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COMPUTATIONAL OPTIMAL GUIDANCE FOR MOON POWERED DESCENT AND SAFE LANDING VIA GAUSS PSEUDOSPECTRAL METHOD

Abstract

As a clear trend in the field of aerospace guidance and control, Computational Guidance and Control (CGC) has emerged recently. In contrast to traditional guidance and control, guidance laws and controllers of fixed structures are replaced by algorithms. The generation of guidance and control commands extensively relies on online computation. The process of determining guidance and control commands does not require significant pre-mission planning, gain tuning, or extensive offline design of nominal references. Applying the idea of CGC, a computational optimal guidance algorithm could be designed for moon powered descent and safe landing. Development of a feasible guidance scheme for moon landers is a challenge because of its significant nonlinearity and multi-constraints. In the paper, a method for the implementation of three-degree-of-freedom guidance for constrained moon powered descent and safe landing is presented. First, the constrained trajectory is generated by Gauss pseudospectral method (including determine the optimal safe landing site) and then the feasibily of the trajectory is validated. Second, based on the obtained reference trajectory, the guidance problem is converted into a trajectory state regulation problem which is a linear time varying system. A robust state feedback guidance law is generated in real time using indirect Gauss pseudospectral feedback method. Finally, simulation results illustrate that the overall guidance scheme can lead to a very accurately controlled flight with all the constraints satisfied even in the presence of initial state uncertainty.