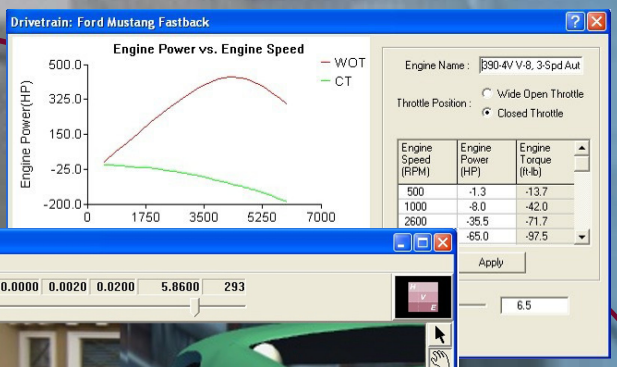
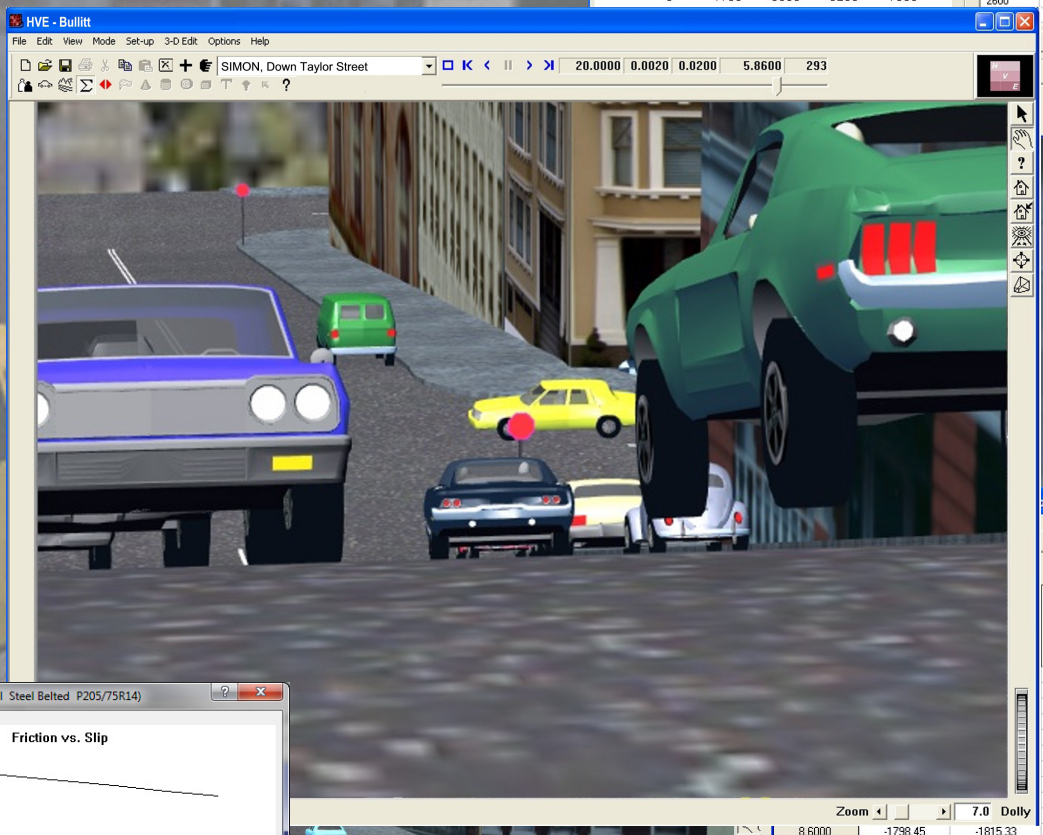
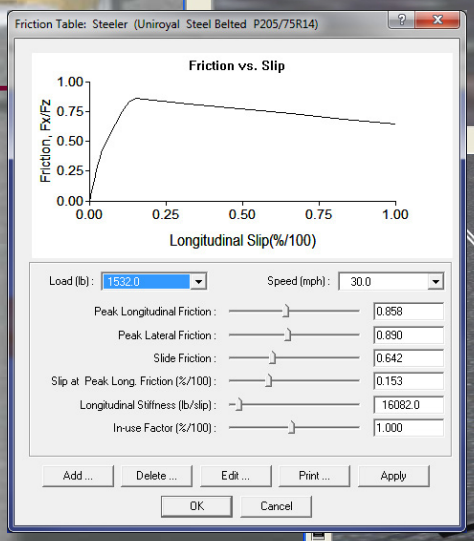
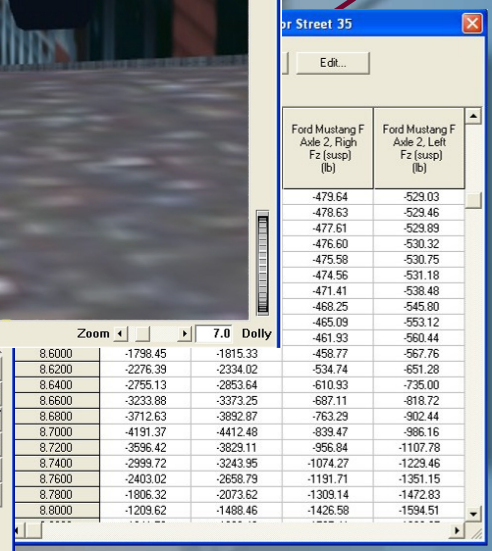
HVE

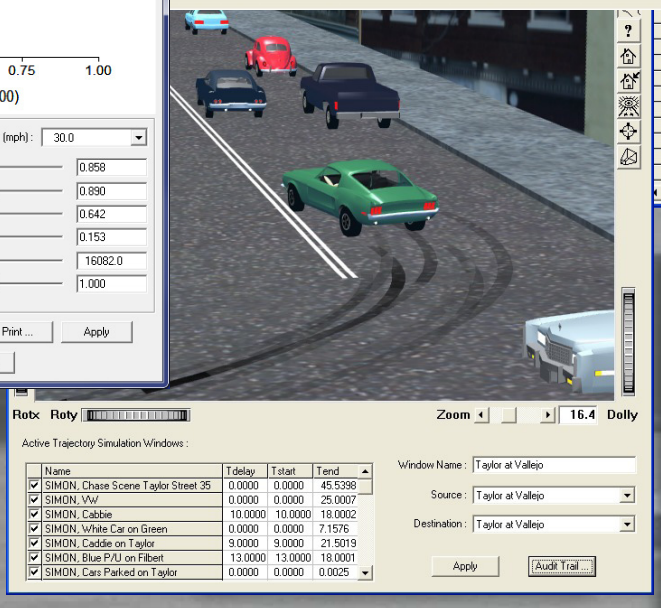
Human-Vehicle-Environment







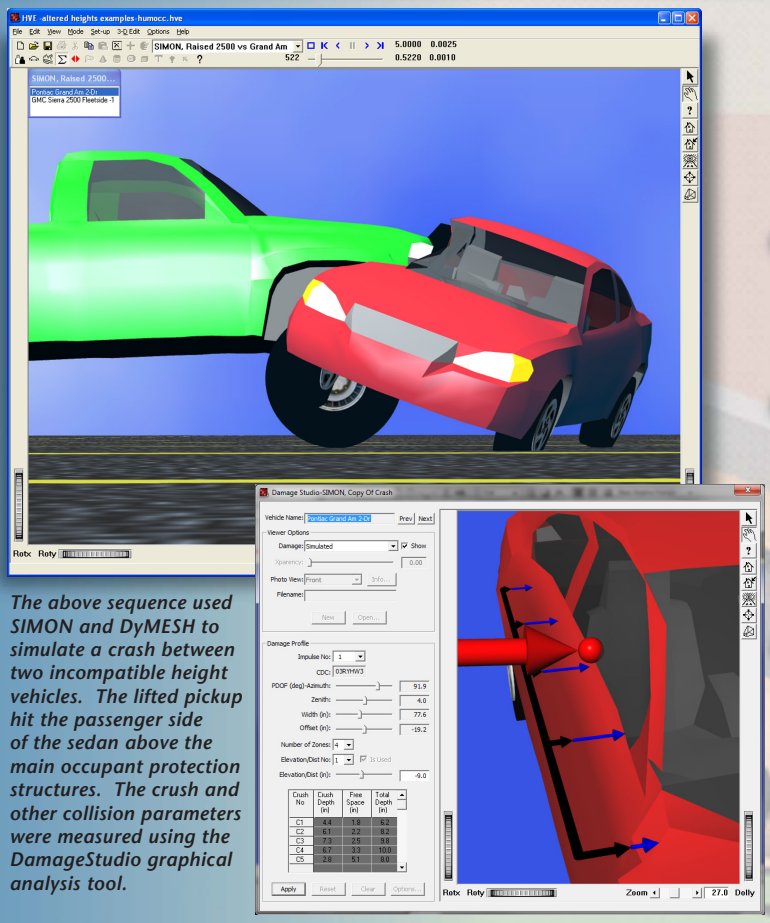




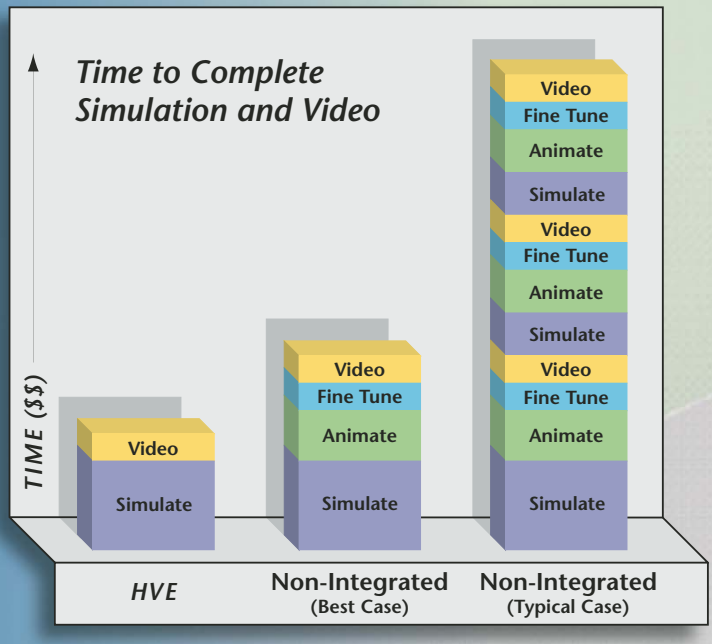
Simulation Software for Vehicle Design and Safety Research

EDC
VISUAL REALITY

HVE: It's about *time* . . .



The above sequence used SIMON and DyMESH to simulate a crash between two incompatible height vehicles. The lifted pickup hit the passenger side of the sedan above the main occupant protection structures. The crush and other collision parameters were measured using the DamageStudio graphical analysis tool.



When you complete your simulation in HVE, you are ready to produce video. This makes HVE a very cost-effective presentation tool for every simulation. Non-Integrated solutions often involve miscommunication, software compatibility problems and numerous iterations between the engineer and animator (such as keeping the tires in contact with a 3-D surface during the entire sequence).

HVE means different things to different people. To a vehicle design engineer, HVE means a way to improve the design process. To a vehicle safety researcher, HVE means a way to study real world issues involving highway safety. What does HVE mean to you?

- ***HVE is a Virtual 3-D World***

  HVE models humans, vehicles and the environment as sophisticated 3-dimensional objects and allows you to study their interaction. *HVE* makes virtually no simplifying assumptions.

- ***HVE is a Visualization Tool***

  The human mind has difficulty interpreting the meaning of voluminous amounts of numerical data generated by a simulation. By comparison, the human mind easily comprehends vast amounts of visual data. Using *HVE* 3-D viewers, you can quickly and easily visualize the meaning of the information within *HVE*'s numerical results.

- ***HVE is an Integrated Solution***

  HVE saves you enormous amounts of time by integrating the 3-D simulation environment, animation controller, 3-D modeler and video output interface into one system. Simulations can be recorded directly in *HVE*.

- ***HVE is an Engineering Design Tool***

  Engineers can use *HVE*'s robust human, vehicle, and environment models to perform detailed parameter studies of individual components such as suspensions, drivetrains, tires and brakes. Vehicle handling behavior while driving over irregular terrain can be simulated to optimize your design. *HVE* provides a cost-effective method for proving design concepts before expensive prototypes are produced.

- ***HVE is a Safety Research Tool***

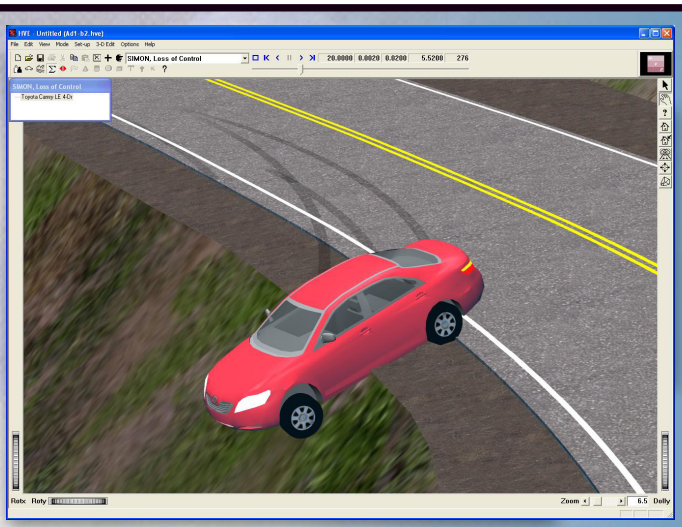
  Safety researchers can use *HVE*'s sophisticated modeling capability to simulate almost any crash sequence. The pre-crash phase can be simulated to evaluate vehicle controllability and driver inputs. The crash phase can be simulated to evaluate crashworthiness and effectiveness of restraint systems. The post-crash phase can be simulated to evaluate the effectiveness of guardrails and median barriers. *HVE* provides a cost-effective method for simulating crash tests before expensive experiments are conducted.

- ***HVE is Modular***

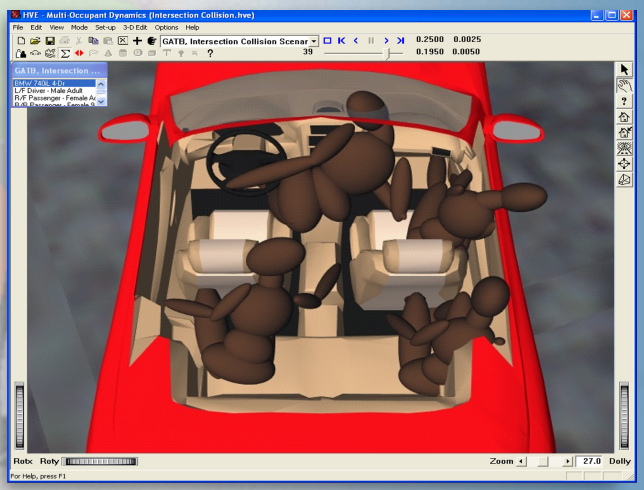
  HVE was engineered to allow you to extend its capabilities. You can choose a simulation model that is tailored to your specific needs, add custom databases, define your own units of measurement, select the number of decimal places in your input and output — you can even convert the program to Spanish. You can use the *HVE* Developer's Toolkit to create *HVE*-compatible versions of any engineering model, including highly validated OEM engineering models used in the vehicle design process.

Using HVE, you can . . .

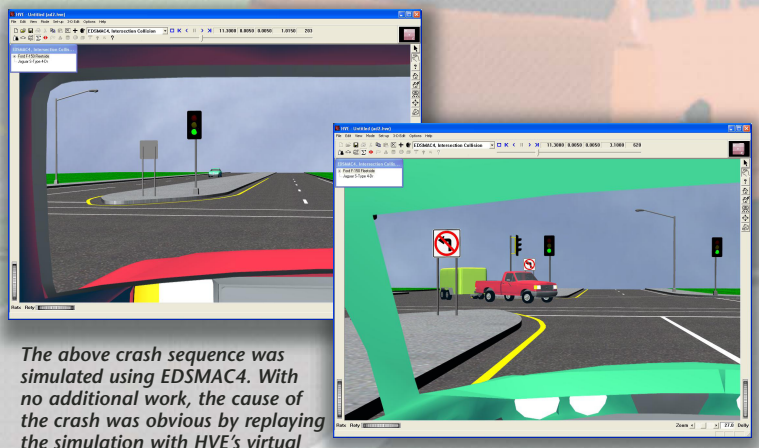
- Simulate vehicle rollovers including exterior damage.
- Simulate the response of multiple occupants during a rollover collision including contact between the occupants.
- Simulate a crash sequence, change the initial conditions to study avoidability and route both results directly to video showing multiple views including the driver of each vehicle.
- Use virtual thermocouples to monitor brake lining temperatures on a downhill grade.
- Use virtual accelerometers to monitor the velocity and acceleration at any location in the vehicle.
- Simulate the transient response of a vehicle before, during and after a tire blowout.
- Study the effect of occupant positioning on restraint system effectiveness.
- Create a complex 3-D terrain mesh and drive a vehicle on it.
- Use the *HVE* Path Follower to simulate the driver steering inputs required to negotiate a complex curve.



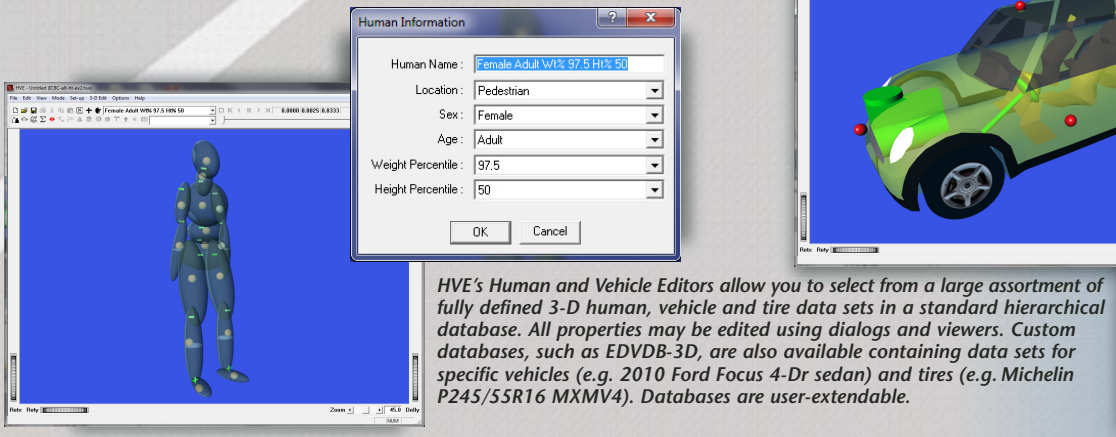
The above sequence used SIMON and DyMESH to simulate loss-of-control and ensuing rollover of a passenger car. The steering inputs required to cause the vehicle to follow the observed tire marks revealed the cause of the crash was due to driver inattention, followed by overcorrection.



The above GATB human simulation involved four occupants in a passenger car. Not only did the occupants strike the vehicle interior, they also struck each other. The collision pulse for this occupant simulation was selected from the EDSMAC4 simulation of the two-car crash.



The above crash sequence was simulated using EDSMAC4. With no additional work, the cause of the crash was obvious by replaying the simulation with HVE's virtual camera attached to the witnesses and driver of each vehicle. HVE's 3-D viewers allow you to zoom, dolly, pan and even spin the entire world.



HVE's Human and Vehicle Editors allow you to select from a large assortment of fully defined 3-D human, vehicle and tire data sets in a standard hierarchical database. All properties may be edited using dialogs and viewers. Custom databases, such as EDVDB-3D, are also available containing data sets for specific vehicles (e.g. 2010 Ford Focus 4-Dr sedan) and tires (e.g. Michelin P245/55R16 MXMV4). Databases are user-extendable.

HVE: It's about *power* . . .

Quickly Set-Up and Execute Simulations Using HVE's Editors.

HUMAN EDITOR

Select humans (consisting of 14 joints and 15 inertial mass segments with up to 3 ellipsoids per segment) from databases according to sex, age, weight percentile and height percentile. Editable parameters include:

- Inertias
  Segment Weight, Rotational Inertias (Roll, Pitch, Yaw)
- Contact Ellipsoids
  Name, Center Coordinates, Semi-Axis Length, Principal Axes, Material Properties
- Injury Tolerance
  HIC, Head Pitch Concussion, Head Side Acceleration, Chest SI, Chest Force, Chest Forward Acceleration, Maximum Axial Femur Load, Maximum Lap Belt Force, Maximum Torso Belt Force
- Joints
  Coordinates, Type, Stop Angles, Stop Elasticities, Stop Energy Dissipation, Elastic Constants (Linear, Quadratic, Cubic), Damping Constant, Full Damping Angular Velocity, Joint Injury Tolerance

VEHICLE EDITOR

Select vehicles from databases according to Type, Make, Model, Year, and Body Style. Vehicle types include Passenger Car, Pickup, Sport-Utility, Van, Truck, Trailer, Dolly, and Fixed and Moving Barriers. Editable parameter groups include:

- Sprung Mass
  Inertias, CG Location, Color, Contact Surfaces, Belt Restraints, Airbag Restraints, Inter-vehicle Connections, Aerodynamic Drag, Body Torsional Stiffness
- Unsprung Mass
  Location, Brake Assembly, Suspension Parameters, Wheel Image
- Tires
  Number, Spacing, Type, Manufacturer, Model, Size, Performance Parameters (Physical, Load- and Speed-Dependent Fx vs Slip, Fy vs Slip Angle, Fy vs Camber, Slip-Rolloff)
- Exterior
  Dimensions, Structural Stiffness, 3-D Geometry File
- Systems
  Brake (ABS System Data, Master Cylinder or Compressor Parameters), Steering (Gear, Column & Linkage Parameters)
- Drivetrain
  Engine, Transmission (Manual or Auto), Differential

ENVIRONMENT EDITOR

Create and edit or import 3-D Environments. Editable parameter groups and file formats include:

- Physical Properties
  Location (Name, Latitude, Longitude, GMT), Date, Time of Day, Atmospheric Conditions (Wind Speed, Wind Direction, Barometric Pressure, Temperature), Local Gravitational Constant
- Material Properties
  Surface Constants (Stiffness, Damping, Friction), Unloading Slope, Bekker Soil Exponent, Soil Modulus (Frictional/Cohesive), Moisture Content, Clay Content
- Sky Attributes
  Ambient Light Intensity, Sky Color, Fog (Type, Maximum Visibility Distance, Color)
- Supported File Formats
  3D Geometry – HVE, DXF, VRML, Inventor
  2D Images – RGB, BMP, TIF, GIF, JPG

EVENT EDITOR

Executes HVE-compatible programs. Observe trajectory simulations and key results of simulations in progress.

- Event Set-Up
  Initial Position & Velocity, Driver Controls (Throttle, Brakes, Steering, Gear Selection, Path Follower), Wheel Data (Tire Blow-Out, Damage, Brake, Tire-Terrain Model), Accelerometers, Damage Profiles, Payload, Collision Pulse, Contacts, Restraints, Vehicle Mesh (Tessellation Options, Inter-vehicle Friction)
- Time-Dependent Output Variables
  Kinematics, Kinetics, Accelerometers, 3-D Damage Profiles, Tires, Wheels, Connections, Drivetrain, Driver Inputs, Occupant Contacts, Belts, Airbags

PLAYBACK EDITOR

View/print all program inputs and outputs, combine and edit multiple trajectory simulations and record simulation movies (AVI format).

- Outputs
  Accident History, Audit Trail, Human Data, Injury Data, Vehicle Data, Damage Data, Environment Data, Event Data, Program Data, Driver Inputs, 3-D Damage Profiles, Messages, Momentum Diagrams, 3-D Site Drawing, 3-D Trajectory Simulations, Variable Output

RECOMMENDED SYSTEM REQUIREMENTS

- Intel Multi-core Processor (Core i7 preferred)
- Windows 7
- 4 GB RAM (minimum)
- 512 MB graphics memory (NVIDIA preferred)

Please visit our website at www.edccorp.com to download HVE-compatible program datasheets, tutorials, examples, simulation movies, technical papers, newsletters and other related information. You may also contact EDC Sales by phone, fax or email for additional information and assistance.

EDC VISUAL REALITY

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