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Transient Dynamics Modeling of Experimental Hypersonic Inlet Unstart[1] KELLEY E. HUTCHINS, MICHAEL SZMUK, NOEL T. CLEMENS, MARUTHI R. AKELLA, The University of Texas at Austin, JEFFREY M. DONBAR, Air Force Research Laboratory, Wright-Patterson AFB, SIVARAM GOGINENI, Spectral Energies, LLC — During unstart, the rapid upstream propagation of a hypersonic engine's inlet-isolator shock system can be readily detected through pressure measurements. Specifically, the magnitude of the pressure readings suddenly and dramatically increases as soon as the leading edge of the shock system passes the measurement location. In this work, attempts to model the transient dynamics governing shock motion have been made through the use of system identification techniques. The result of these efforts is a partially nonlinear dynamic model that describes shock motion through pressure signals. The process reveals the possibility of partitioning the nonlinear behaviors from the linear dynamics with relative ease. Related attempts are then made to create a model where the nonlinear portion has been pre-specified leaving only the linear portion to be determined by system identification. The modeling and identification process specific to the unstart data used is discussed, and successful models are presented for both the full system identification and the partitioned model cases. The suitability of various input data types is explored, and comments on practicality are made.

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