HYBRID GUIDANCE ALGORITHM WITH HEAT-FLUX CONSTRAINT FOR LAUNCH VEHICLES

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Abstract

A hybrid guidance algorithm is developed to meet the heat flux constraint in the exo-atmospheric phase of launch vehicles. The minimum allowable altitude for a particular vehicle velocity is decided by the heat flux constraint. If the optimal trajectory of the vehicle is close to the allowable minimum altitude, then the heat flux constraint is violated. The hybrid algorithm combines the features of a predictor-corrector and a uniform gravity (flat earth) based optimal algorithm. The predictor use a simplified vehicle model with closed loop steering to predict the minimum clearance from the heat flux boundary. The corrector determines a factor for boosting the effective gravity computed by algorithm on-board thus ensuring safe margin from the heat flux boundary. The uniform gravity based analytical algorithm uses this factor, to compute the steering commands. The hybrid guidance algorithm is implemented in the final phase of a three stage launch vehicle. Validation studies carried out using deterministic cases as well as Monte Carlo propulsion and initial conditions dispersions.