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Nonlinear Aerodynamic Parameter Estimation of a Supersonic Air to Air Missile by Using Artificial Neural Networks

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Abstract : Aerodynamic parameter estimation is very crucial in missile design phase, since accurate high fidelity aerodynamic model is required for designing high performance and robust control system, developing high fidelity flight simulations and verification of computational and wind tunnel test results. However, in literature, there is not enough missile aerodynamic parameter identification study for three main reasons: (1) most air to air missiles cannot fly with constant speed, (2) missile flight test number and flight duration are much less than that of fixed wing aircraft, (3) variation of the missile aerodynamic parameters with respect to Mach number is higher than that of fixed wing aircraft. In addition to these challenges, identification of aerodynamic parameters for high wind angles by using classical estimation techniques brings another difficulty in the estimation process. The reason for this, most of the estimation techniques require employing polynomials or splines to model the behavior of the aerodynamics. However, for the missiles with a large variation of aerodynamic parameters with respect to flight variables, the order of the proposed model increases, which brings computational burden and complexity. Therefore, in this study, it is aimed to solve nonlinear aerodynamic parameter identification problem for a supersonic air to air missile by using Artificial Neural Networks. The method proposed will be tested by using simulated data which will be generated with a six degree of freedom missile model, involving a nonlinear aerodynamic database. The data will be corrupted by adding noise to the measurement model. Then, by using the flight variables and measurements, the parameters will be estimated. Finally, the prediction accuracy will be investigated.

Keywords : air to air missile, artificial neural networks, open loop simulation, parameter identification
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