kinematic variables: *X, Y, Z, Roll, Pitch, Yaw, V Tot, Sideslip, Acc Tot, Fwd Acc, Lat Acc, Vert Acc.*
- Choose the *Wheels* output group, Axle 1, Left. Then select he following Kinetics variables: *x, Delta, Fx Imp, Fy Imp, Fz Imp.*

NOTE: These *Fx imp, Fy imp, Fz imp* are the forces acting on the selected wheel, as opposed to the Kinetics output group values, which are total forces (the sum of forces on the sprung mass and the wheel(s)).

- Click *OK* to add the selected variables to the second trailer's Key Results window.

Now let's execute the *SIMON* event:

- Click the *Play* button in the Event controller.

The simulation runs to termination (see Figure 2, which shows the simulation during the impact phase). Replay the event a few times to gain an understanding of the basic crash sequence.

SIMON is including the collision forces and moments between the Subaru's left front corner and the trailer's left side dual tires. Look carefully at the Key Results displayed in Figure 2; you will notice those forces are displayed. Also displayed is the left wheel's x coordinate showing the collision has displaced it from its original position. Note also the wheel/axle now has a steer angle of -10 degrees as a result of the impact.

As the simulation runs to completion, notice how the collision forces and moments affect the dynamics of the entire tractor-doubles combination. After impact, the damaged (steered) trailer axle causes an interesting steering behavior.

Summary

This example shows an important application of the *DyMESH* Wheel Impact model. There is really no other way to rigorously analyze an under-ride collision involving the wheels of a semi-trailer. This simulation also shows that the resulting axle displacement and wheel steer angle can have an important effect on the post-impact dynamics of such a collision.

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. Thank you!

There's Still Time to Register!

2015 HVE Forum
March 2 - 6, 2015
Austin, TX

The 2015 *HVE* Forum offers a great selection of training workshops for beginning, intermediate and advanced users, along with User's Group Meetings, *HVE* White Paper Session and more. This is an excellent opportunity to learn how to use the full features and capabilities of your *HVE*, *HVE-2D* or *HVE-CSI* software, while expanding your network of resources at the same time! Another great benefit is pre-approval for 20 - 35 ACTAR CEUs depending upon your workshop selection over a 3 or 5 day period.

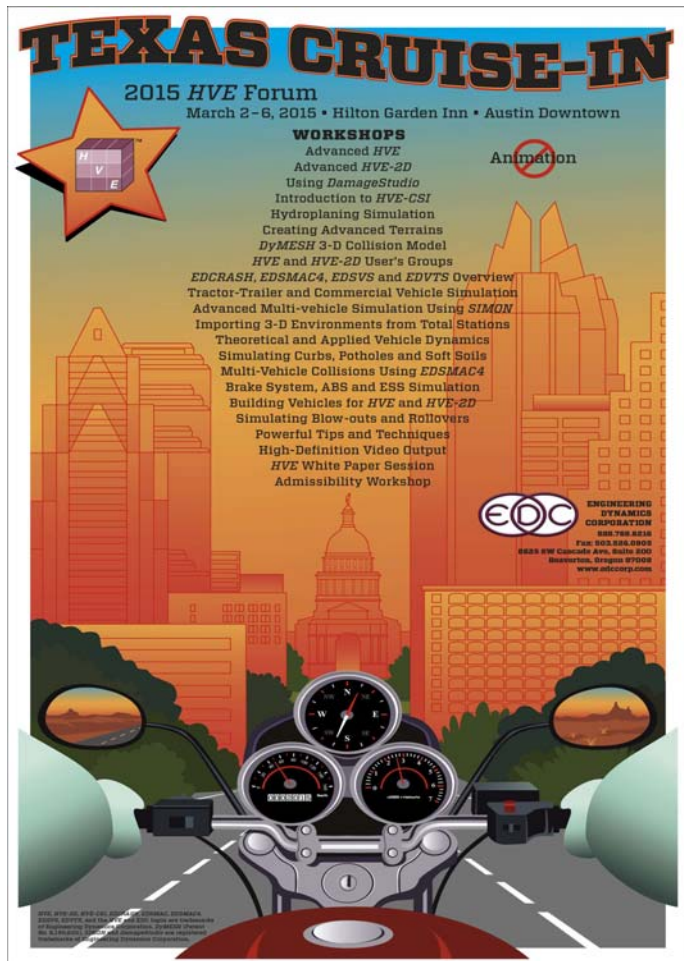
Venue Location

Check out this perfect location for the 2015 *HVE* Forum:

Hilton Garden Inn Austin Downtown
 500 N. Interstate 25
 Austin, TX 78701
 Phone 877.782.9444

Special Topic For 2015: Admissibility

This is the second year for our new Admissibility workshop. Its purpose is to provide a clear framework for *HVE* users wishing to have their *HVE* results admitted in state and federal courts. The focus of this workshop is on admissibility of *HVE* results, not on the more general subject of giving expert testimony.



The material covered in the workshop will include:

- Education of attorneys and judges
- Frye Test for the admissibility of scientific evidence
- Daubert Challenge of witness expertise

This session will be held on Wednesday during the lunch break to allow everyone at the 2015 *HVE* Forum the opportunity to attend. A box lunch will be provided.

Vehicle Building Class Updated

In one of the most popular and important Forum workshops, attendees learn how to build vehicles for *HVE* and *HVE-2D*. The class has been expanded to include instructions on adding vehicle light systems and textures.

Workshop Registration

Workshop schedules, descriptions and registration forms may be downloaded from the 2015 *HVE* Forum pages at www.edccorp.com/2015HVEForum.

EDC Simulations November 9 - 13, 2015 Miami, FL

EDC Simulations is an extensive one-week training seminar that offers an excellent way to learn the inner workings of *EDSMAC*, *EDSMAC4*, *EDSVS* and *EDVTS*. The course focuses on the physics models, the calculations and the underlying assumptions for each simulation's major calculation procedures.

EDC Simulations is designed like a college physics course - a combination of morning lectures and afternoon hands-on lab exercises. The fact that this course has been presented annually for over 25 years ensures that students benefit from a well designed and well executed week of instruction.

EDC Simulations has been pre-approved for 30 ACTAR CEUs. All course materials, including a handbook, training manual, software and temporary licenses will be provided to each student.

Bring your scientific calculator and laptop computer. Lab exercises include loss-of-control simulations, parametric studies, collision simulations and setting up the pre-impact phase of a 15-second crash sequence.

Links to download your course registration form and to make your hotel reservations at the Burbank Airport Marriot are available on the EDC Simulations page in the Training section of edccorp.com. Contact EDC at 888.768.6216 to sign up today!

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: When I import a custom Vehicle Geometry into HVE the geometry seems to always be slightly off, usually a little too high and too far forward, even though I have matched my vehicle's origin to the Total Mass CG location. What am I doing wrong?

A: When importing custom vehicle geometries into *HVE*, the geometry's origin must use the Sprung Mass CG location, not the Total Mass CG location, regardless of whether the user preference for Dimension Basis is set to Sprung Mass or Total Mass when the geometry is imported.

Q: After I execute an event (EDSMAC4, SIMON; it doesn't matter), I receive the message "Output Report Error. Cannot open resource file." Why?

A: *HVE* cannot find the resource files required by *EDSMAC*, *SIMON*.... This is an issue that sometimes occurs when multiple versions of *HVE* are installed on the same computer.

To resolve the problem, confirm that the environment variable "HVESYSFILES" is set to the location of your current *HVE* installation's "sys" folder.

Q: How do I display Key Results within the Video Creator Window?

A: It's easy! First, confirm that Show Key Results is selected in the Options menu. Then, click Variables... In the Video Creator. The Variable Selection dialog is now displayed. Choose the desired variables, just like you do for Key Results and Variable Output.

Q: The HVE installer hangs after entering in all my information and HVE never actually installs?

A: The most common reason for this problem is that your computer's firewall and/or virus protection is being over-vigilant. The easiest solution to this issue is to install *HVE* in Safe Mode. Why Safe Mode? Because most operating system background services, including your computer's virus protection, are not started when you boot in Safe Mode. Windows starts up with a limited set of operating system programs and drivers.

Q: How do I launch Windows in Safe Mode?

A: It depends on your computer's operating system:

Windows XP/VISTA/Windows 7 - When starting your computer, press F8 before the Windows screen appears. Use the arrow keys to choose the safe mode option.

Windows 8 - A lot has changed with the boot procedure in Windows 8 and Windows 8.1. The boot occurs so fast, the user is unable to interrupt it. Please refer to the following link for complete instructions:

<http://www.howtogeek.com/107511/how-to-boot-into-safe-mode-on-windows-8-the-easy-way/>

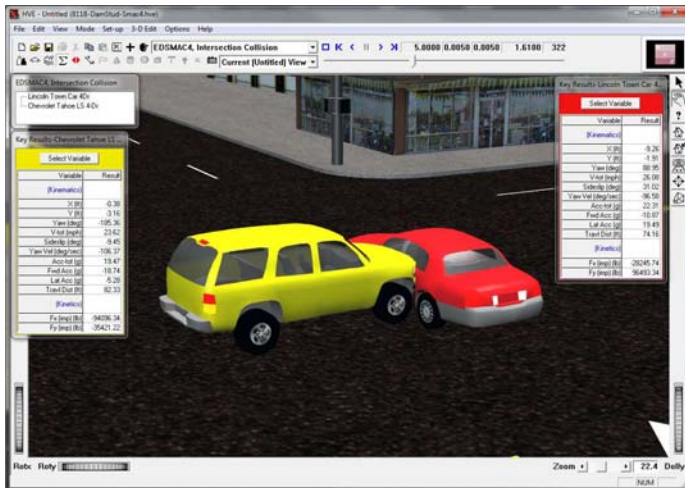
Q: My generic vehicle shows no damage in the Collision Data report, even though I can visually see the collision damage within my EDSMAC4 simulation. Why?

A: Generic vehicles must be tessellated. Otherwise, there are not enough vertices (a generic vehicle has only 40 vertices) to display any damage. To tessellate a vehicle, select it in the Event Editor and then click the Set-up menu and choose *Vehicle Mesh*. In the Vehicle

Mesh Options dialog click the *Tessellate* checkbox. The default value (20 inches) is suitable for most situations. *EDSMAC4* does not require you to tessellate generic vehicles because the visual mesh is not used in the physics calculations. But the Collision Data report needs the tessellated mesh because it uses the mesh vertex damage to calculate the CDC and related damage profile information; no vertex means no damage.

By the way, *EDSMAC4*'s "Traditional" Damage Data Format calculates the damage data using the collision routine's rho vectors. Thus, it does not require a tessellated mesh.

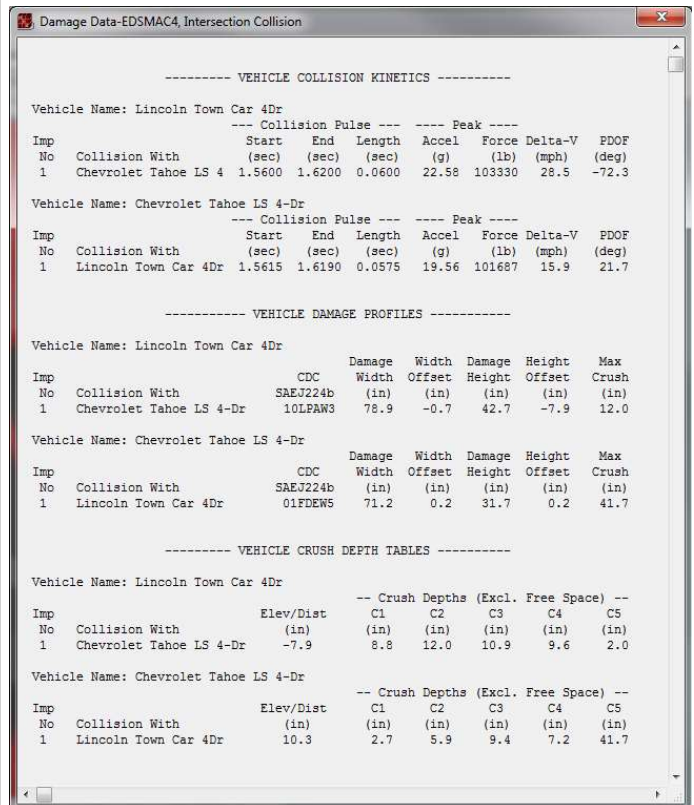
Visit the Support section of www.edccorp.com to download software updates and to view more FAQs from the Knowledge Base.



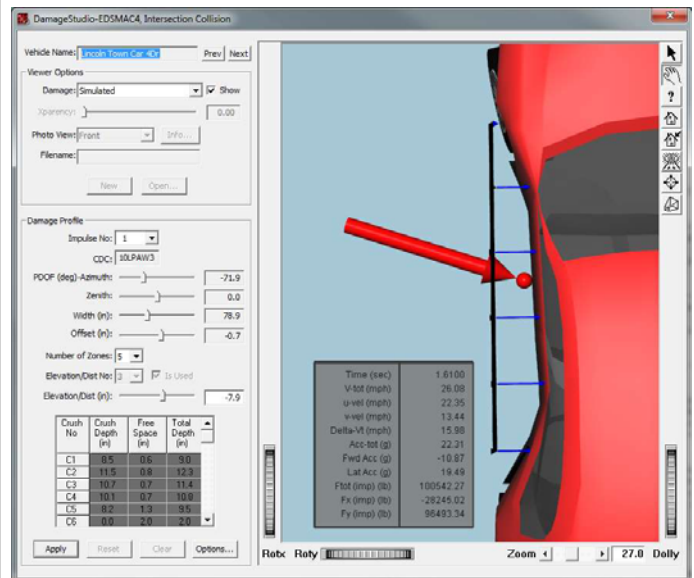
EDSMAC4 simulation displaying an intersection collision between an SUV and a passenger car.

Use *DamageStudio* to Improve 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. This example shows the Collision Data report and *DamageStudio* for the *EDSMAC4* simulation of the intersection collision shown above.



The *EDSMAC4* Damage Data report displays the Collision Data for the collision. The report is divided into three sections: Vehicle Collision Kinetics, Vehicle Damage Profiles and Vehicle Crush Depth Tables.



DamageStudio showing the collision damage results for the passenger car in our *EDSMAC4* intersection collision simulation. Note the Key Results window.

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 **EDC Simulations** courses are designed to fully investigate the inner workings of these *HVE*-compatible 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 lab exercises 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 HVE user interface.* For courses that focus on the *HVE*, *HVE-2D* or *HVE-CSI* user interface, check out the workshops at the *HVE* Forum.

HVE Forum

The **HVE Forum** offers over 30 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 Reconstruction

Miami, FL November, 2016
Los Angeles, CA January 18 - 22, 2016

EDC Simulations

Los Angeles, CA January 19 - 23, 2015
Miami, FL November 9 - 13, 2015

Theoretical & Applied Vehicle Dynamics

Upon Request

2015 HVE FORUM

Austin, TX March 2 - 6, 2015

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 888-768-6216 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 *HVE*-compatible physics programs. The list of *HVE* Training Partners may be found at www.edccorp.com.

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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