Technical Newsletter

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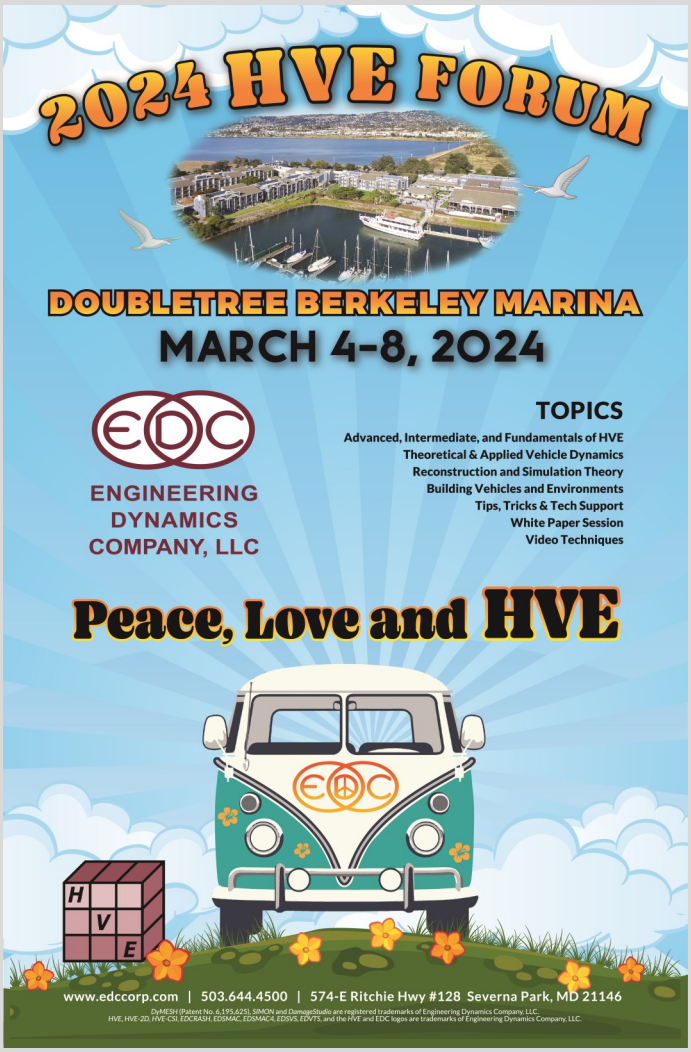
HVE 2023!

HVE 2023 SP1 is available for download! There are several updates and new features in HVE 2023 and SP1 that are listed on page 2 of this newsletter. There are also new vehicles available in the *EDVDB* vehicle database. The list of new vehicles is on page 8.



2024 *HVE* Forum

We were excited to be back in person at the 2023 *HVE* Forum and are looking forward to another great week at the 2024 *HVE* Forum. We are returning to the west coast and are excited to host the Forum at the beautiful DobuleTree by Hilton Hotel Berkeley Marina in Berkeley, California.

The *HVE* Forum is a great opportunity for all levels of users to learn how to use *HVE*. For workshop and hotel information and to register, go to www.edccorp.com or call 503-644-4500. We are happy to discuss the schedule options with you to select the workshops that maximize your week of learning.

New Features in *HVE*

There have been numerous features added to the *HVE* 2023 and SP1 releases. The changes include the following:

- A search feature has been added to the New Vehicle dialog allowing users to quickly find a vehicle in their databases.
- An option has been added to the Vehicle Editor's Sprung Mass dialog to allow the user to transform the vehicle geometry within HVE. The geometry can be translated, rotated, and scaled.
- A option to refresh the vehicle geometry file has been added to the Vehicle Editor's Sprung Mass dialog to re-import the vehicle geometry without having to go through the Geometry File->Open process.
- The Vehicle Wizard can now be used for non-generic vehicles.
- Multiple reports from an event can be added to the Playback Editor at the same time.
- All programs will run in the correct dimension basis (Sprung for 3D / Total for 2D) regardless of the setting; however, the setting is still available to be able to switch the reported values between Sprung and Total mass dimension based on the user's preference.
- The status bar now includes Autoposition, Key Results, Axes, Contacts, Skidmarks, Connections, Tracks, Targets, and Velocity Vectors. Click them to change their status!
- A file called "language_overrides.rsc" can store custom changes that will override values in the "language.rsc" file. This file will not be overwritten when HVE is updated, preventing custom changes from being overwritten.

New Features in *SIMON / DyMESH*

SIMON / DyMESH have several updates in the *HVE* 2023 release, including the following:

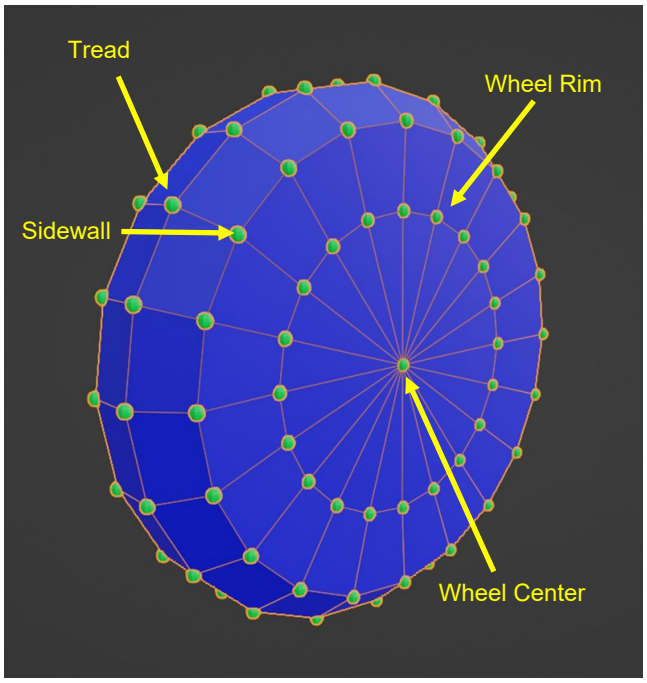
- The Wheel Data Damage Dialog now allows the wheel to be manually moved when DyMESH is used.
- The Wheel Data Damage Dialog now allows a start time for DyMESH wheel damage. This will prevent DyMESH from running for that wheel before the start time.
- The Wheel Data Damage Dialog now has an option to include the environment for wheel damage using DyMESH. This will allow the tire/wheel to interact with the environment geometry.
- A start time was added to the Radial Spring option in the Wheel Data Tire-Terrain dialog. This causes the simulation to use the Point Contact model until the start time is reached in the simulation.
- The integration time step used while DyMESH is active is set independently using the Vehicle Collisions value in the Simulation Controls dialog.
- The DyMESH Tire/Wheel impact model was updated. The number of angular increments for the DyMESH wheel model was increased from 20 to 80. The Wheel "B" stiffness used by DyMESH is based on the Displacement Rate set in the Wheel Damage dialog and the "A" stiffness for both Tire and Wheel is set to be 1/2 the "B" stiffness.

Technical Session - DyMESH Wheel Impact Model

SIMON has an option for tire and wheel collisions using the DyMESH collision algorithm. Each tire/wheel can interact with other vehicles, other tire/wheels, and the Environment.

New Feature!

The tire and wheel in DyMESH are made up of vertices along the tread, the outside edge of the sidewall, the wheel rim, and the center of the wheel. There are now a total of 80 slices; although only 20 are shown in the following image for clarity:

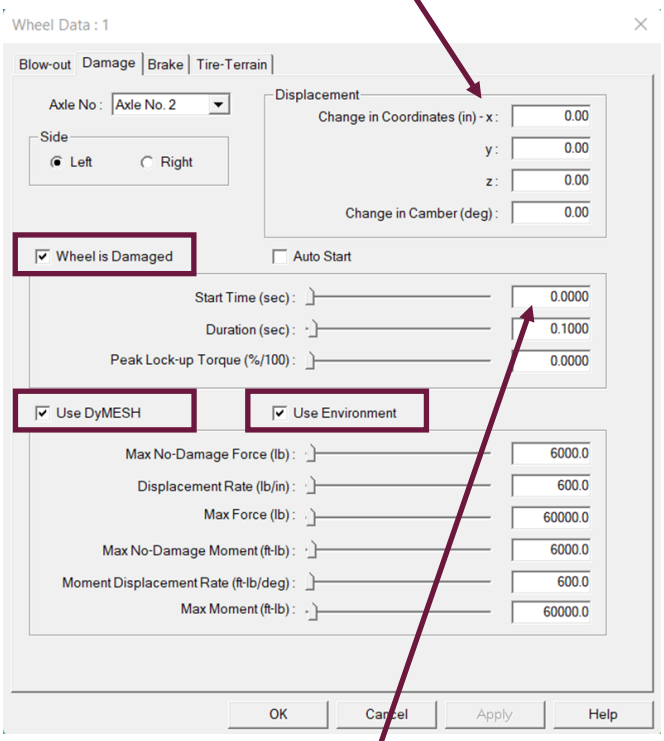


The DyMESH wheel impact model is turned on in the Wheel Data Damage dialog accessed under Setup -> Wheels…

Each wheel end can be activated separately using the Wheel is Damaged and Use DyMESH checkboxes interaction with other vehicles and wheels and the Use Environment check box for interaction with the environment.

New Feature!

Displacements can be used along with the DyMESH wheel impact model.



New Feature!

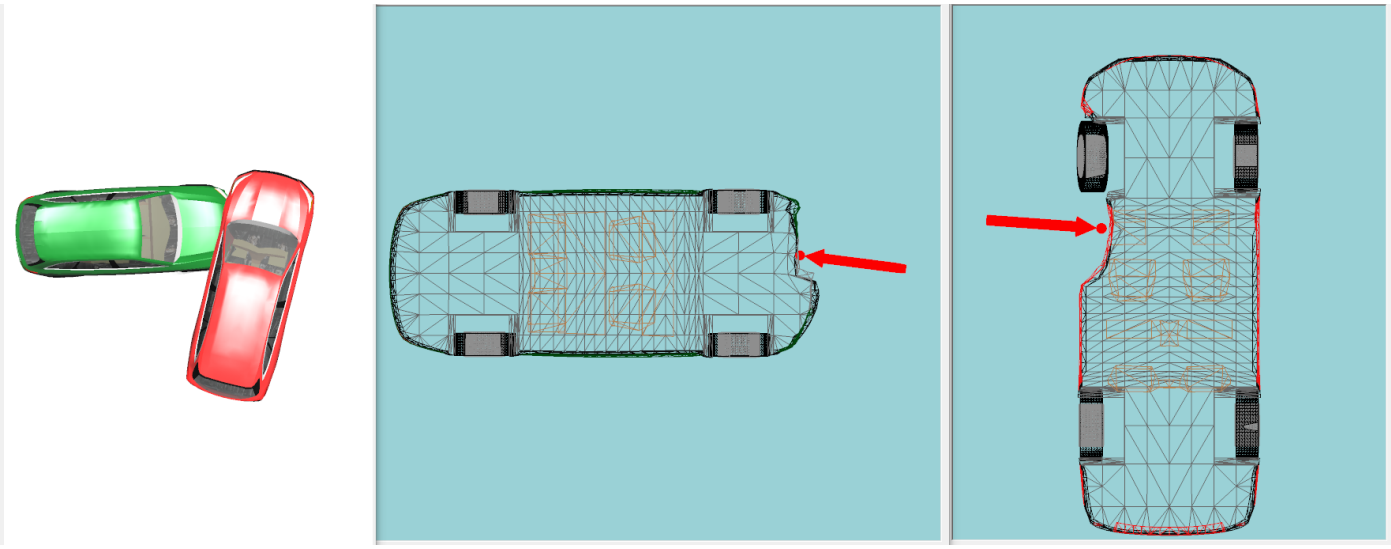
Start Time (sec) controls when the DyMESH wheel impact model is turned on. Auto Start will turn the DyMESH wheel impact model on when SIMON detects any impact with the vehicle.

Technical Session - DyMESH Wheel Impact Model continued

The Tire B stiffness is controlled by Initial Deflection Rate (lb/in) within the Tire Physical Data dialog accessed from the Vehicle Editor. Wheel B stiffness controlled by Displacement Rate (lb/in) within the Wheel Data Damage dialog. This allows the tire and wheel stiffnesses to be independently controlled for the collision being modeled. The A stiffness is set equal to ½ of the B Stiffness, which results in a linear force deflection response of the tire and wheel. When the Use Environment option is activated, the tire tread has a restitution of 1.0 when the tire is interacting with the environment, which results in a response similar to a radial spring tire model.

Example use - Impact into a stiff axle

When a vehicle strikes the axle area from the side, the area around the tire, wheel and axle is often much stiffer than the fenders, doors, and side panels. This can easily be modeled in SIMON / DyMESH by increasing the wheel displacement rate and resulting wheel stiffness. The image below shows the simulated damage in an impact with the green car going 30 mph and the red car stationary. The crush damage to the front of the green car is deeper in the area of the wheel impact as a result of the stiff wheel and soft side structure.



Technical Session—continued

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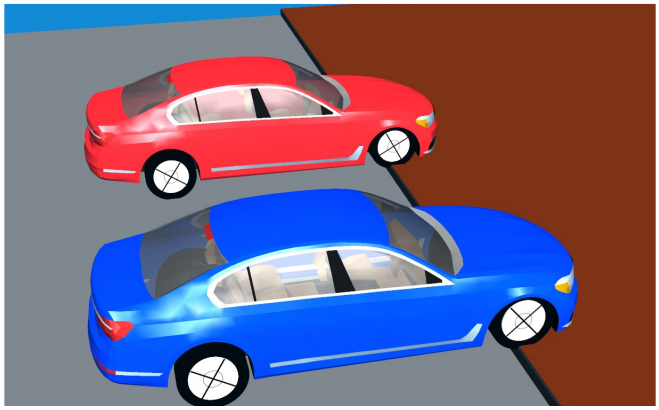
Example use - Curb, potholes, etc.

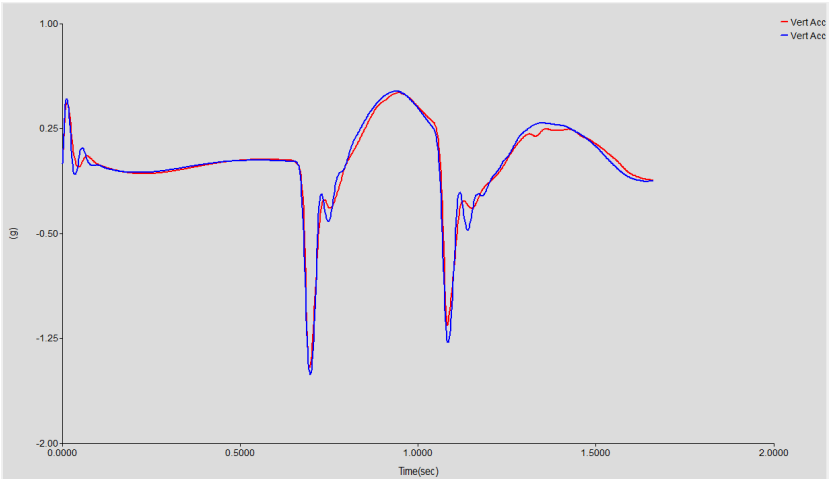
Driving over a curb, pothole, or similar vertical deviation is problematic for the point contact tire model as the tire contact point "jumps" up the change in elevation in a short time causing SIMON to terminate due to excessive tire deflections and forces. Previously the only way to simulate this type of event was to use the radial spring tire model. (For a description of the Radial Spring Tire Model, see the Winter 2005 newsletter). However, using the radial spring tire model can result in significant increases in simulation times.

Tip: New Feature!

Radial Spring Start Time (sec) was added to the Radial Tire Model to help improve simulation times.

These events can now be simulated with the DyMESH Wheel Impact Model using environment interaction. Simulations of the same vehicle driving over a curb using the Radial Spring Tire Model and the DyMESH Wheel Impact Model were performed and the results were compared and found to be in good agreement. The image to the right shows the vehicles driving over a 6 inch curb. The graph below shows the vertical acceleration of each vehicle (red is the Radial Spring Tire Model; blue is the DyMESH Wheel Impact Model.) It was also found that the DyMESH Wheel Impact Model resulted in faster simulation times when compared to the Radial Spring Tire Model.





EDC Reconstruction and Simulations Virtual Courses

The EDC Reconstruction Course is an extensive one-week training seminar that offers an excellent way to learn the inner workings of *EDCRASH*. EDC Reconstruction Course has been pre-approved for 35 ACTAR CEUs.

The EDC Simulations Course is an extensive one-week (Jan. 15 - 19 2024) training seminar that offers an excellent way to learn the inner workings of *EDSMAC, EDSMAC4, EDSVS and EDVTS*. EDC Simulations Course has been pre-approved for 35 ACTAR CEUs.

The courses focus on the physics model, the calculations and the underlying assumptions for each of the programs' major calculations procedures.

The courses are designed to be like a college physics course—a combination of morning lectures and afternoon hands-on lab exercises. The fact that these courses have been presented for over 25 years ensures that students benefit from a well designed and well executed week of instruction.

All course materials, including a handbook, training manual, software and temporary licenses, will be sent to each student.

Provide your scientific calculator and laptop computer. Four lab exercises include damage-only analysis, collinear head-on and rear-end collisions and oblique collision.

Links to download the course registration forms are available on the EDC Training section on www.edccorp.com.

Contact EDC at training@edccorp.com or call 503-644-4500 to sign up today!

Call for *HVE* White Papers

HVE users interested in presenting a technical paper in the *HVE* White Paper Session at the 2024 *HVE* Forum are invited to submit an abstract for consideration. This session is an opportunity for you to showcase your skills to other *HVE* users as well as to non-*HVE* users who may wish to hire you as a consultant. *HVE* White Papers are made available to download from the *HVE* White Paper library, providing excellent visibility for your work.

The following subjects will be considered:

- *HVE* Case Studies
- Innovative Tips and Techniques Using *HVE*
- Any Application of *HVE* Showcasing its Capabilities (especially events involving important 3-dimensional vehicle behavior)

If you are interested in contributing, please submit your abstract of 100 to 250 words in length to EDC. Please email complete contact information for the lead author with an abstract to forum@edccorp.com.

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 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 is available at www.edccorp.com.

FAQs

Q: I need to describe SIMON and DyMESH in a report, can you help?

A: SIMON incorporates DyMESH ®, a general-purpose, 3-D non-linear collision model for simulating vehicle-to-vehicle and vehicle-to-barrier collisions. DyMESH calculates 3-D forces and moments between the interacting meshes of each vehicle model. SIMON includes these collision forces and moments with suspension forces, aerodynamic forces, and inter-vehicle connection forces to produce the total vehicle-fixed forces and moments acting on the vehicle at each timestep. The resulting body damage is visualized as the 3-D mesh geometry changes during the event. (From: https://www.edccorp.com/index.php/hve-software/simon)

Q: When simulating a 2-vehicle collision in DyMESH, HVE reports the same collision forces for both vehicles. When I activate the DyMESH Wheel Impact model and execute the same event, there is about a 1000 lb. collision force difference between the vehicles, why?

A: The DyMESH wheel impact model is designed to transfer all vertical wheel impact forces through the vehicle's suspension which is why you see a difference in the collision forces between the vehicles when the DyMESH Wheel Impact model is activated.

Q: What are the most important specs to consider when ordering a new computer to maximize HVE's performance?

A: A good graphics card, high clock speeds and lots of RAM. More specifically, HVE prefers NVIDIA graphics cards and HVE physics programs execute on one core at a time, so having higher clock speeds is more important than more cores.

Q: When simulating an impact with a stopped vehicle, the stopped vehicle always experiences a minor acceleration during the initial few timesteps before there is any contact between the vehicles, why?

A: The blip in velocity you are seeing during the initial tenth of a second is the vehicle's tires and suspension settling. When creating a SIMON event, HVE's auto position places the edge of the unloaded tire on the environment's surface. At this point in time, before the event begins, both the tires and suspension are unloaded. Even though the initial suspension height represents the loaded suspension, SIMON hasn't had a chance to apply the vehicle's weight to the suspension or tires. When the event is executed, SIMON applies the sprung mass to the suspension and tires which causes a small temporary acceleration until both have settled. While there is no way to completely avoid this, you can reduce the amount of settling at the beginning of your simulation by turning Auto position off (under the #Options pull down menu) and manually lowering the initial position of your stopped vehicle a fraction of an inch. The exact amount will have to be determined by trial and error.

Q: Can HVE model motorcycles?

A: Yes! Please read the following papers for more information.

"Comparison of Computer Simulations and Reconstruction Methodologies for Motorcycle Accidents" 22nd Annual Congress of the European Association of Accident Research and Analysis, Paper 2013-07, October 2013.

HVE-WP2008-3, "Computer Simulation of Staged Motorcycle-Vehicle Collisions Using EDSMAC4" https://www.edccorp.com/library/HveWpPdfs/WP2008-3.pdf

SAE 2012-04-16 "Simulating Moving Motorcycle to Moving Car Crash" - https://www.sae.org/publications/technical-papers/content/2012-01-0621/

New Vehicles in the *EDVDB*

The following vehicles have been added to the *EDVDB* vehicle database since the last newsletter and available in *HVE* 2023.

Make/Model/Body Style	Model Years
Audi Q7 Premium Plus 4-Dr	2017 - 2023
Audi S4 4-Dr Sedan	2017 - 2023
BMW X5 M50i 4-Dr	2019 - 2023
Jeep Compass 4-Dr	2018 - 2021
Jeep Renegade 4-Dr	2015 - 2023
Land Rover LR2 4-Dr	2008 - 2015
Land Rover Range Rover Sport 4-Dr	2014 – 2022
Land Rover Range Rover Velar 4-Dr	2018 - 2023
Mazda 2 5-Dr Hatchback	2011 - 2015
Mercedes E350 4-Dr Sedan	2010 - 2017
Audi Q7 Premium Plus 4-Dr	2017 - 2023
Audi S4 4-Dr Sedan	2017 - 2023
BMW X5 M50i 4-Dr	2019 - 2023
BMW X6 M50i 4-Dr	2020 - 2023
Jeep Compass 4-Dr	2018 - 2021
Jeep Renegade 4-Dr	2015 - 2023
Land Rover LR2 4-Dr	2008 - 2015
Land Rover Range Rover Sport 4-Dr	2014 - 2022
Land Rover Range Rover Velar 4-Dr	2018 - 2023
Mazda 2 5-Dr Hatchback	2011 - 2015
Mercedes E350 4-Dr Sedan	2010 - 2017
Toyota Tacoma 4-Dr Dbl.Cab Std.Bed	2016 - 2023

If you have any specific vehicles that you would like to see added to the *EDVDB* vehicle database, please let us know by sending an email to vehicles@edccorp.com. We will do our best to try to add them to the database.

HVE Discussion Groups on LinkedIn

www.linkedin.com/groups/8809876

The *HVE* Users Group is a discussion group for users to ask questions, share knowledge, and discuss techniques. There will also be announcements made in the group regarding software releases, development, future training meetings, etc. Please take a moment to join.

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Severna Park, MD 21146 USA

Engineering Dynamics Company

Training Course Schedule

EDC Reconstruction

Virtual Course……2024 TBD

EDC Simulations

Virtual Course.. ……..January 15 - 19, 2024

2022 HVE Forum

Berkeley, CA……...March 4 - 8, 2024

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