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Predictive Analytical Model for Isolator Shock-Train Location in a Mach 2.2 Direct-Connect Supersonic Combustion Tunnel JOE LINGREN, LEON VANSTONE, KELLEY HASHEMI, The University of Texas at Austin, SIVARAM GOGINENI, Spectral Energies LLC, JEFFREY DONBAR, Air Force Research Laboratory, MARUTHI AKELLA, NOEL CLEMENS, The University of Texas at Austin — This study develops an analytical model for predicting the leading shock of a shock-train in the constant area isolator section in a Mach 2.2 direct-connect scramjet simulation tunnel. The effective geometry of the isolator is assumed to be a weakly converging duct owing to boundary-layer growth. For some given pressure rise across the isolator, quasi-1D equations relating to isentropic or normal shock flows can be used to predict the normal shock location in the isolator. The surface pressure distribution through the isolator was measured during experiments and both the actual and predicted locations can be calculated. Three methods of finding the shock-train location are examined, one based on the measured pressure rise, one using a non-physics-based control model, and one using the physics-based analytical model. It is shown that the analytical model performs better than the non-physics-based model in all cases. The analytic model is less accurate than the pressure threshold method but requires significantly less information to compute. In contrast to other methods for predicting shock-train location, this method is relatively accurate and requires as little as a single pressure measurement. This makes this method potentially useful for unstart control applications.

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