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FREQUENCY BEHAVIOR OF LIQUID FUELED RAMJET WITH VARIABLE AREA NOZZLE

Abstract

The performance of liquid fueled ramjet with adjustable nozzle is directly relevant to the optimal control of terminal shock position by proper manipulating the fuel flowrate and nozzle throat area. To design such control system, it is essential to model the dynamics of ramjet. The linear ramjet model with multiple inputs based on linearization of one-dimensional governing equations is therefore developed including the inlet dynamics, shock motions, heat release dynamics in combustor and the dynamics of adjustable exhaust nozzle. Then the frequency responses of shock position to fuel flowrate and nozzle throat area are obtained and compared, however, it is inconvenient for controller design, so frequency identification is used to get the rational polynomial transfer function approximations(RPTFA), which agrees well with the original model in amplitude responses and phase shift. In order to obtain low order model for optimal control, the model reduction is applied. Results show that the agreement of the frequency behavior between the low order model and the high order model is good, which is useful to design the optimal control system of ramjet engine.