Aerospace Engineering Doctoral Defense

Reduced Order Model-Based Prediction of the Nonlinear Geometric Response of a Panel Under Thermal, Aerodynamic, and Acoustic Loads

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abstract

The accurate response prediction of hypersonic aircraft panels to the extreme loading environments of hypersonic flight is of immense importance to the U.S. Air Force. However, the extreme nonlinearity of the response, as well as the multidisciplinary nature of the problem results in full order simulations that require an unrealistic amount of time and computational power to be carried out. Reduced order modeling has emerged as a potential solution to this problem, offering a reduction in the effective degrees of freedom of the problem, while maintaining accurate response predictions. The work to be presented involves a representative hypersonic panel subjected to thermal, aerodynamic, and acoustic loads. The structural displacements and temperature fields are predicted using reduced order models (ROMs), while the aerodynamic pressure and heating are accounted for with piston theory and Eckert's reference enthalpy method, respectively. Results from the ROM are validated using full order finite element analysis (Nastran).

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