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## Computer Based 3D Wildland Fire Simulation Program

**Case Study: USFS** *courtesy Web Site Dynamic Animations Systems Inc., Contractor for the National Fire Academy and the US Forest Service.* <http://www.d-a-s.com>

Through a partnership with the National Fire Academy, DAS was selected to support the training needs of the USDA Forest Service. To support one of their training needs, DAS developed a 3D wild land fire fighting training simulator. The software operates on a standard PC platform with a “windows operating system”. This training simulator provides a physically realistic fire propagation model based on fuel types, various environmental conditions, and the terrain topography. Trainees have the ability to request resources and build fire lines to hinder and stop the propagation of the fire, and instructors have the ability to alter the environmental conditions that in turn affect the behavior of the fire.

The training environment consists of two or more networked PCs where one PC acts as the instructor’s console and the other PCs are the student workstations as shown in the following figures:

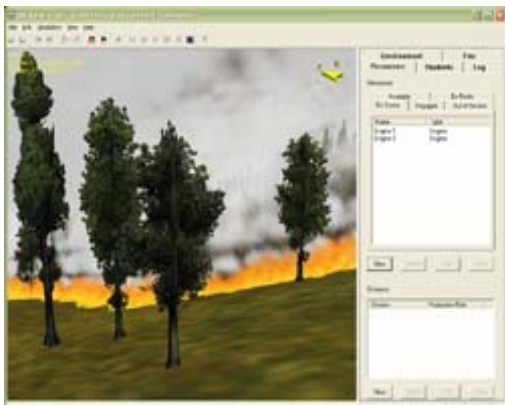


Fig.1 Instructor Workstation illustrating approaching fire

Instructors are given complete control over the simulation environment with the ability to affect the fire propagation by changing environmental conditions such as wind speed and direction and the ability to speed up or slow down the propagation based on student experience. Students have minimal interaction with the actual simulation environment. Their actions and decision-making process indirectly effect the environment based on changes made to the environment by the instructor.

For example, based on available resources the students may decide to construct a fire line beginning at the heel of the fire and proceeding up the left flank. From this request the instructor would decide when those resources arrive and then define the fire line at the instructor’s console. The students would then begin to see the results of their decision as the fire proceeds and is impeded by the constructed line and as the fire may escape around the line if improperly constructed. The entire simulation is recorded for after-action-review in the classroom.

As a follow-on task to the simulation environment DAS is developing a scenario editor application that allows the USFS define and construct the simulation world from scratch. The scenario developer begins with the height field definition of the terrain. Currently the format of the height field information can be in either the Windows BMP format or the USGS SDTS DEM format. From the height field information, the scenario editor constructs the terrain skin based on the user-defined post spacing. Once the terrain skin is defined, the developer can apply geo-typical textures, populate the terrain with a number of vegetation types, structures, and miscellaneous objects. Road networks and water sources (e.g. streams and ponds) can also be defined.

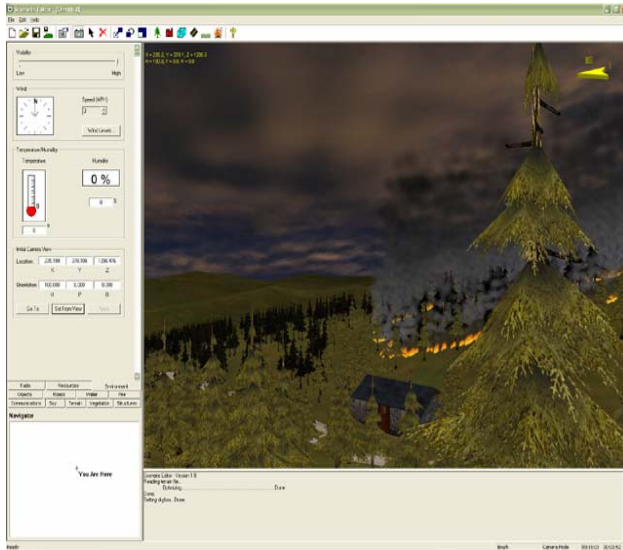


Fig.2 Scenario Editor Screen shot showing the fire approaching upon the Urban-Wildland Interface.

The scenario editor used to design USFS training simulations. The designer can start with an empty terrain and completely design the environment down to the individual trees, road networks, water sources, and structures.

The scenario editor also has the ability to define the initial environmental conditions, the resources (e.g. dozers and engines) that will be available to the students, how fire propagates with respect to the various fuel types, and the roles that individual student work stations will play in the scenario. Future enhancements plan to include light scattering to simulate the effect of inversion where morning temperatures cause the smoke in the environment to pancake and fill the region. As the day progresses, the inversion breaks and releases the smoke and gives the fire new life. Light scattering will also add the ability to alter the time of day in real-time.



fig. 3 Visual representation of inversion through light scattering.

Other planned additions include:

- Addition of the audio clues such as the sound of the roaring fire and helicopters flying by to provide water drops.
- The ability to import USGS DLG shape files into the scenario editor to automatically generate the location of vegetation, road networks, water sources (e.g. lakes and streams), structures, etc.
- A simulation log/database viewer for class pre-loading and after action review (AAR)
- Visual representations of various weather conditions such as rain.
- Fire spread through the tree crown
- Audio tracking of voice traffic and syncing of the audio to the simulation for AAR
- Development of Graphics Library for Geographic area specific Vegetation Types; Brush, Trees. Structures and Objects.