1014-74-73 **James D Walker*** (jwalker@swri.edu), Southwest Research Institute, Division 18/Bldg. 88, 6220 Culebra Road, San Antonio, TX 78238. *The Mathematics of Space Shuttle Return to Flight: Impact Damage Modeling.*

With the loss of the space shuttle Columbia, the Columbia Accident Investigation Board recommended that detailed mathematical models of various aspects of space shuttle operations be developed. The huge return-to-flight effort has had a goal of quantifying risk and has been developing the recommended physics-based models of various phenomena. This talk will overview the return-to-flight effort in quantifying impact-related risk to flying the space shuttle. Particular discussion will focus on the models for debris impact into the thermal tiles. The models have at their center a full-fledged Riemann solver for the strongly nonlinear materials such as the thermal tiles and the insulating foam from the external tank. The Riemann solver is based on the Hugoniot jump conditions that produce discontinuous, weak solutions to the hyperbolic conservation equations. The assumptions in the model then reduce the impact problem to a system of ordinary differential equations that are solved numerically. The models will be described and will be compared to large-scale numerical simulations of impact and experimental data for ice, insulating foam and ablator materials striking thermal tiles. The application of the models in the shuttle program will be detailed. (Received July 18, 2005)