EDC Technical Newsletter

Sand, Sea and HVE
2022 HVE FORUM

WORKSHOPS
Advanced *HVE*
HVE Admissibility
EDSMAC4
SIMON / DyMESH
Intermediate Simulations for *HVE* & *HVE-2D*
Simulation Fundamentals for *HVE* & *HVE-2D*
Advanced 3D Environments
3D Editor: Functionality, Friction Zones & Importing Models
BrakeDesigner
Tips, Tricks & Tech Support
HVE White Paper Session
Theoretical & Applied Vehicle Dynamics
Simulation Movies: HD Video Output
Advanced Video Techniques
Building a Vehicle for *HVE* & *HVE-2D*

ENGINEERING DYNAMICS COMPANY, LLC

February 21–25
Crowne Plaza at the Bell Tower Shops
Fort Myers, Florida

www.edccorp.com | 503.644.4500 | 550M Ritchie Hwy #128 Severna Park, MD 21146

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> *"Tell me and I forget, teach me and I may remember, involve me and I learn."*
> -Benjamin Franklin

HVE 2021!

HVE 2021 is available for download! There are several updates and new features that are listed on pages 2 and 3 of this newsletter. There are also new vehicles available in the *EDVDB* vehicle database. The list of new vehicles is on page 10.

2022 *HVE* Forum

Due to COVID-19, the 2021 Forum ended up as a virtual training. We are extremely optimistic that we will be back in person at the 2022 *HVE* Forum in Fort Myers, Florida during the week of February 21-25, 2022. We have again added some new workshops to the tried and tested workshops available at the Forum.

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 *HVE* since the *HVE* 2020 release in September 2020. The changes include the following:

- The Export Preview Case option allows users to export a case file for distribution. The resulting preview file (.hvp) can be opened in *HVE*; however, only the Playback Editor will be operational allowing all of the inputs/outputs reports to be viewed. The Human, Vehicle, Environment, and Event Editors are disabled preventing the case from being modified.

- A button called "Reset Defaults" has been added to the Technical Support dialog launched from the Help menu. This will reset the positions of the various dialog windows within *HVE* to their original positions. This is useful if you are unable to locate a dialog for example when switching from a two monitor to a one monitor setup.

- A checkbox was added to the User Preferences dialog to allow users to choose if the date/time information should be included when reports are printed from the Playback Editor.

- A checkbox was added to the User Preferences dialog giving users the option to store vehicle geometries internal to the case file. This allows case files to be distributed without having to include the vehicle geometries as separate files. For distribution files (.hvp), the vehicle geometry files are automatically embedded in the case file, prevents access to the underlying vehicle geometry file, and protects any copyright.

- Clicking on the integration timestep, playback timestep, or maximum time fields on the playback toolbar within an Event Editor automatically opens the Simulation Controls dialog and places focus on the appropriate field to make it easier to change these values. Clicking on the current time field on the playback toolbar in the Event Editor or the Playback Editor allows a specific time to be entered and the simulation will change to that time.

- The DeltaV and PDOF calculations in Damage Studio were updated. The PDOF was previously the angle of the force at the peak force. The PDOF is now calculated at each output time step based on the impulse direction up to that time. The DeltaV was previously calculated by integrating the total acceleration over time. The DeltaV is now calculated by integrating each direction over time and finding the resultant.

- The calculations for DeltaV and PDOF reported in the Damage Data Report for *EDSMAC4* and *SIMON* were updated. The PDOF was previously the angle of the force at the peak force. The PDOF is now based on the impulse direction at the end of the impulse. The DeltaV was previously calculated by integrating the total acceleration over time. The DeltaV is now calculated by integrating each direction over time and finding the resultant. Previously the end of an impulse was set when there were no longer impact forces. This is still the case if the Accident History Basis is set to Force. However, now if the Accident History Basis is set to Acceleration, the end of an impulse is set when the total acceleration drops below the Threshold (g) value set in Calculation Options. (Note that with these changes the Damage Data report is now consistent with how the separation time is set in Accident History).

- Termination velocity conditions in *EDSMAC4* and *SIMON* were updated so that if the termination linear and angular velocities are set to zero, the simulation will not terminate when all vehicles are stopped. This allows all vehicles to be stopped at the beginning of a simulation and all vehicles to stop during a simulation without the simulation terminating. A stopped vehicle is still free to move as a result of throttle application or an impact.

- The stopped vehicle conditions in *EDSMAC4* and *SIMON* were updated to reduce or eliminate sliding when vehicles are stopped. A stopped vehicle is defined as 0.1 mph over the termination linear velocity setting and 1/2 deg/sec above the termination angular velocity setting. This prevents vehicles from sliding when the termination velocities are set to zero.

- Towed vehicle velocities and sideslip can be entered independent of the tow vehicle in *SIMON*. If the towed vehicle velocity is left as '0' it will use the tow vehicle velocities in the same manner as previously. This allows users to start simulations with towed vehicles already sideslipping.

- An entry box for the minimum time when a connection failure can occur was added to the Calculation Options menu in *SIMON*. This will prevent a connection from failing due to high forces/moments during earlier timesteps.

- Vehicles with no axles can be added in the vehicle editor for use in *SIMON*.

- A new tire model option (Semi-Empirical V3) was added to the Calculations Options. The new tire model includes the following updates. Camber and cornering forces are set to zero for low wheel speeds (spin velocity times tire radius less than 24 inches per second). The tire roadway coefficient of friction is not able to exceed the peak friction value.

- The contact search routine used by *SIMON* to determine if DyMESH should be called was updated. The new routine may add to the simulation time in some scenarios; however the effect should be minimal or not noticeable in most cases. The new routine should fix cases, usually with severe roll or pitch, in which vehicle meshes had overlapped without generating contact.

- A checkbox was added to the DyMESH Options dialog to allow contact between a tow vehicle geometry and its trailer geometry. This should be used carefully as this may cause unintended connection forces.

- Entries were added to the DyMESH Options dialog to set a start time for DyMESH and a separate start time for environment contact. This is extremely helpful for body to environment contact (rollovers) as it can reduce the simulation times. Also, this option can be used to prevent the tractor/trailer contact until a set time for when the trailer contact option is used.

Technical Session - Jackknifed Tractor-trailer

Tip #1

You can now enter the current time directly in the time field in the playback toolbar!

Although simulating jackknifed tractor-trailers is not new to *HVE*, several of the new features in *HVE* improve and expand the capabilities when simulating a jackknife event.
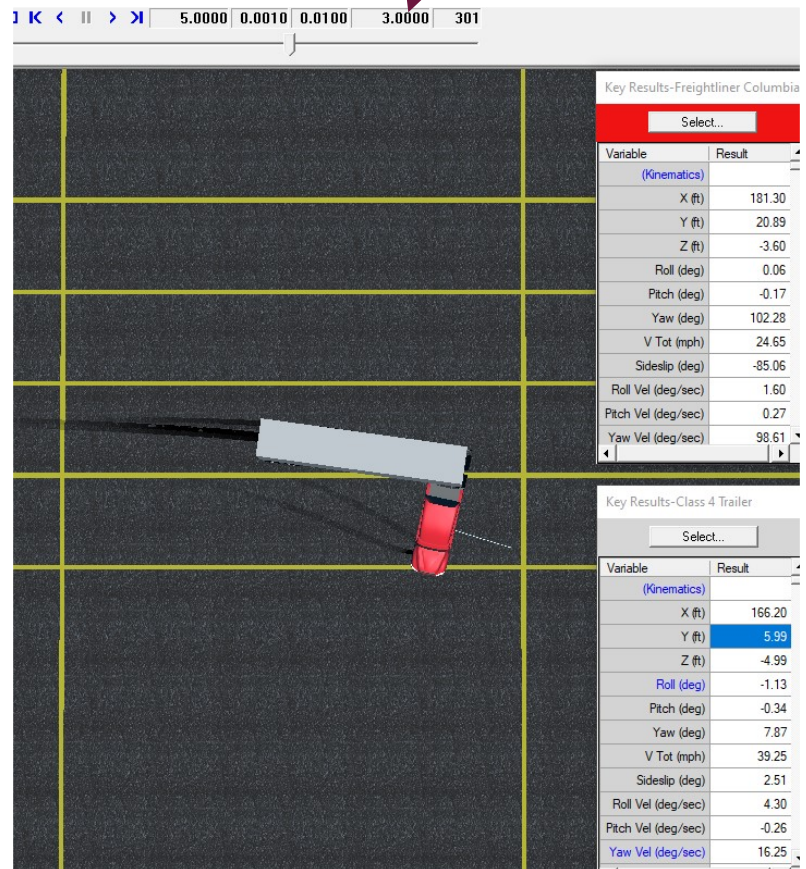
How to start a simulation with a tractor-trailer already jackknifed.

Let's assume you have the jackknife conditions shown to the right. You can now create a simulation with the conditions shown as the starting values.

The tractor position, orientation and speed are set as is typically done. The orientation of the trailer is set as is typically done; however, the selecting the Velocity is Assigned option now allows the starting speed of the trailer to be set to a different magnitude and direction than the tractor.

Technical Session—Jackknife continued

The simulation now starts with the tractor-trailer already in a jackknifed condition as shown to the right.

Tip #2

Make sure to change the Max Articulation yaw angle for the tractor's connection to allow the trailer to jackknife.

Key Results-Freightliner Columbia	
Select...	
Variable	Result
(Kinematics)	
X (ft)	181.30
Y (ft)	20.89
Z (ft)	-3.67
Roll (deg)	0.00
Pitch (deg)	0.00
Yaw (deg)	102.28
V Tot (mph)	24.65
Sideslip (deg)	-85.04
Roll Vel (deg/sec)	0.00
Pitch Vel (deg/sec)	0.00
Yaw Vel (deg/sec)	98.61

Inter-vehicle Connections:...

Front Connection
Type : None
Coordinates (in) - x : 130.5
y : 0.0
z : 0.0

Rear Connection
Type : Fifth Wheel
Coordinates (in) - x : -152.4
y : 0.0
z : -3.0

Properties...
OK   Cancel

Connection Properties: Freightliner Colu...

Radius (in) : 18.000
Friction : 0.050

Linear
Free Play (in) : 0.000
Stiffness (lb/in) : 19055.0
Damping (lb-sec/in) : 484.7
Breakaway Force (lb) : 1000000.0

Angular
Max Articulation (deg) - Roll : 0.0
Pitch : 30.0
Yaw : 180.0
Stiffness (in-lb/deg) : 12000000.0
Damping (in-lb-sec/deg) : 2.1
Breakaway Torque (ft-lb) : 1000000.0

OK   Cancel

Key Results-Class 4 Trailer	
Select...	
Variable	Result
(Kinematics)	
X (ft)	166.18
Y (ft)	6.02
Z (ft)	-5.01
Roll (deg)	0.00
Pitch (deg)	-0.31
Yaw (deg)	7.87
V Tot (mph)	39.00
Sideslip (deg)	2.51
Roll Vel (deg/sec)	0.00
Pitch Vel (deg/sec)	0.00
Yaw Vel (deg/sec)	16.25

How to simulate the contact between a tractor and trailer in a jackknifed condition.

Executing the simulation shown will result in the tractor geometry overlapping the trailer geometry even if DyMESH is turned on. With the new Tow Vehicle / Trailer Contact option you can now simulate the contact between the tractor geometry and the trailer

DyMESH Options - SIMON, Trailer Swing DyMESH
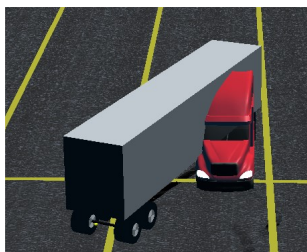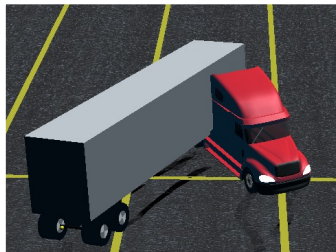
☑ Use DyMESH
☐ Include Environment
☐ Force To x-y Plane
☑ Tow Vehicle / Trailer Contact

DyMESH Version No :
○ Version 3
● Version 4

DyMESH Start Time (sec) : 0.0000
DyMESH Environment Start Time (sec) : 0.0000

Search
Option :
○ Automatic
● Set Box Size   (in): 20.00

Force Smoothing
Option :
○ Version 1 and 2
● Version 3 and Later

OK   Cancel

No Contact   *Contact*

Tip #3   geometry.

**Don't forget to tesselate the trailer geometry.**

Technical Session—Jackknife continued

Note that allowing contact between the trailer geometry and tractor geometry may cause unintended impact forces. For example if there is overlapping geometries at the start of the simulation, such between the fifth wheel and trailer. DyMESH will simulate impact forces between the geometries and these will affect the connection forces.

How to prevent DyMESH from executing until the jackknifed condition causes the trailer to contact the tractor.

Because the tractor geometry and trailer geometry are in close proximity to each other at the start of a simulation, DyMESH may be executed from the first time step causing longer than normal execution times. The new DyMESH Start Time option can be used to prevent DyMESH from running until a specific time, for example right before the trailer geometry contacts the tractor geometry as a result of the jackknife.

The Key Results in the example simulation with a DyMESH Start Time set to 0.33 sec shows at time 0.33 sec there are no impact forces and at time 0.34 sec there are impact forces.
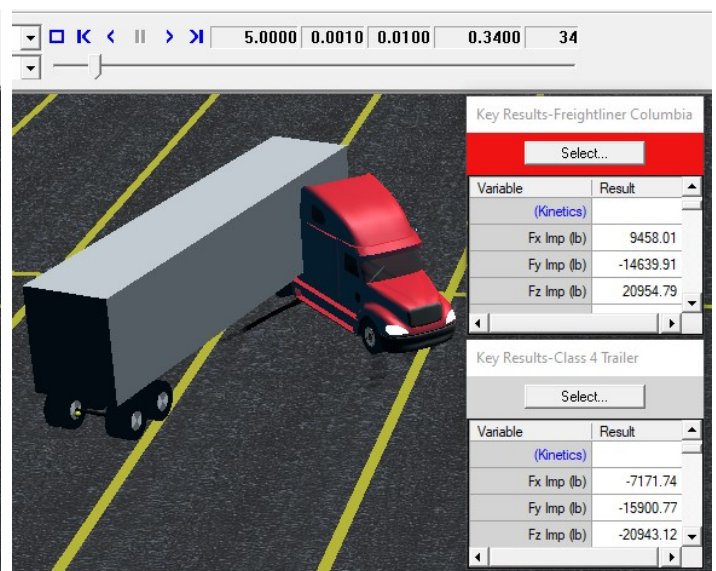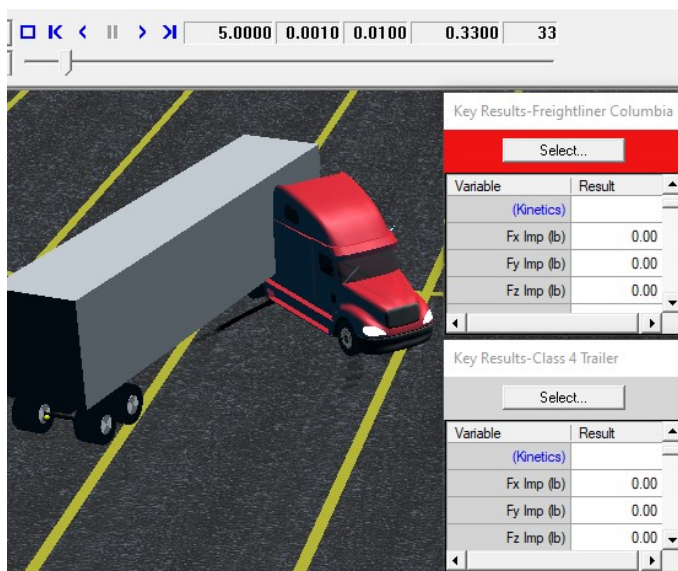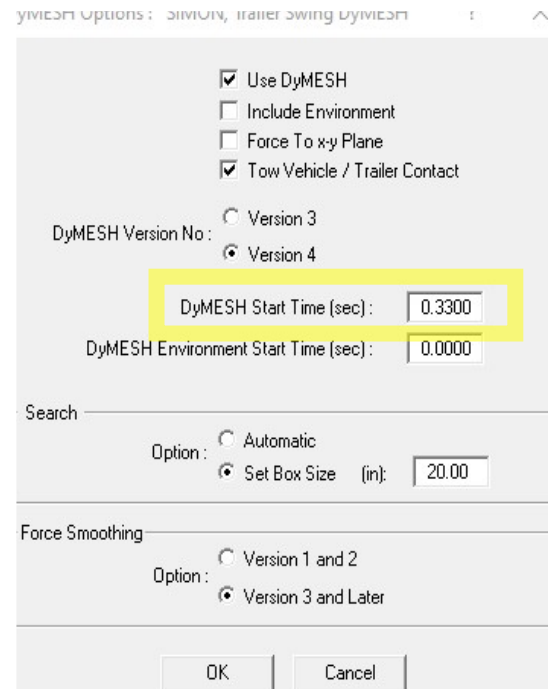
Technical Session—Jackknife continued

How to simulate a trailer separation resulting from a jackknifed condition.

Assume that you know when the tractor-trailer connection fails causing the trailer to separate. You can use the Connection Failure Start Time option in *SIMON* to simulate the separation. To ensure that the separation occurs, set the Breakaway Force or Torque to a value less than the simulated connection force or torque at the time of the separation.

Connection Properties: Freightliner Colu... ✕

Radius (in) :	18.000
Friction :	0.050

Linear

Free Play (in) :	0.000
Stiffness (lb/in) :	19055.0
Damping (lb-sec/in) :	484.7
Breakaway Force (lb) :	1000.0

Angular

Max Articulation (deg) - Roll :	0.0
Pitch :	30.0
Yaw :	180.0
Stiffness (in-lb/deg) :	12000000.0
Damping (in-lb-sec/deg) :	2.1
Breakaway Torque (ft-lb) :	1000000.0

OK   Cancel

Calculation Options: SIMON, Separation   ✕

Tire Model Method :
- ○ Semi-Empirical, Vers 1
- ○ Semi-Empirical, Vers 2
- ◉ Semi-Empirical, Vers 3

Steer DOF :
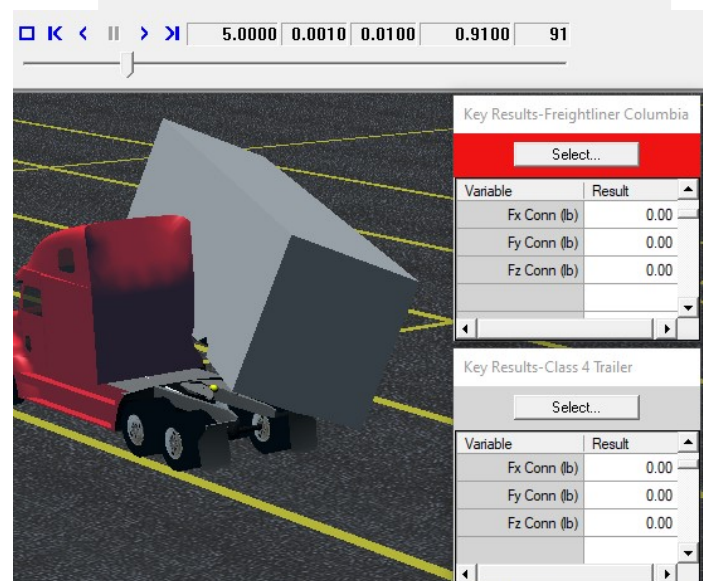- ◉ Off
- ○ Normal
- ○ Append
- ○ AutoStart

Hydroplaning Model :
- ◉ Off
- ○ NASA
- ○ NASA-TTI
- ○ Gallaway

Connection Model :
- ○ Use Both Vehicles
- ◉ Use Heavier Vehicle
- ○ Use Tow Veh Properties

Solid Axle Inertia :
- ○ Use Axle Only
- ◉ Use Axle + Wheels

Acccident History Basis :
- ◉ Force
- ○ Acceleration
- Threshold (g) : 1.00

Connection Failure Start Time (sec) : 0.45

□ K ‹ II › ›I   5.0000 0.0010 0.0100   0.9100   91

Key Results-Freightliner Columbia

Select...

Variable	Result
Fx Conn (lb)	0.00
Fy Conn (lb)	0.00
Fz Conn (lb)	0.00

Key Results-Class 4 Trailer

Select...

Variable	Result
Fx Conn (lb)	0.00
Fy Conn (lb)	0.00
Fz Conn (lb)	0.00

EDC Reconstruction
November 8 - 12, 2021
Virtual

The EDC Reconstruction Course is an extensive one-week training seminar that offers an excellent way to learn the inner workings of *EDCRASH*. The course focuses on the physics model, the calculations and the underlying assumptions for each of the program's five major calculations procedures.

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

EDC Reconstruction Course has been pre-approved for 35 ACTAR CEUs. 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 your course registration form are available on the EDC Reconstruction Course page in the 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 2022 *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: Is it possible to simulate the effect of a gust of wind on the side of a trailer?

A: The best way to simulate a wind gust against the side of a vehicle is to use the Collision Pulse option within *SIMON*. Within the Event Editor select the desired vehicle and then click #Set-up > #Collision Pulse. Here one can enter the Force and Moment vs Time data to simulate the effects of a wind gust. We recommend reading *HVE* White Paper 2008-1 "Application of *HVE SIMON* to the Analysis of Lateral Wind Loading on High-sided Vehicles" by William Blythe which can be found on www.edccorp.com. *HVE*'s Environment Editor does allow one to enter Wind Speed and Direction which is used to calculate aerodynamic drag but at this time that cannot be used to simulate lateral forces. For more information on applying a Collision Pulse please look at pages 2-26 through 2-28, 4-40 through 4-45, and 16-26 of the *HVE*-User's manual.

Q: One of my Key Results dialogs are missing, how can I get it back?

A: First ensure that the Key Results option is checked under the #Options pull-down menu. Assuming it is, click #Help > #Tech Support, from the top pull-down menu to bring up the EDC Technical Support dialog. Here you will find the "Reset Defaults" button at the bottom right-hand corner of the support dialog. When selected, this will force all open dialogs to return to their original locations, including the Key Results windows.

Q: My simulation displays damage within the Event Editor but when I look at the Damage Data report or Damage Studio no damage is displayed, why?

A: When using a generic vehicle geometry, one must add tessellation for *HVE* to report damage within the Playback Editor. This can be accomplished within the Event Editor by selecting the desired vehicle and then clicking #Set-up > #Vehicle Mesh, from the top pull-down menu. Within the Vehicle Mesh Options dialog click the Tessellate box and enter the desired amount of tessellation. The default value of 20 inches will be enough for damage to be reported within the Damage Data report and Damage Studio.

Q: Can I add a vehicle to an existing event?

A: One is not able to add or subtract vehicles from an existing event, but one can swap out vehicles. This can be done by first adding the desired vehicles within the Vehicle Editor and then within the Event Editor reset the event and click #Mode > #Information, from the top pull-down menu. Within the Event Information dialog take note of the order of the vehicles within the Event Humans and Vehicles list and then unselect all vehicles within the Vehicle List. Now add the desired vehicles from the Vehicle List in the same order as before but select the new vehicle you would like to add in place of the vehicle you want to replace. The only stipulation is that the vehicles being swapped must have the same drive axle(s) and engine location.

New Vehicles in the *EDVDB*

The following vehicles have been added to the *EDVDB* vehicle database since the last newsletter and available in *HVE* 2021.

Make/Model/Body Style	Model Years
BMW X3 xDrive28i 4-Dr	2011 - 2017
Lexus IS250 4-Dr	2014 - 2020
Subaru WRX 4-Dr	2015 - 2020
Subaru Outback 4-Dr	2020 - 2021
Subaru Crosstrek Ltd 4-Dr	2018 - 2020
Toyota Avalon XLE 4-Dr	2013 - 2018
Hyundai Genesis AWD 4-Dr	2015 - 2016
Genesis G80 AWD 4-Dr	2017 - 2020
Chevy Silverado 1500 CrewCab	2019 - 2021
GMC Sierra 1500 CrewCab	2019 - 2021
Jeep Wrangler Sahara 4-Dr	2018 - 2021

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.

Engineering Dynamics Company

Training Course Schedule

EDC Reconstruction

Virtual Course….……November 8-12, 2021

EDC Simulations

Virtual Course.. ……...January 17-21, 2022

Theoretical & Applied Vehicle Dynamics

Upon Request

2022 HVE Forum

Fort Myers, FL.……....February 21-25, 2022