# EDC

Technical Newsletter

HVE Version 4 Coming in November!

Finally, the words you have waited for all summer….*HVE* Version 4 will ship next month! Multiple teams of engineers have been thoroughly testing and debugging to ensure the code is robust, stable and ready for use on your cases. Those of you who have been following the progress of *HVE* Version 4 via our website FAQ page are aware that we are now in the final processes of field testing and validation. The FAQ page also contains information on suggested computer requirements and benchmark comparisons. This page will be updated with more information, so be sure to visit it at www.edccorp.com/products/hvev4faq.html. The screenshots on this page are examples of the new, integrated single-window interface design.

E-mail: newsletter@edccorp.com
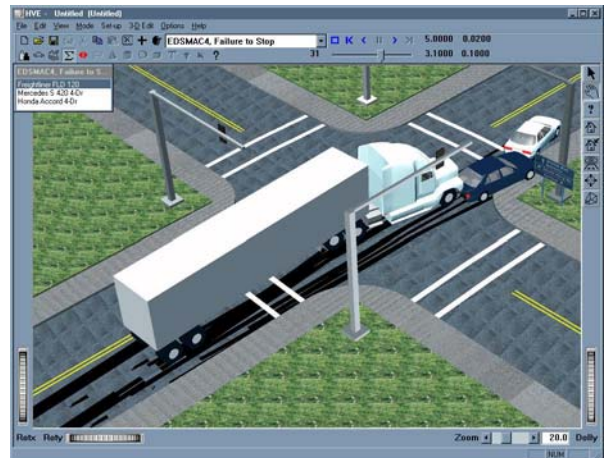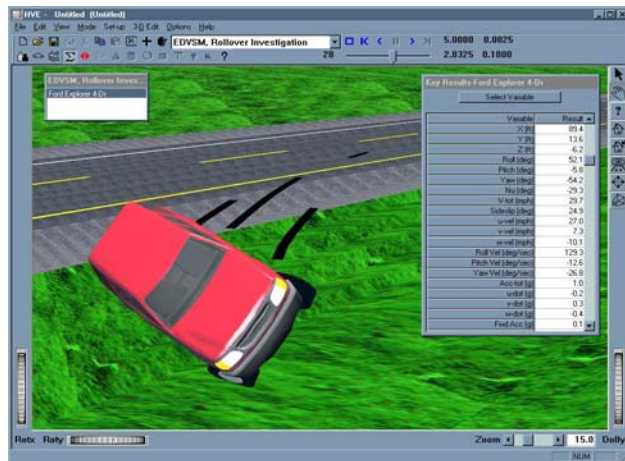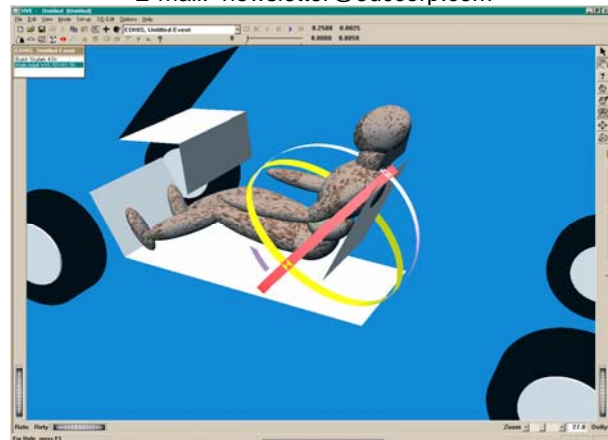
WELCOME!

The EDC Technical Newsletter is published for the benefit of *EDVAP*, *HVE-2D*, and *HVE* users. Its purpose is to pass along ideas and innovations that might improve your use of EDC software. If you have any questions or comments, please contact:

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INSIDE

Technical Session

This installment of the Technical Session discusses time-distance studies. A time-distance study is used to define the relative positions of two or more moving objects as a function of time. (The objects are typically vehicles and/or humans – although they may conceivably be anything.) The study may be tabular (i.e., X-Y coordinates vs. time) or visual (i.e., a trajectory simulation). If visual, it may be 2-dimensional or 3-dimensional. In any case, the goal of a time-distance study is to define what is often referred to as the *last clear chance* for each driver and/or pedestrian to avoid a possible collision. By comparing the time at which the last clear chance occurs for each participant with typical human perception-reaction times, the crash recon-structionist can draw conclusions regarding causation and avoidability.

Our Technical Session will use *EDSMAC(4)* to demonstrate the procedures involved. We will assume the crash has already been reconstructed and simulated. Thus, pre-impact paths and initial velocities are known. A little planning helps: start the simulation well before impact so the simulation begins before the point of last clear chance. The methods for *HVE-2D* and *HVE* are different, so they will be discussed separately.

HVE-2D **Procedure**

A scaled diagram of the crash sequence is shown in Figure A. The simulation is executed at 0.1 second intervals. As the vehicles progress along their pre-impact trajectories, identify the time when visibility begins. Referring to Figure A, Point A, represents the obstruction. Think of point A as a "fulcrum". Rotate a straight edge (e.g., a ruler or similar object) about point A until the straight edge intersects the driver's eye and the first visible part of the other vehicle *at the same simulation time*. Do this for each vehicle's driver, identifying this time (let's call it T_n, where n is the driver's vehicle number). You may find that the driver of one vehicle can see the other vehicle slightly before or after the other driver can see his/her vehicle.

Next, note the simulation time for various important events: the time at which each vehicle begins steering ($T_{Steer,n}$), the time at which each vehicle begins braking ($T_{Brake,n}$), and the time of collision (T_{Coll}). We now have all the necessary data to draw some very important conclusions:
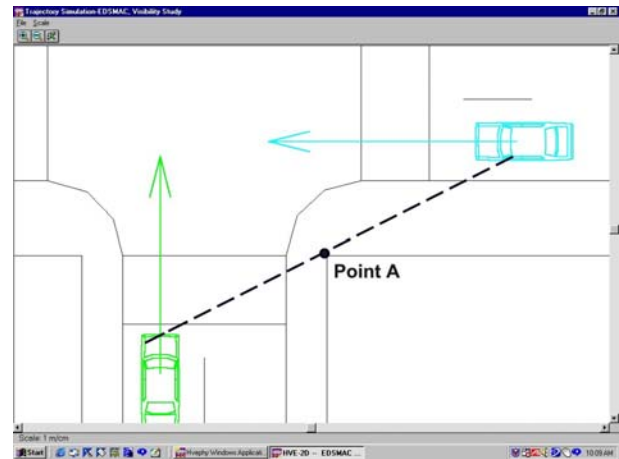

Figure A-HVE-2D Scaled Diagram of Crash Sequence

The total time available (T_{Avail}) for driver n to avoid impact is

$$T_{Avail,n} = T_{Coll} - T_n \qquad \text{(Eq. 1)}$$

The actual perception/reaction time ($T_{P/R,Steer}$) driver n begins steering is

$$T_{P/R,Steer,n} = T_{Steer,n} - T_n \qquad \text{(Eq. 2)}$$

The actual perception/reaction time ($T_{P/R,Brake}$) driver n begins braking is

$$T_{P/R,Brake,n} = T_{Brake,n} - T_n \qquad \text{(Eq. 3)}$$

By comparing $T_{P/R}$ with accepted values (see footnote), one can draw important conclusions regarding driver attentiveness.

The above procedure shows why a scaled trajectory simulation has a major advantage over a tabular approach: The table does not include the effect of the obstruction. Thus, when a table is used, the reconstructionist still needs to plot the distances on a scaled diagram that includes the obstruction.

Footnote
Olsen (SAE Paper No. 870600) provides a good reference for driver perception/reaction times. For designing highways, the AASHTO Manual (A Policy on the Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials, Washington, DC, 1990) uses 2.5 seconds as a visibility requirement.

HVE Procedure

A 3-D model of the crash site is shown in Figure B. The procedure is quite similar to the procedure for HVE-2D. One huge difference is that *HVE* allows the user to attach the camera to the vehicle at the driver's vehicle-fixed eye coordinates so you can *see* when the other vehicle becomes visible. Proceed to display the simulation, stopping when the other vehicle first becomes visible. This has been done in Figure B (note the other vehicle is just becoming visible beyond the corner of the building). Again, repeat this process for the other driver; the times may be slightly different.

Eqs. 1 through 3 (previous page) are also used for the *HVE* procedure.
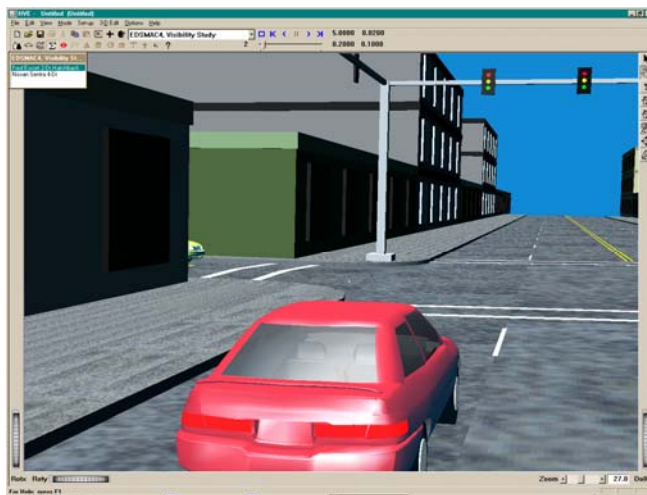

Figure B-HVE Event View of Crash Sequence

Note there is a significant benefit to using *HVE* for a time-distance study: In addition to learning directly about visibility through the use of a vehicle-fixed camera, the user inherently learns about *conspicuity*. For example, a simple tabular study or *HVE-2D* simulation tells the user when visibility first exists, but it does not address the qualitative aspect, *How Visible?* Straight-line visibility may exist between a driver's eye and a child's head, but that does not say anything about *how visible* the child's head might be from a distance of, say, 300 feet (can you pick out a cantaloupe a football field away?).

EDC Technical Reference Library

EDC has a library of technical papers and other publications that may be extremely helpful to you. In many cases the publications are free, while others require a fee to cover the cost of printing and handling. For a detailed listing of the publications, please visit the Library section of the EDC website at www.edccorp.com. Here is a list of a few of the available publications:

"An Overview of the Way EDCRASH computes Delta-V", SAE 870045, Engineering Dynamics Corp., 1987.

"An Overview of the Way EDSMAC computes Delta-V", SAE 880069, Engineering Dynamics Corp., 1988.

"Application and Misapplication of Computer Programs for Accident Reconstruction", SAE 890738, Engineering Dynamics Corp., OR, 1989.

"Further Validation of EDCRASH Using the RICSAC Staged Collisions", SAE 890740, Engineering Dynamics Corp., 1989.

"Further Validation of EDSMAC Using the RICSAC Stage Collisions", SAE 90010, Engineering Dynamics Corp., 1990.

"Validation of Several Reconstruction and Simulation Models in the HVE Scientific Visualization Environment", SAE 960891, Engineering Dynamics Corp., 1996.

"Updating the Vehicle Class Categories" SAE 960897, Engineering Dynamics Corp., 1996.

"Validation of the EDVSM 3-Dimensional Vehicle Simulator", SAE 970958, Engineering Dynamics Corp., 1997.

"Differences Between EDVDS and Phase 4", SAE 1999-01-0103, Engineering Dynamics Corp., 1999.

"An Overview of the EDSMAC4 Collision Simulation Model", SAE 1999-01-0102, Terry D. Day, Engineering Dynamics Corp., 1999.

"Validation of DyMESH for Vehicles vs. Barrier Collisions", SAE 2000-01-0844, Terry D. Day, Engineering Dynamics Corp., Allen R. York, AR York Engineering, Inc. 2000.

"Applications and Limitations of 3-Dimensional Vehicle Rollover Simulation", SAE 2000-01-0852, Engineering Dynamics Corp., 2000.

User Hints and Tips

General

- Cases of secondary vehicle impact (where two vehicles impact each other twice) can be reconstructed easily using *EDCRASH*. The technique is to perform a momentum only analysis. Obviously, this will not work for collinear impact, but collinear impacts rarely result in secondary collisions. If you do put in damage for an event in which there was a secondary collision, you are likely to receive an error message because the damage analysis ignores the second collision.

HVE

- You can make "photographs" of whatever is on your screen using a program called snapshot. Simply open a winterm on your SGI, and type "snapshot". A small gray box will appear with the word "snapshot" written in white letters across it. Move your cursor on top of the box and it will change from the shape of an arrowhead to the shape of a camera. Press and hold down the left mouse button while in camera mode and you can stretch a rubber band to define the border of your picture. After placing the first corner, you can go back to the opposite corner and place that one. If your rubber band is not exactly how you want it, you must start again by going back to the snapshot box. Once your rubber band is positioned properly, click the right mouse button to access the menu for saving and exiting. First, assign a new file name ending in the .rgb extension. Then save, or exit and save. You will now have the .rgb file, entitled yourfile.rgb, in the directory from which you typed "snapshot".

- If you are going to transfer this figure to a PC and use it in software such as Microsoft Word or Adobe Illustrator, however, you now need to convert the .rgb file to .tif. You can do this, as well as any editing, in Image Works. Simply type "imageworks" in the winterm, click on File-Open, and select your file. When ready to save, select File-Save As. Under File Format, select TIFF. Use the Set Directory buttons to

- Identify the location in which you want your new file to reside. Enter the new file name as yourfile.tif Click Accept. You are now ready to use the image for making reports, slides, posters, or whatever you need.

- Take advantage of *EDGEN* to make humans, vehicles, or just about anything move in a prescribed path where simulation is not important. An important example of *EDGEN's* utility is when there are vehicles in the scene that are not involved in the event that you are simulating. Create one or more *EDGEN* events with these vehicles and combine them with the simulation in the Playback Editor.

HVE-2D

- You can make "photographs" of whatever is on your screen for use in reports, slides, posters, or wherever you need them. With the image open (Trajectory Simulation, Damage Profile window, etc.), select the window that you wish to capture by clicking on the title bar. Press the Alt and Print Screen buttons simultaneously. Open the Paint Application. On most PCs you can find this by clicking on the Start button in the lower left-hand corner of the screen and selecting Programs-Accessories-Paint. With Paint open, go to File-Paste (ctrl-v). This will place an image of the selected window into the Paint window. Without clicking on the image, go to Edit-Copy To. This allows you to save the image to a file. Give the file a name and select the desired file format. You are now ready to use the image for making reports, slides, posters, or whatever you need.

- If you are a new user of *HVE-2D*, make sure to work through the tutorials found at the end of each chapter in the Physics Manual. By doing the tutorials, you will learn how to navigate efficiently through the interface and gain a

greater understanding of the physics programs.

HVE-2D FAQ's

This section contains answers to questions submitted to Technical Support by users of the new HVE-2D Version 1.32.

Q. What is the source for the tire data found in the Vehicle Editor?

A. All default tire data in the *HVE-2D* Vehicle Database is based on results from experimental studies performed by Calspan, UMTRI, or EDC. The majority of data for passenger vehicle tires is derived from tests performed by Calspan Corporation in 1983 [*Extended Tire Testing*; Tapia, G.A.; Report No. 6871-V-1, Nov. 1983]. These tires were tested on Calspan's flat-bed tire test machine. The majority of data for heavy truck tires is derived from tests performed at the University of Michigan in 1981 [unpublished data; University of Michigan Transportation Research Institute, 1981]. These tires were tested on UMTRI's flat bed tire test machine. Tire data for tires that were not tested by either Calspan or UMTRI are found by interpolating between actual test data. There is very little tire data available past the early 1980's. However, in 1999 EDC conducted a comprehensive test program of 21 unique tires at the Calspan tire test facilities. This data is available for purchase from EDC's Library section at www.edccorp.com.

Q. When I position vehicles during event set-up by using the manipulator I can only set the yaw angle to between −180 deg and 180 deg. What if I want the angle to be outside that range?

A. You have realized the importance of differentiating between −140 deg and 220 deg. In HVE-2D, the direction of rotation is inferred by the difference in heading angles between user-entered positions. In order to enter angles outside the range of −180 to 180, you

must enter the yaw angle numerically in the Position/Velocity dialog window. Remember to press the Enter key after typing in your value.

Q. When I open the Damage Profile Preview Window for an *EDSMAC* simulation, the vehicle does not look damaged. Why?

A. You must open both a Trajectory Simulation and a Damage Profile Preview Window for your event in the Playback Editor to view vehicle damage. Similar to playing a Trajectory Simulation, when you press the Play button in the Playback Editor you will see the damage displayed as a function of time. More detailed instructions on viewing damage are included in the file HVE2d/damage.DOC.

Q. I notice that the size of case files saved in version 1.32 is much larger than version 1.2 cases. Why? Also, how can I reduce the size of case files?

A. If you save a case after executing the event, the output tracks (time-based data) now include the damage profiles, which is a large amount of additional data. If you want to minimize the size of your files to save space on your hard drive, press the reset button in the Event Editor before saving the file for the final time. This will erase your output tracks, but will not affect your event set-up. The next time you open the file again, simply run the event to recreate the output tracks.

Q. I am using Windows NT as the operating system for my PC, and sometimes I can't enter values into the driver control tables (e.g. throttle, brakes, and steering) or the *EDCRASH* damage profile crush depth table. Why?

A. When using the NT operating system, these tables may sometimes stop responding to user inputs. This problem is related to *HVE-2D's* ability to run in Windows 3.1 (a 16-bit operating system). The workaround for this problem is to save your file and exit *HVE-2D*, then shut down and restart your computer. You can then restart *HVE-2D* and pick up where you left off.

Product Announcements

Reserve Your HVE Demo CD Today!

Version 4 of the *HVE* 3-D simulation environment is shipping in November! Now is the perfect time to discover how *HVE*-compatible physics programs will bring you closer to your work, whether in vehicle dynamics, occupant safety or crash reconstruction.   *HVE* will also make you more efficient and effective in your work. Contact EDC today to reserve your *HVE* Version 4 Demo CD and experience the power for yourself!

With the Demo CD, you can explore the capabilities of the 3-dimensional human and vehicle simulation models, the sophistication of state-of-the-art collision models, review several example simulation studies and also view detailed simulation results and movie files generated directly by *HVE*. The Demo CD will allow you to use *HVE* for 30 days, without obligation.

HVE Version 4 is fully compatible with Windows® 98, 2000 and NT® operating systems, allowing you to install *HVE* directly on your own desktop PC, laptop or network server. Visit the *HVE* Version 4 FAQ page on the EDC website for more information.   You will find this page at www.edccorp.com/products/hvev4faq.html.

HVE-2D v.1.32 Now Shipping

The latest release of *HVE*-2D is shipping to all *HVE*-2D users during the month of October. Version 1.32 is a minor update, mostly containing bug fixes for Version 1.30. A full set of updated Operations manuals and updates to sections of Physics manuals are being shipped along with the CD. Please make the time to install your Version 1.32 update and also replace the pages in your manuals.

Nine new vehicle models have been added to the EDVDB vehicle database. These models account for over 45 model years of vehicles. *EDVDB* now contains well over 700 vehicles spanning model years from 1968 to 1999.

A transparent feature that occurs during the installation of the Version 1.32 update is the adjustment of the environment variable for HVESYSFILES. By replacing the existing lines in the autoexec.bat file with new lines for HVE2DSYSFILES, all *HVE*-2D users who wish to try out *HVE* on their PC will be able to successfully install and use the *HVE* Version 4 Demo CD.

SIMON® and DyMESH®

HVE users are now taking advantage of the latest advancement in software and simulation technology by using the *SIMON* vehicle simulation model. *SIMON* provides an advanced analysis capability for simulation studies involving single vehicles, articulated vehicles, collisions, vehicle design issues and safety research. *SIMON* can also use the *DyMESH* 3-D collision model to calculate 3-D forces and moments between the interacting meshes of vehicle models. These forces are included with aerodynamic, suspension and inter-vehicle connection forces calculated by *SIMON* and each time step of simulation.

SIMON uses a new, general-purpose 3-D dynamics engine developed by Engineering Dynamics Corporation. The dynamics engine allows a sprung mass with six degrees of freedom (x, y, z, roll, pitch, yaw) and unsprung masses with up to five degrees of freedom (axle roll, z, steer, left wheel spin, right wheel spin) per axle. Each vehicle model may have up to three axles (six axles for full trailers) and single or dual tires.

SIMON is available as a model for studying the response of any number of unit vehicles simultaneously. There are two options for *SIMON* that allow you to extend your studies to articulated vehicle configurations, and/or to study inter-vehicle collisions. The first option allows you to create articulated vehicles using compatible front and rear connections. The second option allows you to use the *DyMESH* 3-D collision model. If you simply wanted to study crashes between unit vehicles, you would use *SIMON* with the *DyMESH* option. If you wanted to study crashes involving both unit vehicles and articulated vehicles, you would use *SIMON* with both options.

At the present time, *SIMON* may only be used as a vehicle dynamics simulation model for studying unit and articulated vehicle configurations. The *DyMESH* 3-D collision model option for *SIMON* will be introduced before the end of the year. For more information about how to put *SIMON* to work for you, please contact the Sales Department or visit our website at www.edccorp.com.

HVE Version 3.01 Now Available

Version 3 of the *HVE* 3D simulation environment was shipped the week of June 19, 2000. New functionality implemented in Version 3 will allow for simulation studies involving steer degree of freedom, change in weight distribution due to occupant loading, and events including more than 3 trailers. *HVE* users will notice several refinements to the interface have also been implemented.

HVE Version 3 has been compiled for both IRIX 6.3 and IRIX 6.5 operating systems. This has eliminated the interrupted message queue process and event reset problems, which may have been experienced by *HVE* users with the IRIX 6.5 operating system. *HVE* users will be sent the proper *HVE* version corresponding to their IRIX version.

HVE users still using IRIX 6.3 may now wish to update to IRIX 6.5. It is not mandatory that you do so in order to use *HVE*. If you are going to update to IRIX 6.5, please contact EDC Technical Support for basic instructions before proceeding with the update.

Past Technical Sessions Now Available

EDC has reformatted and compiled all of the Technical Session, Tips, and Contributor's Corner columns from each Technical Newsletter, dating from Jan/Feb 1986 to present. The valuable information presented in these columns will increase your knowledge of the physics models and the *HVE*, *HVE*-2D, and *EDVAP* programs, as well as provide examples of powerful applications of the software. The price for the document is US $45.00 and includes shipping within the US. International customers will pay additional shipping charges to their delivery address.

EDC's Website

Make sure to visit the EDC website at http://www.edccorp.com to check out upcoming events and new products, and to visit our library of

technical papers and other reference materials. You can order all of these publications from EDC, many of them free of charge.

Technical Support

Technical Support can be reached by telephone between 8:00 AM and 5:00 PM PST at 503-644-4500 and by email at support@edccorp.com. Please be ready to provide your user ID# , your name, your company name and contact phone number when you call or include it directly in your email.

Training Courses

Vehicle Dynamics

Theoretical and Applied Vehicle Dynamics extends the theory of the SAE course and includes direct applications using the *HVE* three-dimensional simulation environment as well as a solid theoretical background for such simulations. The course is focused toward those with an advanced interest in vehicle dynamics, accident reconstruction and simulation.

EDC Reconstruction & EDC Simulation

EDC provides excellent 1-week training courses on the use of EDC Reconstruction or Simulation software. Even long-time users agree that the courses are extremely beneficial and challenging.

The courses are designed to investigate fully the program's inner workings. Lectures are full of helpful hints gained from years of experience.

HVE Forum

The *HVE* Forum is an excellent opportunity for *HVE*, *HVE-2D* and *EDVAP* users to jump to a new level of ability. By participating in workshops and special lectures, attendees can brush up on their present skills, learn new techniques of applying simulation modeling, and learn how to use the latest advancements in the software. The *HVE* Forum also presents a great opportunity to meet other users and expand your network of resources and information.

Course Registration

Our courses are typically full, so be sure to register early to avoid missing out! You may register for a course simply by contacting EDC Customer Service at 503-644-4500, or by sending an email to training@edccorp.com. We look forward to seeing you at our next course!

Engineering Dynamics Corporation
Training Courses

EDC Simulations

Los Angeles, CA .... January 22-26, 2001

Coral Gables, FL……………… November 13-17, 2001

EDC Reconstruction

Coral Gables, FL .... November 13-17, 2000

Theoretical and Applied Vehicle Dynamics

Southwest, USA…………………………..January, 2001

Upper-Midwest, USA…………………………April, 2001

2001 *HVE* Forum

Santa Fe, NM .... May 7-11, 2001

NUCPS Training

NUCPS offers four different courses using *EDVAP* and/or *HVE-2D*. For more information about the courses and registration, please contact NUCPS at (800) 323-4011.

Northwestern University Center for Public Safety Training Courses

MATAR (*EDCRASH*)

Evanston, IL .... March 19-23, 2001

COMPTAR I (*EDCRASH*)

Evanston, IL .... March 12-16, 2001

COMPTAR III (*EDSMAC*)

Evanston, IL .... October 2 - 6, 2000

COMPTAR IV (*EDCRASH* & *EDSMAC* Extended)

Evanston, IL .... March 26-30, 2001