Technical Newsletter

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

HVE 2019!

HVE 2019 will be available in October. The big news is that it includes the tools to make a point cloud terrain truly useful for simulation. A really cool tool, called Scissors, allows the user to cut the terrain into pieces and change (increase or decrease) the number of polygons in each region. This new tool is the subject of our Technical Session (see Page 2). *HVE* 2019 is currently in beta. Contact EDC if you are interested in participating the *HVE* 2019 Beta Program.

HVE 2019 also includes several new vehicles and tires in the EDC Custom Database. See page 6 for a list of the new vehicles and tires.

All users with a current Update/Support policy will automatically receive their upgrade to *HVE* 2019. There will also be an attractive promotion for users with an expired Update/Support policy.

2020 HVE Forum

The *HVE* Forum returns to Austin, Texas, during the week of February 24 - 28, 2020. We were there in 2015, and the venue is excellent, on the end of Sixth Street (if you are familiar with Austin, you'll know that Sixth Street is the center of an amazing music scene).

The *HVE* Forum is the best way to advance your knowledge and skill using *HVE*, as well as to stay up to date on the latest program features. There are more than 30 individual workshops for all levels of users. Evening social hours provide a great opportunity to network with other *HVE* users.

The *HVE* Forum focuses on *HVE*'s user interface (navigation, creating vehicles and environments, making movies, and other creative tasks that take advantage of *HVE*'s powerful feature set).

For workshop and hotel information and to register, go to edccorp.com/HVEForum or call 888-768-6216. We are happy to discuss the workshop options with you to select the workshops that maximize your week of learning.

Technical Session

This Technical Session introduces a new tool, called *Scissors*, the backbone of a very effective way to quickly import environment terrains created from point clouds and immediately drive on them using simulation.

Background

A point cloud is a set of millions of points that can be used to visualize a 3-D environment. A point cloud can be created using a laser scanner (e.g., Faro) or a moving drone (e.g., Pix4D) that flies over the environment. A point cloud also contains color information for each of the points. Thus, the point cloud can look like a very realistic representation of a crash site.

Point clouds are not perfect. Three major issues are:

Artifacts – The point cloud often contains unwanted objects that need to be removed. This is especially true near the edges of the scanned area, but can also occur anywhere on or above the terrain's actual surface.

Surface Noise – The scanned surface of a perfectly flat highway will not be perfectly flat. Rather, it will resemble a gravel road (i.e., bumpy). This is a problem because a vehicle simulation "drives on" this surface, and driving on a flat interstate freeway is quite different from driving on a flat gravel road.

Millions of Points – The point cloud contains millions of points. This level of resolution is great for detailed definition of features, such as curbs and potholes. But such resolution is unnecessary for a flat highway, and it significantly slows down execution (the simulation's tire model interacts with the surface and needs to search the entire point cloud database to identify exactly where on the surface the tire is interacting at any point in time).

Another issue with point clouds was alluded to above: A simulation's tire model needs to interact with polygons, not points. That's because the tire model needs the exact elevation, surface normal and friction factor for the surface that the tire is currently interacting with. That information cannot be obtained directly from points. Therefore, the point cloud needs to be "meshed," that is, the points are used to define triangles that represent the surface. It would be possible to import the point cloud, and then have *HVE* convert the points into a mesh. We have chosen not to implement that functionality because the process of meshing the points is already available in the post-processing software used by most scanner and aerial drone systems. When the surface is meshed, care needs to be taken that the color and detail are not removed.

Scissors

The new Scissors tool is included in the 3-D Editor's Surface tool. It allows the user to cut out a region of the selected surface and create a new surface object. Importantly, the water-tight connectivity to the original surface is maintained (i.e., there are no gaps) when the new surface object is created. This new surface can also be smartly decimated (more on this later).

The Surface Editor now has four pick modes: *Object*, *Face*, *Vertex*, and the new *Scissors* mode. When *Scissors* mode is selected, the user can click at various points on the current surface object, leaving markers that define an area to be removed from the current surface object and become a new and separate object.

Decimation

The new surface object can now be *decimated*. Decimation reduces the number of polygons, thus, speeding up execution. But the polygon count needs to be reduced smartly. This involves the implementation of two new and very important technologies:

Removing noise (artificial irregularities in the surface due to errors in data acquisition during scanning). An intelligent smoothing algorithm is employed for this purpose.

Not removing the pothole (or curb, or other actual irregularity in the terrain that is important to the simulation). The smoothing algorithm includes an intelligent method to interpret elevation changes that allows it to distinguish noise from real elevation changes.

The amount of decimation is assigned using a qualitative range from 0 (no decimation) to 1 (maximum decimation). In practice, the intelligent algorithm allows the user to set the Decimation range very close to 1, thus maximizing the speed of execution.

How-to

The typical approach to using these new tools is:

- Import the densely tessellated (i.e., millions of polygons) surface, setting the default surface type to *Other* so the simulation's tire model won't see it.
- Use the Scissors tool to 'cut out' the portion of the surface to be driven on. This region becomes a new and separate object that is seamlessly connected to the original surface object.
- Change the surface type from *Other* to *Road*. Now the tire model will 'see' this surface, but not the surrounding surface.

- Decimate the new surface to reduce the number of polygons the tire model needs to search.

After performing these simple steps, the environment now contains two surface objects: The densely tessellated (and highly detailed) outlying area of type *Other* (so the simulation's tire model won't consider it) and a sparsely tessellated and (smartly) smoothed area of type *Road*, which the tire model will use.

The seam connecting the two surface objects is water-tight.

Tutorial

Let's use an example to illustrate the use of Scissors and Decimation. Before we get started, we'll describe the surface to be imported. It started as a point cloud created using an aerial drone. The points were converted to VRML and surfaced using Photoscan. The result is a VRML mesh and a JPEG texture map. These files were placed in *HVE*'s Environment folder. It should be noted the above steps are essentially the same when using a laser scanner to create the point cloud.

Now, let's get to work.

- Start *HVE*
- Add an environment and open the DroneTerrainExample.wrl terrain file.
- Change the Default Type to *Other* (we discussed the reason for this smart move earlier in this Technical Session).
- Press *OK*. The terrain is displayed in the Environment viewer. See Figure 1.
- Click *3-D Edit* menu option and launch the 3-D Editor. The terrain is displayed in the 3-D Editor perspective viewer.
- Click on the terrain. The red bounding box indicates the surface object is selected. The Surface Editor dialog is displayed. The default Pick Mode is *Object*. The Object Attributes dialog shows the Type is *Other*. See Figure 2.
- Change the Pick Mode to *Scissors*. The cursor changes to a crosshairs, indicating we're in Scissors mode.

Now, let's decimate the driving surface.

- Click on the surface in several locations to choose the desired region to cut out of the original surface. See close-up in Figure 3.
- Click *Apply*. The red bounding box now surrounds the Scissored area, indicating it is selected.

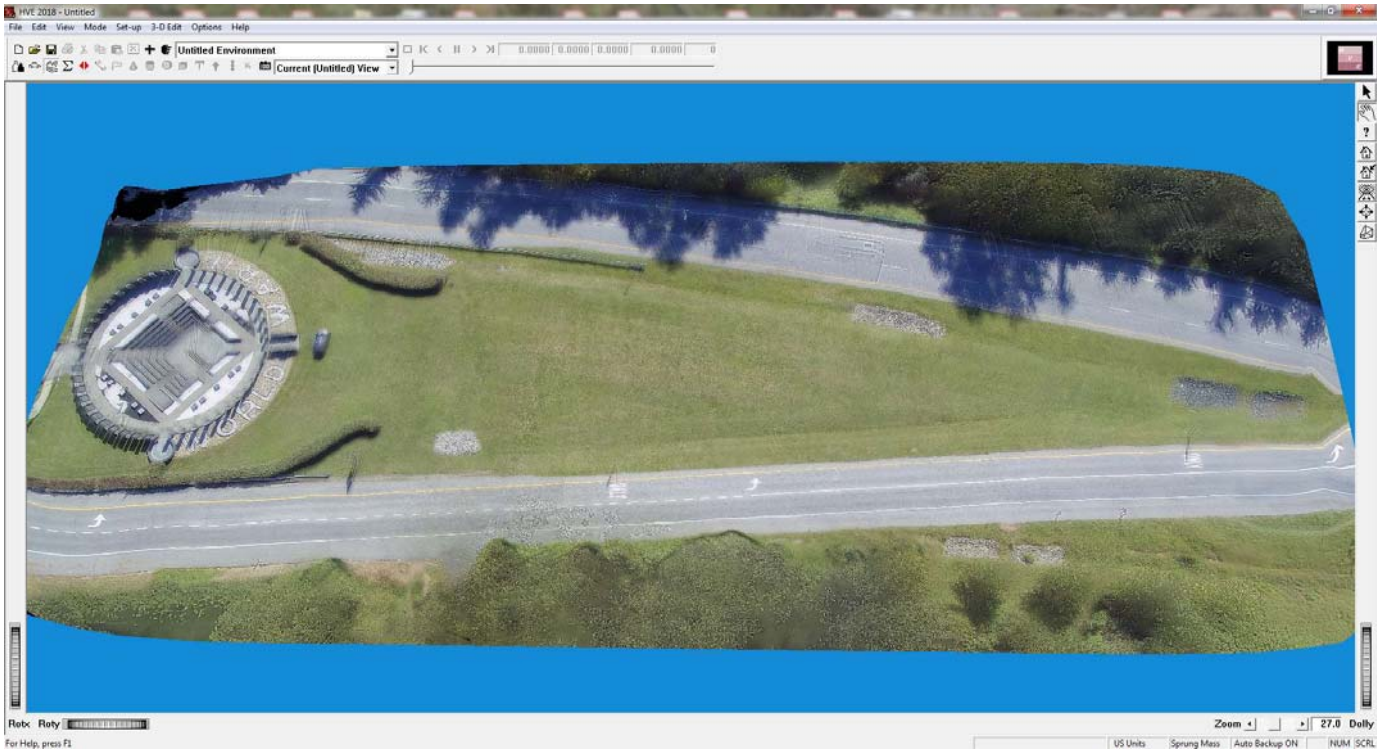

Figure 1 - Meshed point cloud terrain displayed in the Environment Viewer.

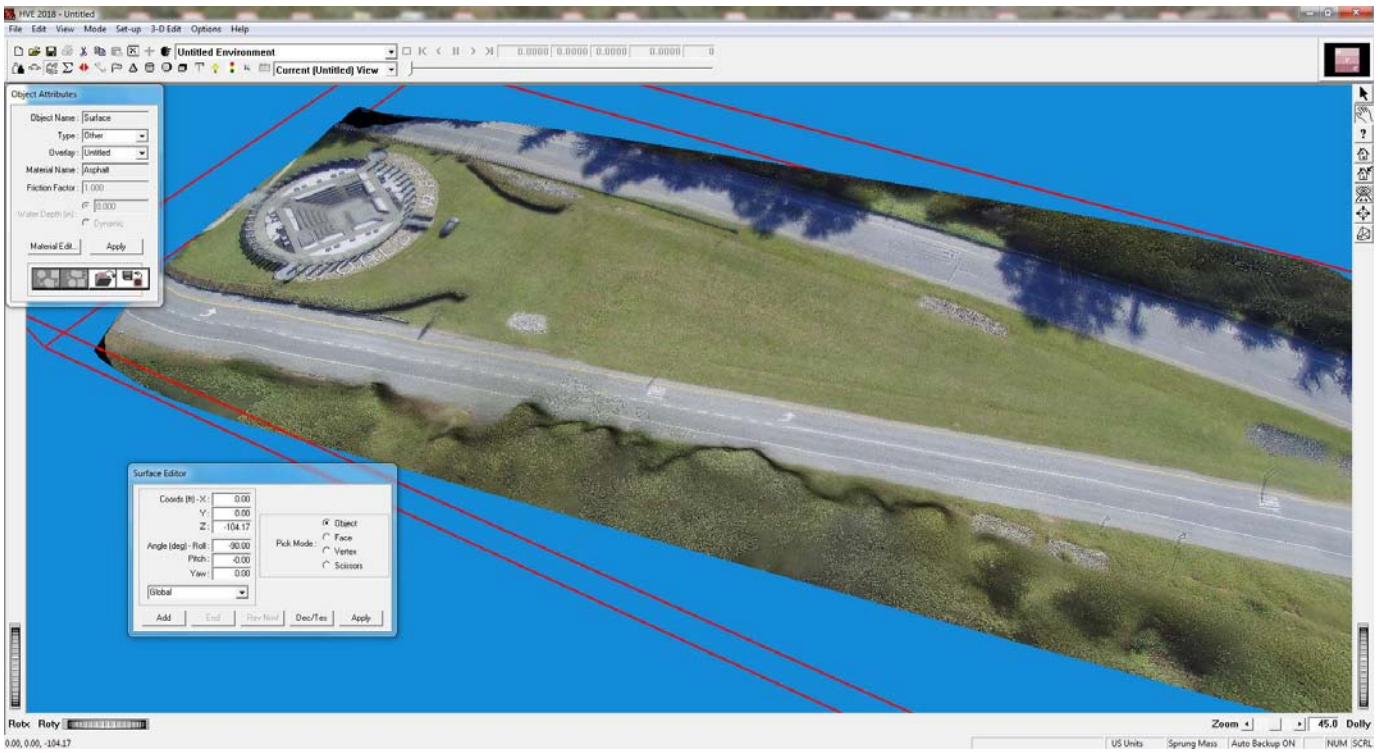

Figure 2 - Terrain surface object selected in the 3-D Editor, as indicated by Surface Editor dialog and the red bounding box surrounding the entire object. The Object Attributes dialog indicates the surface is of Type Other, meaning it will not be considered by the simulation's tire model.

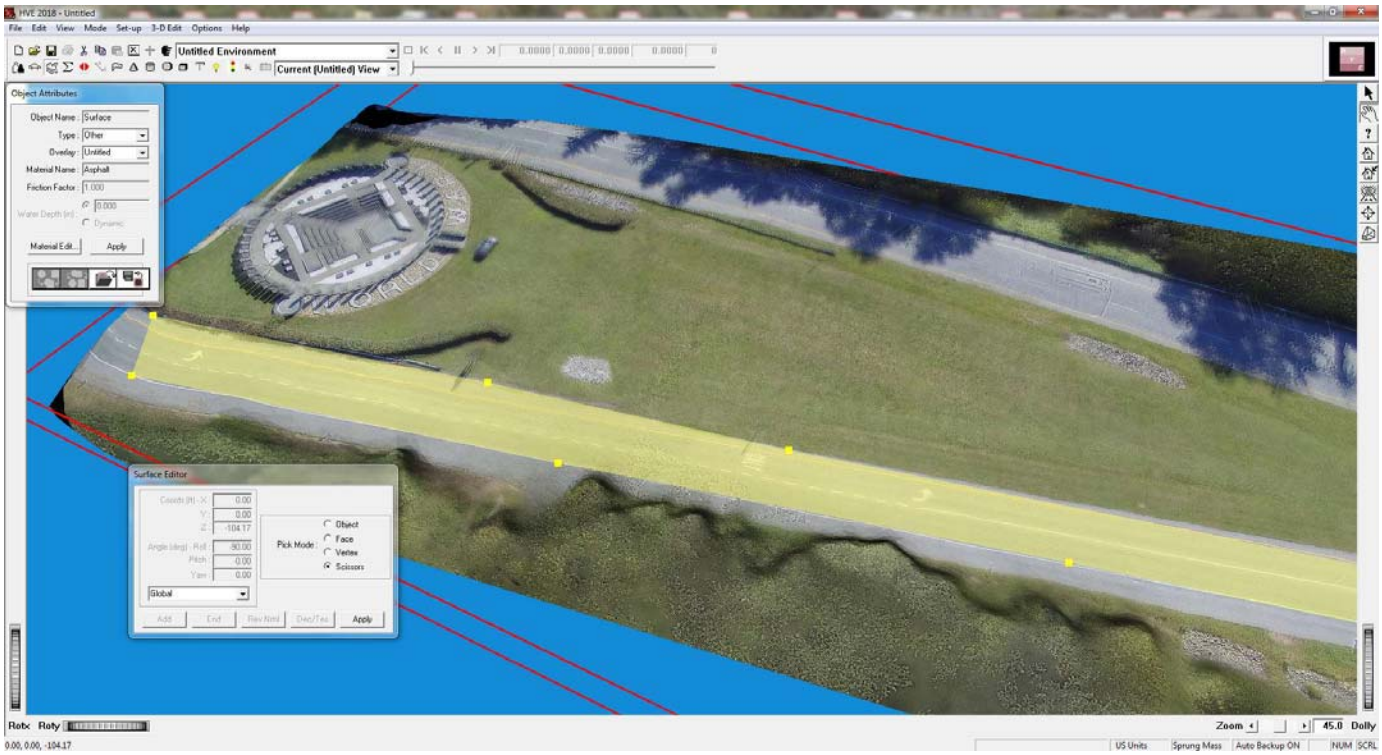

Figure 3 - Using Scissors to cut out the desired surface (the part of the surface we want to drive on). Note the markers that define the highlighted region.

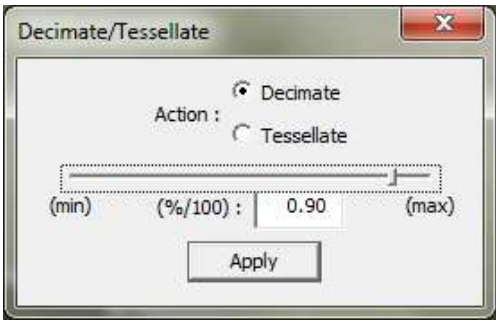

Figure 4 - Decimate/Tessellate dialog)

- Click *Dec/Tes* to display the Decimate/Tessellate dialog (see Figure 4).
- Right-click in the viewer and set the Draw Style to *Wireframe* so we can see the effect of our decimation.
- Click *Decimate* (it may already be selected).
- Set the Decimation to 0.90 and press *Apply*.

The selected region is smartly decimated (see Figure 5). Its seam with the original surface is water-tight. Note that, by viewing in wireframe, we can instantly see the effects of the Decimation. Zoom in to inspect the details.

- Finally, using the Object Attributes dialog, change the Type to *Road* (this step may not be necessary).

At first, the decimated region may look rather strange. Close inspection reveals this is the result of ensuring a water-tight seam between the decimated and original (undecimated) surfaces.

The terrain is now ready for use in a *SIMON* simulation. While there are hundreds of thousands of polygons in the original (undecimated) terrain, the SIMON simulation will only search the newly created region (which happens to have only 622 polygons).

NOTE: The Tessellation feature will be implemented in HVE 2019 Service Pack 1. It works much like the vehicle mesh tessellation option in the Event Editor.

EDC would like to thank Tony Cornetto, of Momenta, LLC, for supplying the original environment.

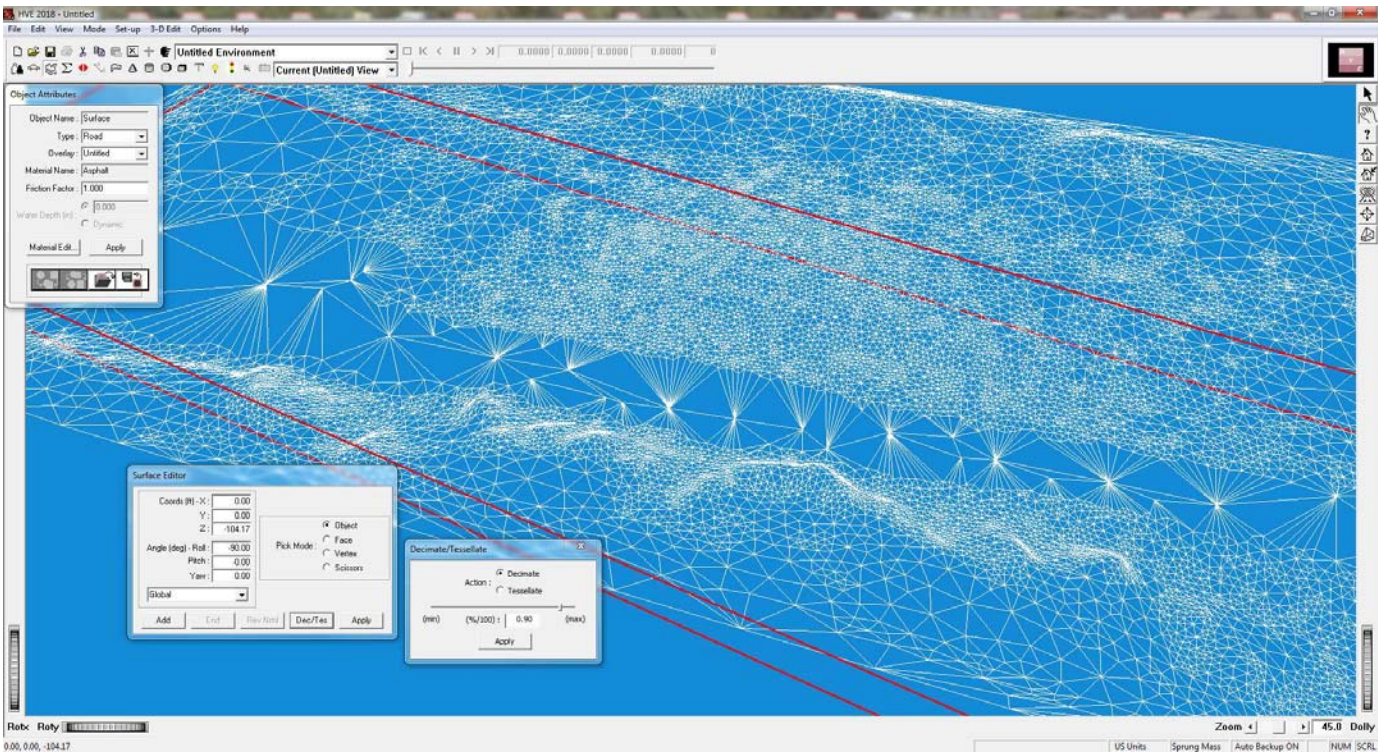

Figure 5 - Wireframe view of terrain, showing original surface and smartly decimated driving surface. Note that the Object Attributes dialog indicates the driving surface is of Type Road.

EDC Simulations November 4 - 8, 2019 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 of the programs' major calculation procedures.

EDC Simulations 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 annually for over 30 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, are provided to each student.

Bring your scientific calculator and laptop computer. Eight hands-on 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 Hampton Inn Dadeland, Miami, FL, are available on the EDC Simulations page in the Training section of edccorp.com. Contact EDC at 888.768.6216 to sign up today!

Call for *HVE* White Papers

All users interested in presenting an *HVE* White Paper at the 2020 *HVE* Forum are invited to submit an abstract (approximately 150 to 250 words in length) for consideration. *HVE* White Paper topics include *HVE* case studies, novel applications that showcase *HVE*'s capabilities, and any tips and techniques that show other *HVE* users how to take full advantage of *HVE*'s powerful features. It is also a great opportunity to contribute your knowledge and experience to the *HVE* user community. Submit your abstract via email to forum@edccorp.com. Abstracts are due by November 1, 2019.

New Vehicles

As of January 1, 2019, EDC is back in the business of building vehicles. As a result, EDC and Vehiclemetrics databases will be sold and maintained separately. This is expected to increase the total number of vehicles available to *HVE* and *HVE-2D* users.

We have redesigned our internal systems, resulting in a significant efficiency increase. Tables 1 and 2 list the new vehicles and tires added to the EDC Custom Vehicle and Tire Database since January 1, 2019.

Table 1: New Vehicles

YEAR RANGE	VEHICLE Make/Model
2018	Toyota Camry SE 4-Dr Sedan
2015 - 2018	Honda Fit EX-L 5-Dr Hatchback
2018	Honda Accord Touring 4-Dr Sedan
2015 - 2018	Honda HR-V EX-L SUV
2012 - 2018	Ford Focus 5-Dr Hatchback
2017 - 2019	Honda CR-V 4-Dr SUV
2012 - 2019	Nissan Versa S 4-Dr Sedan
2013 - 2019	Nissan Pathfinder 4-Dr SUV
2015 - 2019	Ford Mustang 2-Dr Coupe
2017 - 2019	Audi Allroad 5-Dr Wagon
2015 - 2019	Subaru Outback 4-Dr SUV
2013 - 2019	Lincoln MKZ 4-Dr Sedan
2014 - 2019	Ford Transit Connect 5-Dr Van
2015 - 2019	Ford Edge SE 4-Dr SUV
2013 - 2018	Ford Escape SE SUV

Table 2: New Tires

TYPE	MANUFACTURER/MODEL	SIZE
Passenger Car	Generic	P185/65R15
Passenger Car	Generic	P185/65R16
Passenger Car	Generic	P235/55R17
Passenger Car	Generic	P225/60R18
Passenger Car	Generic	P235/45R18
Passenger Car	Generic	P235/60R18
Passenger Car	Generic	P245/45R18
Passenger Car	Generic	P235/40R19
Passenger Car	Generic	P245/40R19
Passenger Car	Generic	P235/55R20

We are adding about one new vehicle every two weeks, so we expect to add 20 to 25 new vehicles in 2019. As they are added, these new vehicles will be made available in each software update and service pack release.

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 modified a vehicle's crush stiffness in HVE's Vehicle Editor but I do not see the applied change reflected within the Vehicle Data Report, why isn't the change being applied?

A: *SIMON* only looks at 3D Stiffness values while *EDSMAC4* and *EDCRASH* only look at the 2D values. If you are an HVE user, you will see a radio button for 2-D and 3-D stiffness values. These are independent values that allow you to modify the 2-D stiffness and 3-D stiffnesses without affecting each other, so you can set up and execute *SIMON* and *EDSMAC4* events without needing to change back and forth betrween runs. (*HVE-2D* users only see 2-D coefficients, so this issue does not apply.)

Another issue to be aware of applies to *EDCRASH* users. In the Event Editor, the Damage Profiles dialog *inherits* the stiffnesses from the Vehicle Editor, but from then on, *EDCRASH* uses the values in the Damage Profiles dialog. Changing the stiffnesses in the Vehicle Editor will have no effect.

Q: When I simulate a heavy truck and trailer(s), as soon as I execute the event the trailer rotates and disconnects from the truck. I then receive the message "Event Termination: Excessive Inter-vehicle Articulation Angle", Why? (There has been no collision yet.)

A: This is the result of instability in the numerical integration routine. The default timestep is too large. The culprit is a heavy vehicle connected to a very light veghicle (e.g., a dolly, or possibly a light trailer).

If you are using *EDSMAC4*, set all of the integration timesteps (Collision, Separation and Trajectory) to 0.001 seconds or less. *SIMON* users need only reduce the Trajectory timestep (*SIMON* does not use the Separation and Collision timesteps).

*Q: How can I export an *.H3D vehicle geometry from HVE?*

A: H3D files are unique to HVE so they can't be directly imported into another CAD program. Fortunately because they are so similar to the *.IV file format, you can manually change the file's extension from *.H3D to *.IV. An IV geometry file can be imported into a CAD program. However, we are aware of only two CAD programs that support .IV files: "Deep Exploration" by Right Hemisphere and "Poly Trans" by Okino.

However, almost all vehicle geometries are also available from EDC in DXF and VRML formats upon request. All you have to do to obtain a copy of it is determine if the vehicle was created by EDC or Vehiclemetrics and then contact the corresponding company and request a copy of the desired vehicle geometry.

Q: How can I achieve a specific vehicle deceleration rate, say, 0.2g's, in an HVE event?

A: The answer depends on the physics model used.

For *SIMON*:

Step 1 - Create a *SIMON* simulation on a flat surface (the ProvingGround.h3d terrain is perfect for this).

Step 2 - Start the simulation at a high speed, say 80 mph, and set up a Pedal Force braking table. Start at 0 pounds at t=0 seconds and a second entry for 100 pounds at 5 seconds.

Step 3 - After running the simulation, go to Variable Output in the Playbadk Editor and export and graph in Excel the simulation results for forward acceleration as a function of brake pedal force. While this seems like a lot of work it only takes about 5 minutes, and it becomes a very useful reference tool for your case work.

NOTE: You can perform a similar task to determine the required level of throttle using the %WOT throttle table option. This is a bit more complicated because you need to do it for each gear ratio and associated speed range.

For *EDSMAC4*:

Step 1 - Create your *EDSMAC4* simulation

Step 2 - Use the Tractive Effort throttle table option, and enter a total force (at each drive wheel) such that the total force divided by the vehicle's mass equals the desired acceleration (can you see a direct application of Newton's 2nd law?).

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

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

Los Angeles, CA . . . . . January 20 - 24, 2020
Miami, FL . . . . . November, 2020

EDC Simulations

Miami, FL . . . . . November 4 - 8, 2019
Los Angeles, CA . . . . . January, 2021

Theoretical & Applied Vehicle Dynamics

Upon Request

2020 *HVE* Forum

Austin, TX . . . . . Feb 24 - 28, 2020

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 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 at 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 the group hosted by long-time user Tony Cornetto. Tony is the lead instructor at the *HVE* Forum *Advanced HVE Workshop*. You can connect at:

https://www.linkedin.com/groups/8809876/

There are currently 37 members. Check it out!

Engineering Dynamics Corporation
8625 SW Cascade Blvd, Suite 200
Beaverton, Oregon 97008 USA
Phone 888.768.6216 / FAX 503.526.0905
Email: info@edccorp.com
Website: www.edccorp.com