# Validated Reconstruction and Simulation Programs Available for *HVE*

## *EDCRASH*

EDCRASH is a reconstruction analysis of single- or two-vehicle accidents, including collision. EDCRASH primary purpose is to determine impact speed and delta-V (a measure of impact severity) based on accident site and vehicle damage measurements. EDCRASH is also well-suited for collisions with immovable barriers, such as bridge abutments and large trees. While EDCRASH has been extended and revalidated for use in HVE to account for 3-D terrain, EDCRASH is essentially a 2-dimensional physics reconstruction program.

## *EDSMAC4*

EDSMAC4 is a simulation analysis of vehicle collisions. Based on EDSMAC, EDSMAC4 includes numerous extensions developed by EDC. Any number of vehicles, trailers, and/or barriers may be included. Simultaneous collisions between any number of objects are allowed (examples include a multi-vehicle freeway pile-up, pinning a vehicle between a striking vehicle and a tree, etc.). The original SMAC collision model has also been extended significantly, and now includes A and B stiffnesses for each side, as well as direct support for barrier collisions. EDSMAC4 also provides a robust model for collisions involving articulated vehicles towing any number of trailers, with or without dollys. EDSMAC4 also provides a collision pulse for occupant crash simulations (see EDHIS and GATB below). While EDSMAC4 has been extended and revalidated for use in HVE to account for 3-D terrain, EDSMAC4 is essentially a 2-dimensional physics simulation program.

## *EDVSM*

EDVSM is a 3-D simulation analysis of the dynamic response of a motor vehicle to driver inputs and 3-D road conditions. Based on the HVOSM-VD2 model developed at Calspan, EDVSM incorporates numerous enhancements developed by EDC, including a powerful tire-terrain interaction model and Tire Blow-out Model. The user enters initial position, velocity and driver controls. The program calculates 3-D vehicle kinematics, tire forces and moments, suspension forces and deflections, aerodynamic forces, and drive and brake system torques. Vehicle body vs terrain interaction is also modeled by calculating the force between the vehicle 3-D mesh and the terrain mesh. Using EDVSM, a vehicle may be simulated driving on virtually any surface under any conditions, including airborne vehicles and complete rollover.

## *EDVDS*

EDVDS is a 3-D simulation analysis of the dynamic response of a commercial vehicle to driver inputs and 3-D road conditions. A tow vehicle and up to three trailers may be simulated. EDVDS is an extended version of the Phase 4 program developed at UMTRI. Extensions include full 3-dimensional simulation capability, an updated suspension model with jounce/rebound stops, an updated tire model that supports 360° slip angles and 2-step radial tire stiffness, and the ability of each tire to respond to an arbitrary 3-D terrain. These advancements extend the capabilities of researchers to study real world highway safety issues involving commercial vehicles. Typical human factors issues include driver inputs and speed; vehicle factors include brake system and suspension design, loading conditions, and tire properties; and environment factors include superelevation and slippery road conditions.

## *SIMON*

SIMON is a 3-D dynamic simulation analysis of the response of one or more vehicles to driver inputs, inter-vehicle collision(s) and factors related to the environment (e.g., 3-D terrain, atmosphere). SIMON is a newly developed simulation model, using a new, general purpose 3-D vehicle dynamics engine developed by EDC. The dynamics engine allows a sprung mass with six degrees of freedom and multiple axles with up to five degrees of freedom per axle. The user assigns initial position, velocity and driver controls for each vehicle. Trailers and dollys are automatically positioned behind a tow vehicle according to connection compatibility and location. SIMON then predicts the motion of each vehicle's sprung mass, the motions of the unsprung masses, suspension dynamics, tire dynamics and current brake system parameters at each wheel. Numerous other output parameters are also available. Vehicle body damage from a collision simulation is also calculated and displayed using HVE's 3-D viewers. SIMON was specifically designed to take advantage of the rich feature set available in the HVE simulation environment, including the HVE Brake Designer, HVE ABS Simulation Model, HVE Driver Model, HVE Tire Blow-out Model and the patented DyMESH 3-D Collision Model.

## VALIDATED RECONSTRUCTION AND SIMULATION PROGRAMS AVAILABLE FOR *HVE* (cont.)

### *EDHIS*

EDHIS is a 3-D analysis of the response of a human occupant during a motor vehicle collision. EDHIS is based on the HSRI-3D model developed at UMTRI, and includes several extensions and refinements produced by EDC. The model was developed as a tool to study advanced safety concepts and designs of seat restraint systems from the viewpoint of occupant protection. EDHIS employs airbag and belt (torso and lap) models useful for studying issues related to restraint system effectiveness. EDHIS is a 12 degree-of-freedom analysis, dividing the body into three masses (head, torso and lower extremities) and 2 joints (neck and hips). The body is visualized using the HVE 15-segment /14-joint human model by combining the head and neck segments to form the head; the pelvis, abdomen and chest segments are combined to form the torso; the right and left upper legs, lower legs and feet are combined to form the lower extremities.

### *GATB*

GATB (Graphical Articulated Total Body) is a 3-D computer model based on the computer program ATB (Articulated Total Body). The GATB model may be used to study occupants or pedestrians involved in motor vehicle collisions. GATB represents the human body with 15-segments and 14-joints. The GATB model has 48 degrees-of-freedom for each human. Each of the 15 mass segments can move and interact with the environment. GATB computes human kinematics, joint angles and torques, contact forces between the human and contact panels attached to the vehicle, and contact forces between humans or between a single human's limbs. Using GATB, up to 4 human models can be placed inside a car during a crash to predict how the humans would move, what they would hit inside the car, or how an ejection could occur. GATB can also be used to simulate a human body being struck by a vehicle's exterior to study pedestrian impacts. (Developed and supported by Collision Engineering Associates, Inc.)

### *EDGEN*

EDGEN uses positions and velocities supplied at up to eight user-specified locations (e.g. Initial, Pre-braking, Impact, etc) to determine the time required to travel between each location. Using this time, EDGEN calculates the average linear accelerations between each location, and then calculates the current velocity and position at each timestep between the user-entered positions

## ALSO AVAILABLE FOR *HVE*

### *EDVDB-3D Vehicle Database*

EDVDB-3D is a comprehensive vehicle database developed by EDC for use with *HVE*. EDVDB-3D contains several hundred unique vehicles. Every vehicle in the database is complete with all the data necessary to perform a complex reconstruction or simulation. The use of EDVDB-3D will improve results, increase productivity and save time.

### *EDKEY*

The EDKEY provides the flexibility to use the software on multiple computers, such as a desktop and a laptop. Simply plug the EDKEY into the computer that you wish to run the software on, and the application is unlocked. This flexibility makes is easy to work on computers at your office, your home or while traveling.

**For more information about *HVE*, contact EDC Customer Service or visit our website at www.edccorp.com. The website offers detailed product descriptions, tutorials, simulation movies, technical publications, newsletters and other helpful information available to directly download from the pages of the site.**



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