SPRING 2011 ENGINEERING DYNAMICS CORPORATION

Technical Newsletter

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

Version 8.20 - Coming June 2011

Version 8.20 of *HVE*, *HVE-2D* & *HVE-CSI* is currently undergoing beta testing and is scheduled to be released in June. Here are a few of the exciting enhancements users will find in Version 8.20:

HVE Electronic Stability Systems Model

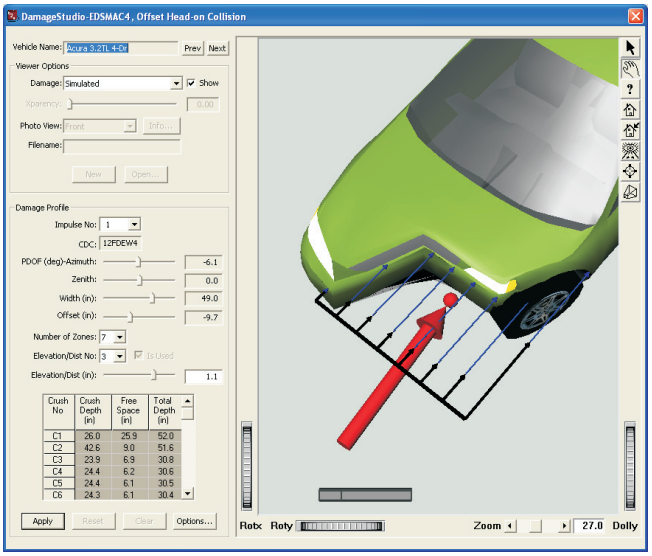
The majority of manufacturers today offer vehicles fitted with some form of electronic stability control (ESC) safety system designed to assist the driver in recovering from a dangerous situation, such as a loss of control resulting from an emergency evasive maneuver or a poorly judged turn on a wet road. According to the IIHS, an ESC system reduces fatal single-vehicle crashes by over 55% and fatal single-vehicle rollovers by almost 80%. To provide accident reconstructionists with the ability to investigate and reconstruct crashes involving vehicles fitted with ESC systems, EDC has implemented the new *HVE* Electronic Stability Systems (ESS) Model in *HVE* Version 8.20.

Whether the vehicles involved in your crash have Vehicle Stability Assist (VSA), Vehicle Dynamic Control (VDC), Electronic Stability Program (ESP) or other branded electronic stability control safety features, the *HVE* ESS model will allow you to perform detailed investigations of loss-of-control and related issues. When using the ESS model, you are still working within the limits of the vehicle's handling performance and the ability to maintain traction at the tire/road interface. The Technical Session of this newsletter focuses on the inner workings of the ESS model and provides an application of the model for a high-speed cornering and braking maneuver using *SIMON*.

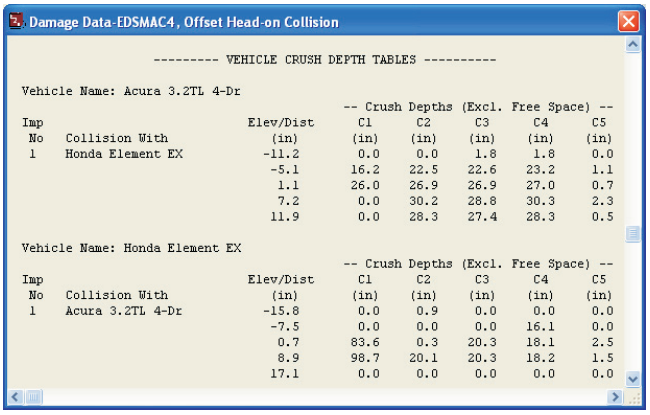
DamageStudio® for *HVE-2D & EDSMAC4*

DamageStudio will be available in Version 8.20 as an option for both *HVE* and *HVE-2D* users. In addition to *SIMON/DyMESH* simulations, *EDSMAC4* will support *DamageStudio*, allowing *HVE-2D* users to visualize their collision data, and correlate collision damage with the kinetics, delta-V, acceleration and other important collision parameters from their simulations.

Additionally, the *EDSMAC4* Collision Data reported in the Damage Data output report provides users with the



same results available in *SIMON/DyMESH*, including the familiar Damage Width, Damage Offset and Crush Depth Table (C_1, C_2, etc.), measurements for the simulated crush profile. This ability allows quick comparison to real-world evidence.



Damage Data-EDSMAC4, Offset Head-on Collision

--------- VEHICLE CRUSH DEPTH TABLES ----------

Vehicle Name: Acura 3.2TL 4-Dr

Imp No	Collision With	Elev/Dist (in)	C1 (in)	C2 (in)	C3 (in)	C4 (in)	C5 (in)
			-- Crush Depths (Excl. Free Space) --				
1	Honda Element EX	-11.2	0.0	0.0	1.8	1.8	0.0
		-5.1	16.2	22.5	22.6	23.2	1.1
		1.1	26.0	26.9	26.9	27.0	0.7
		7.2	0.0	30.2	28.8	30.3	2.3
		11.9	0.0	28.3	27.4	28.3	0.5

Vehicle Name: Honda Element EX

Imp No	Collision With	Elev/Dist (in)	C1 (in)	C2 (in)	C3 (in)	C4 (in)	C5 (in)
			-- Crush Depths (Excl. Free Space) --				
1	Acura 3.2TL 4-Dr	-15.8	0.0	0.9	0.0	0.0	0.0
		-7.5	0.0	0.0	0.0	16.1	0.0
		0.7	83.6	0.3	20.3	18.1	2.5
		8.9	98.7	20.1	20.3	18.2	1.5
		17.1	0.0	0.0	0.0	0.0	0.0

And So Much More...

Version 8.20 also provides users with numerous other enhancements, bug fixes and new vehicles added to the *EDVDB* vehicle database. More details about "What's New" in Version 8.20 are available by visiting www.edccorp.com/Version820.

Technical Session

This Technical Session describes the new *HVE* Electronic Stability Systems Model, available in *HVE* Version 8.2.

An Electronic Stability System (ESS) calculates several vehicle state variables describing current wheel spin velocities and vehicle yaw rates, and compares those values with what is expected based upon current driver inputs. The results are used to vary the current levels of drive torque and brake pressure at each wheel in a manner intended to reduce yaw velocity error and, therefore, improve stability. ESS can work in conjunction with a vehicle's anti-lock braking system (ABS).

ESS can include two different types of systems. A Traction Control System (TCS) helps to maintain traction at each wheel by reducing drive torque for drive wheels that are spinning, and rerouting that drive torque to wheels that aren't. A Yaw Stability Control system (YSC) helps to maintain vehicle directional control during a steering maneuver by applying or reducing drive torque and/or brake pressure to individual wheels to reduce the current yaw moment.

The *HVE* ESS model includes both a TCS model and a YSC model. These models are included in *SIMON*.

Background

SIMON is a 3-D vehicle simulation model with 6 degrees of freedom for the sprung mass (x,y,z,roll,pitch,yaw) and 2 degrees of freedom for each wheel (z,spin). It is the wheel spin degree of freedom that is particularly important to the ESS model. The equation for the spin degree of freedom calculates wheel spin dynamics at each wheel based on current levels of drive and brake torque. Without the wheel spin degree of freedom, wheel spin velocity cannot be determined accurately when wheel slip is occurring (note that the spin degree of freedom at each wheel is also a requirement for an ABS simulation model).

State Variables

The state variables are (1) the current spin velocities at each wheel, and (2) the current vehicle yaw velocity. On a real vehicle, these variables are measured by spin velocity sensors at each wheel and a yaw rate sensor normally located near the vehicle's center of gravity. On a simulated vehicle, because these state variables are included in *SIMON*'s equations of motion, wheel spin velocity and vehicle yaw velocity are calculated from first principles at each integration timestep.

The current driver inputs (steering, throttle and braking) are also state variables that describe the maneuver that the driver is attempting to perform. In particular, these state variables provide the current steering wheel angle, engine drive torque and brake system pressure. On a real vehicle, these inputs are monitored by the vehicle's on-board computer; on a simulated vehicle, they are monitored by *SIMON*'s steering system, drivetrain and braking system models.

The vehicle's simulated speedometer reading is determined from the tire radii and average wheel spin velocities. Note that the speedometer may indicate a speed that is different from the forward velocity calculated from the equations of motion if one or more wheels have significant longitudinal tire slip. Thus, the speedometer output simulates the vehicle's actual speedometer reading.

The expected spin velocity at each wheel is calculated from the speedometer reading, wheel y coordinate and tire static loaded radius. This spin velocity is compared to the actual spin velocity from the equations of motion to determine the current spin velocity error at each wheel. The expected vehicle yaw rate is calculated from the speedometer reading, nominal wheel steer angle and wheelbase. This value is compared to the actual yaw velocity from the equations of motion to determine the current vehicle yaw rate error. The yaw rate and spin velocity errors are used by the TCS and YSC models to modulate the current levels of drive torque and brake pressure at each wheel.

ESS Control Inputs

ESS controls are presented in the Vehicle Editor's new ESS dialog (see Figure 1), which is part of the Drivetrain Data. TCS and/or YSC are enabled by checking the appropriate checkbox. Values for individual thresholds and activation rates are also presented in this dialog.

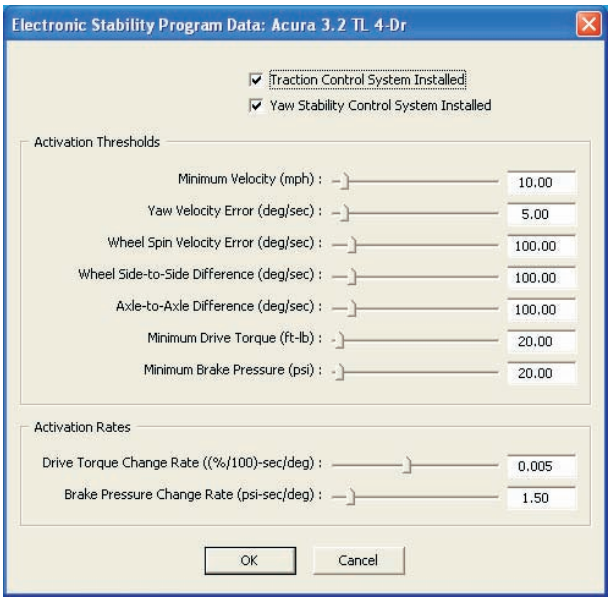


Figure 1 - Electronic Stability Systems dialog

TCS Logic

In order to activate TCS during a maneuver, the current throttle application must result in a wheel torque greater than the TCS threshold wheel torque. Given that condition exists, the TCS operates at two levels: axle-to-axle difference and side-to-side difference. If the axle-to-axle difference in average spin velocity is greater than the axle-to-axle threshold, the torque on the spinning axle is reduced and applied to the other axle (applies only to vehicles with multiple drive axles). If the side-to-side difference is greater than the side-to-side threshold, the torque on the spinning wheel is reduced and applied to the opposite wheel (the sum of the drive torques at each wheel remains constant). The torque increase or decrease at each wheel is then calculated as the product of the wheel spin velocity error and the torque change rate (see ESS dialog, Figure 1).

TCS is activated when individual wheels spin because of a lack of traction (e.g., a vehicle is stuck in the mud or on a split-mu surface). TCS may also become activated while a vehicle is accelerating through a curve.

YSC Logic

In order to activate YSC during an event, the current vehicle yaw rate must be greater than the YSC yaw rate threshold. One of two additional conditions must also exist: The current throttle application must result in a wheel torque greater than the TCS threshold wheel torque, or the current brake pedal application must result in a brake system pressure greater than the YSC threshold system pressure. Given the required conditions exist, the YSC modulates either wheel drive torque (throttle threshold exceeded) or wheel brake pressure (brake threshold exceeded). If the throttle threshold is exceeded, the torque is modulated using the TCS logic (see above). If the brake threshold is exceeded, the brake pressure is modulated according to the current wheel spin velocity error. The amount of pressure modulation (increase or decrease) is calculated as the product of the spin velocity error and the pressure change rate (see ESS dialog, Figure 1).

Brake pressure changes at each wheel due to YSC occur before the ABS modulation. Thus, ABS still performs the task of preventing unintended wheel lockup during heavy braking.

YSC is activated when a vehicle is negotiating a curve and begins to oversteer (spin out) or understeer (plow).

ESS Outputs

The effects of TCS and YSC may be observed by monitoring wheel spin velocity, drive torque, brake torque and brake pressure (Key Results, Wheel group). TCS and YSC activation states (ON or OFF) may be observed directly in the Key Results, Drivetrain group.

Of course, the overall effect on vehicle directional stability and control may also be observed visually, as shown in Figures 2 and 3.

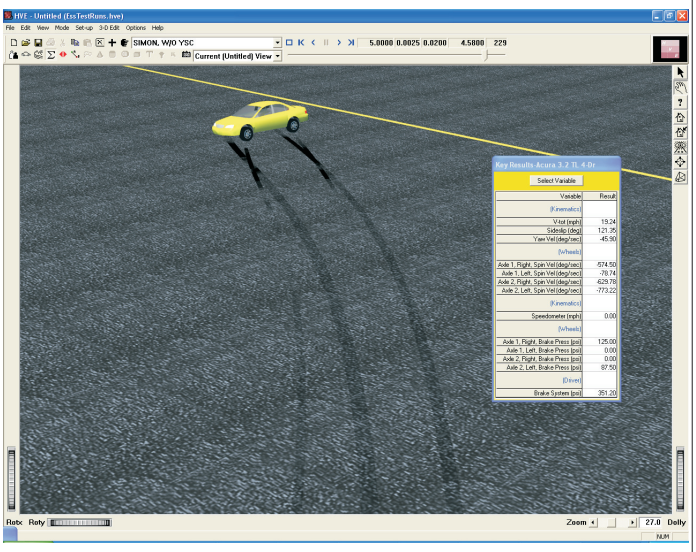


Figure 2 - Without Yaw Stability Control, the vehicle at 75 mph, 20 degree steering input and 20 lb of brake pedal force spins out.

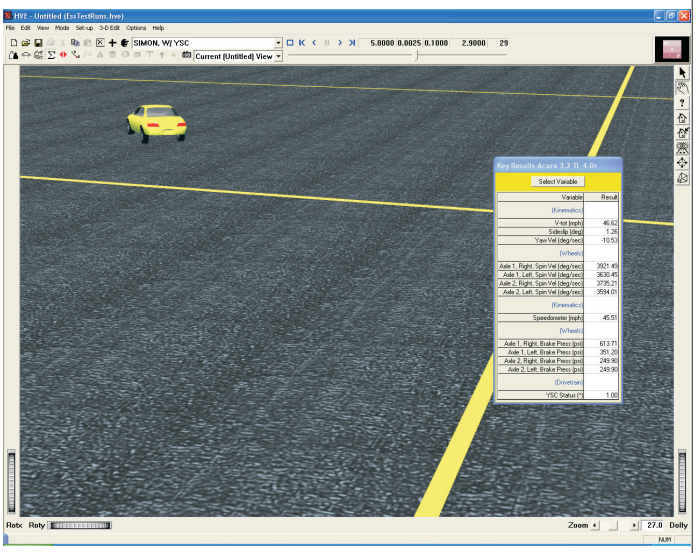


Figure 3 - With Yaw Stability Control activated, the same vehicle and driver inputs result in a controlled turn with minimal sideslip (about 1 degree).

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 in the EDC Technical Newsletter. Thank you!

Past Technical Sessions

Looking for a quick refresher or an overview on how to use and apply the functionality of your *HVE* software? The Technical Sessions in each newsletter contain helpful information on using the software, understanding the functionality and calculations, and also supporting and defending your work. Users often find the details they are looking for faster by referring to a Tech Session than by digging through the reference manuals or extensive technical papers. To help you get up-to-speed quickly, check out the following list of Tech Sessions in newsletters available to download directly from the EDC website library:

- Articulated Vehicle Off-tracking (Winter 2011)
- Vehicle Dynamics Parameters (Fall 2010)
- Preview of *DamageStudio* (Summer 2010)
- *SIMON*'s New Damage Data Report (Spring 2010)
- Using the DXF Translator (Winter 2010)
- *HVE* Hydroplaning Model (Fall 2009)
- *HVE* Automatic Transmission Model (Summer 2009)
- Wheel Setup Options (Spring 2009)
- Detailed Overview of *DyMESH* (Summer 2008)
- *DyMESH* Version 2 (Winter 2008)
- Steer Degree of Freedom Model (Summer 2007)
- Restitution (Spring 2007)
- Tire-Terrain Sidewall Impact Model (Winter 2007)
- Pole Impacts Using *EDSMAC4* (Fall 2006)
- Using the Soft Soil Tire-Terrain Model (Summer 2006)
- Anatomy of a Simulation (Spring 2006)
- Steer Axis Geometry Now Available In *SIMON* (Fall 2005)
- Effect of the Point on Curve in *EDCRASH* (Summer 2005)
- Tire-Road Friction (Spring 2005)
- Suite of New Tire-Terrain Models (Winter 2005)
- Report on the use of *DyMESH* by *HVE* Users (Fall 2004)
- *HVE* Path Follower (Summer 2004)
- Tire Blow-out, Wheel Damage and Wheel Brake Set-up Options (Spring 2004)
- High-level Introduction to *DyMESH* (Winter 2004)
- How the Brake System on a 3-D Simulation Model Works (Summer 2003)
- Simulating Barrier Collisions Using *EDSMAC4* (Spring 2003)
- *EDCRASH* Damage Message Explained (Winter 2003)
- How the Steer Degree of Freedom Works (Fall 2002)
- How Tire Skidmarks are Produced and Displayed by *HVE* (Summer 2002)
- Spring 2002 - Anti-Lock Braking: Part II
- Synchronizing Output Time and Playback Interval (Fall 2001)
- Using *HVE* for Motorcycle Crash Reconstruction (Summer 2001)
- Rollover Simulation (Spring 2001)
- 4-Spring and Walking Beam Suspensions (Winter 2001)
- Time-Distance Studies (Fall 2000)

2011 *HVE* Forum Recap

The 2011 *HVE* Forum not only offered a record number of workshops for *HVE*, *HVE-2D* and *HVE-CSI* users, it also broke the attendance record for *HVE* Forums over the past 16 years! Workshops were held for all levels of users, from Introduction to *HVE-CSI*, *HVE-2D* and several physics programs, all the way up to real-world case studies in the Advanced *HVE* workshops, and using the new 3-D damage analysis tool, *DamageStudio*. Workshop attendees were encouraged to ask lots of questions. In addition, attendees learned even more by networking between workshops and during the social hours. The net result: A great learning experience that helped attendees better understand the software's capabilities and apply the software on more cases.

Attendees had great things to say about the quality and content of the workshops offered this year. Here are a few comments taken directly from the general evaluation forms:

- *"As a new user I was unfamiliar with HVE. I attended these workshops to get an understanding of how to properly navigate the software. Having attended the full week of hands-on intro workshops, I am now comfortable navigating the software, and in fact, I now see even greater potential for the use of the software in what we do."* - Kevin Tully
- *"Every user of HVE should attend the HVE Forums. There always are gems to be picked up."* - Dr. William Blythe

In addition to the workshops, users met to discuss suggested improvements they would like to see in future updates. The User's Top 10 Wish Lists were provided to EDC directly after the meetings.

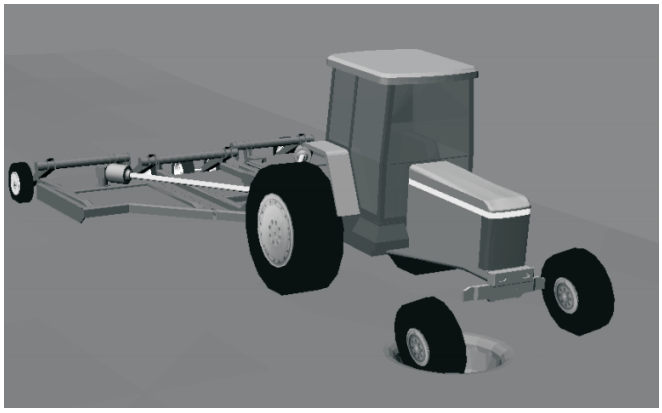
2011 *HVE* White Papers Now Available in Library

The *HVE* White Paper Session at the 2011 *HVE* Forum provided attendees with exceptionally detailed information about the application of advanced modeling capabilities in *SIMON*, future capabilities for developing accurate high-resolution terrain models for *HVE* simulations, and also a methodology for analyzing hydroplaning situations. The following papers are now available to download from the *HVE* White Paper section of the EDC website library:

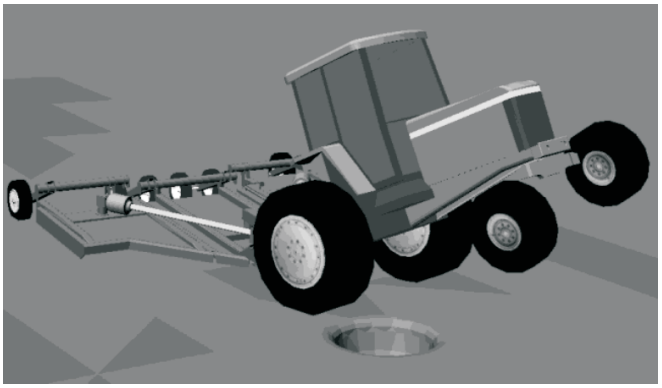
WP-2011-1 - "Modeling a Pothole Impact of an Agricultural Tractor Using *HVE* and *SIMON*" - Ciro Ramirez, PhD, PE, CSHO and R. Joe Thornhill, PhD, PE, CSHO - Thornhill, Ramirez & Associates, Inc..

Abstract: This paper presents an *HVE* study of the dynamics of a cabbed agricultural tractor pulling a large rotary shredder when impacting a deep pothole. The study was conducted using the *SIMON* physics module as part of an effort to quantify the way in which a tractor operator could be ejected from the tractor cab, possibly resulting in serious injuries from the shredder. The *HVE* radial spring tire model was used to predict tractor bounce as it encountered the hole at a variety of attack offsets and two different speeds. Unique vehicle features modeled for this study included agricultural tires and a rigid, unsprung front axle mounted on a pivot and angle limiting stops.

A follow-up study was conducted by combining the *SIMON* soft soil model and field measurements to estimate the coasting distance of the tractor and shredder at the incident site if engine fuel flow is stopped.



WP-2011-1: Tractor entering pothole, RF wheel aligned 10.9 inches right of pothole centerline. Speed 7.25 mph, tractor weight 10,000 lb.



WP-2011-1: Tractor pitch-up and CCW yaw rotation resulting from response to pothole.

WP-2011-2 - "Introduction to *HVE* 3D Environments with Google SketchUp" - R. Torrey Roberts, P.E., Anthony D. Cornetto III, P.E. and Ronny Wahba, P.E. - SEA Limited

Abstract: Creating an accurate and appealing 3D model for use in *HVE* is an important part of accident reconstruction simulation. Google has released software in recent years, which can be utilized to create 3D models for *HVE* environments. SketchUp (SU) is a 3D drawing program by Google that is supported by Google Earth's (GE) Digital Elevation Model (DEM), Aerial Photography and 3D Warehouse (3DW). DEM data can be imported from GE with overlaid aerial photography and used in SU as a starting point for 3D accident scene modeling. 3DW provides pre-made models of environmental objects and vehicles submitted by other users of SU. The accident scene model created with SU can be imported into *HVE* as a 3D environment. The 3D model can also be exported to a .kmz file and viewed with GE software. This paper will discuss the use of SU as a 3D environment-modeling tool and give some examples of its application.

WP-2011-3 - "Hydroplaning During Steady-State Cornering Maneuvers" - L. D. Metz - Metz Engineering and Racing, LLC

Abstract: Vehicles running in wet conditions may experience hydroplaning of one or more tires. Hydroplaning can, and often does, change vehicle braking, acceleration and handling characteristics dramatically. Proper analysis of this behavior requires accommodating the clearing of paths for the rear tires that may result from the front tires engaging the water-coated surface first. In this work, tire overlap and associated hydroplaning behavior are theoretically and experimentally examined.

2012 *HVE* Forum

February 27 - March 3, 2012
New Orleans, LA

The attendees of the 2011 *HVE* Forum voted to take the 2012 *HVE* Forum back to "The Big Easy" for a second time. Planning is already underway for new workshops covering topics such as new techniques for environment modeling and the advanced application of simulation models for real-world crash investigations. Save the dates of February 27 - March 3, 2012, on your calendar and plan to join your colleagues for the workshops, users groups and networking opportunities at the 2012 *HVE* Forum.

The 2012 *HVE* Forum will be held at the JW Marriott, which is conveniently located on Canal Street in the French Quarter of New Orleans. Attendees of the 1998 *HVE* Forum will recognize this location as the former Le Meridien hotel used for the event that year. Workshop information, early registration forms and special hotel room rates will be available soon at www.edccorp.com/2012HVEForum.

See you in New Orleans, and remember . . .

"Laissez Les HVE Cours de Formation Rouler!"

2012 *HVE* Forum

HVE White Paper Session
Call for Papers

All users interested in presenting a technical paper in the *"HVE* White Paper" session at the 2012 *HVE* Forum are invited to submit an abstract for consideration. *HVE* White Paper topics include *HVE* Case Studies, any application of *HVE* showcasing its capabilities, and innovative tips and techniques using *HVE*.

This session is an opportunity for you to showcase your skills to other users as well as to *non-HVE* users who may wish to hire you as a consultant. All papers are published and presented at the *HVE* Forum and also made available to download from the EDC website for continued exposure to the entire industry. Visit the *HVE* White Paper section of the EDC website library for a complete list of previous papers.

Please submit your abstract to the attention of EDC Customer Service at forum@edccorp.com before September 1, 2011.

HVE and Windows 7

According to reports from users, *HVE* is working fine on computers running Windows 7 32 bit and 64 bit operating systems. We also have received good feedback on the speed of running *HVE* and complex simulations on i5 and i7 type processors.

Here are two pieces of advice about new computers:

- When installing on Windows 7 computers, accept the default installation location (e.g., C:\HVE) rather than placing the installation within the Program Files directory as you may have done with Windows XP and older installations. The permissions restrictions on any folder within the Program Files directory will cause you extensive frustration. Work smart by installing in the default location.
- We continue to recommend Nvidia graphics cards, especially the GeForce line, and advise extreme caution when selecting computers with AMD (formerly branded as ATI) graphics cards, particularly the Radeon line. We've had a report from a user who bought a computer with an ATI Radeon HD 5000 series card that displayed the wheels and tires on a *HVE* vehicle as an inner and outer disc rather than as a proper cylindrical shape.

Unexpectedly Running In Demo Mode

If you start your *HVE* software and it unexpectedly tells you that you are "Running in Demo Mode", please contact EDC Technical Support for assistance. The support technician will immediately check the following two conditions with you:

- "Do you have the correct version number license file installed?" - The license file installed on your computer contains the exact version number of the software it will allow you to use. You must install the proper license file when you install an update. Did you use the license file on your installation CD?
- "Have you plugged your *EDKEY* in?" or "Is this the right hard drive that you are running the software on?" - The license file contains a code that either matches a unique code for your hard drive or your *EDKEY*. If the codes don't match, you will get a message that indicates your "License is Node Locked".

If you have any questions about your license, you can quickly check your codes and license information by selecting *Help*, *Tech Support* within *HVE.*

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 am using the HVE Driver Model - Path Follower option to assign a path for one car to crash into another at a specific point. When the vehicles come into contact with each other, I am getting an "Exceeding Driver Comfort Level" error message and my event stops. Can I get past this error message?

A. The HVE Driver Model Path Follower option allows for the driver of the vehicle to attempt to follow an indicated path. The control parameters for the driver include an adjustable maximum lateral acceleration value (a.k.a. driver comfort level) that is based on the statistical behaviors of everyday drivers. The HVE Driver Model is not intended to be used during a crash. When one car crashes into another, the accelerations experienced by the "driver" quickly exceed a normal comfort level (the real driver is probably unconscious anyway), which is why you are getting this error message. You have two choices to resolve your situation: Either do not use the Path Follower for the collision simulation, or terminate the Path Follower event before the collision. A third option, which is trickier, is to place the final path position at a point that causes the run to terminate just before impact.

Q. I'm doing an acceleration study of a passenger car and I keep getting a "Threw a rod" error message if I don't shift the gear in time in my SIMON event. I want to try to maximize the RPM before I shift gears, so I'm trying to carefully watch the Key Results for Engine RPM and time my shifts accordingly. Is there an easier way for me to do this?

A. Yes there is! Use the Automatic Transmission model and set the shift points at the exact RPM you want. To change from manual transmission to automatic transmission, go to the Vehicle Editor and click on the engine icon of the vehicle. In the Powertrain dialog, click on the Transmission button. In the Transmission Data dialog, change the type from Manual to Automatic and adjust the shift points accordingly. When you rerun your *SIMON* event, your transmission will shift gears automatically, allowing you to focus your efforts on studying the acceleration capabilities of the vehicle.

Q I am running a SIMON event of a heavy commercial vehicle performing a handling manuever. When I start the simulation, the vehicle's axles are jumping all over the place causing the vehicle to behave erratically. What's happening?

A. By looking at your case file, we can see that you increased your Vehicle Trajectory integration timestep from the default of 0.025 to 0.1 seconds. With such a large time between calculations, the axles on the vehicle have become dynamically unstable. By setting your timestep back down to the default, 0.025 seconds, your vehicle will behave as expected. If you are going to be looking at a collision using *DyMESH* in this event, we recommend that you further reduce the timestep to 0.001 seconds (see DyMESH Timesteps in the DyMESH Options dialog).

Q. I want to get a clearer picture of the actual crush damage profile from my EDSMAC4 simulation. Is there a better way for me to do this than by plotting out the change of shape of x and y coordinates identified in the Damage Data report? I've heard about the new capabilities of DamageStudio for analyzing the damage profile and reporting measurements like C1 and C2, but I don't see that it's available for my EDSMAC4 event. Any suggestions?

A. In Version 8.20, DamageStudio will be an option for both *HVE* and *HVE-2D* Users, and will allow you to analyze your *EDSMAC4* results in great detail!

Q. I have set up a SIMON event and I am trying to simulate one car crashing into another. However, when I run the event, the vehicles just pass through each other. Why aren't they colliding with each other? (This question also frequently appears as "I have set up a SIMON event and I am trying to simulate a roll over. However, when I run the event, the vehicle body passes through the road rather than bouncing off. Why isn't the body hitting the ground?)

A. *SIMON* is a 3-D vehicle dynamics simulation program with an option to use the *DyMESH* 3-D collision model. You have set up a *SIMON* event, which will simulate the trajectories of the vehicles based upon the conditions, but in order to have a vehicle-to-vehicle or vehicle-to-environment collision, you need to turn on *DyMESH*. On the menu, select Options, *DyMESH* and then check the box for *Use DyMESH*. If you need to have the vehicle body interact with the terrain model, also check the box for *Include Environment*. When you run the event now, *DyMESH* will continually look for interaction between the mesh (geometry file) of one vehicle versus another vehicle, or against the mesh of the terrain model, and will properly calculate the collision forces and moments and pass them to *SIMON*.

Visit the Support section of 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.

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 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 2013
Miami, FL . . . . . November 7 - 11, 2011

EDC Reconstruction

Los Angeles, CA . . . . . January 23 - 27, 2012
Miami, FL . . . . . November 2012

2012 *HVE* FORUM

New Orleans, LA . . . February 27 - March 3, 2012

Theoretical & Applied Vehicle Dynamics

On-site Courses Available Upon Request

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 or contact EDC Customer Service at 503.644.4500 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 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:

Yahoo - tech.groups.yahoo.com/group/HVErecon - Discussion group hosted by Roman Beck of Beck Forensics, Inc.

DiscoverHVE.com - Online training and discussion group hosted by Wes Grimes of Collision Engineering Associates

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