

of sight of an observer. The present invention operates on any scenes, using the derived radiance and transmittance of the cloud to arrive at a new scene with the cloud affects present in a physically correct manner.

An equation for radiative transfer to infrared imagery is as follows:

where $LO(i,j)$ is the radiance from scene element (i,j) in clear air, $T(i,j)$ is the transmittance of the smoke cloud for the (i,j) scene element, LC is the radiance of the smoke cloud due to the thermal emission of the aerosol that makes up the cloud, and $LS(i,j)$ is the path radiance due to scattering. ATLAS simplifies this equation by ignoring the path radiance due to scattering. This does not mean that path radiance due to scattering is not important. Path radiance is ignored because it is difficult to account for and is many times a small affect. The simplified equation can be rearranged to yield the following expression for transmittance:

Whereas the present invention deals with adding real clouds to simulated or real two-dimensional scenes, the following four articles deal with creating *artificial clouds* in simulated two-dimensional scenes: "Visualization of Battlefield Obscurants," by G. Y. Gardner and G. M. Hardaway, 1992, in Proceeding of the 1991 Battlefield Atmospheric Conference; "Theoretical and Measured Fractal Dimensions for Battlefield Aerosol Cloud Visualization and Transmission," by D. W. Hoock, 1992, in Proceedings of the 1991 Battlefield Atmospheric Conference; "Modeling Time-Dependent Obscuration for Simulated Imaging of Dust and Smoke Clouds," by D. W. Hoock, 1991, in SPIE Vol. 1486 Characterization, Propagation, and Simulation of Sources and Backgrounds, pp. 164-175; and "Improved COMBIC and Fractal Smoke Models for Use in the TACOM Thermal Image Model (TTIM)," by F. G. Smith, C. S. Hall, T. J. Rogne, and J. L. Manning, 1990, in Proceedings of the Tenth Annual EOSAEL/TWI Conference.

U.S. Pat. No. 4,493,647, entitled WEATHER RADAR SIMULATOR, discloses a device for simulating a weather radar in an aircraft simulator. The device of U.S. Pat. No. 4,493,647 generates a radar signal for different cloud formations that are stored in a memory device. U.S. Pat. No. 4,493,647 does not add real clouds to a simulated two-dimensional scene as the present invention does.

