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NONLINEAR MODEL PREDICTIVE CONTROL FOR OBSTACLE AVOIDANCE IN PLANETARY LANDING

Abstract

To enforce a safety and zero landing position/velocity error objective in the descent phase of deep space missions, the onboard controller should be able to transfer the vehicle from its initial position to the landing site while obeying engineering constraints and avoiding large obstacles en route. This becomes particularly important for future landing missions as the requirement of scientific interest increases, indicating a more complicated landing terrain condition. In this paper, the obstacle information detected in a certain range ahead the vehicle is considered as part of the state vector and included into the optimization. The descent trajectory and feasible avoidance maneuver are generated applying nonlinear model predictive control which directly deals with the nonlinear constraints and largely cuts down the computational complexity. By considering possible mismatch between the actual system and its model, a robust autonomous safe landing system can be obtained and implemented in planetary soft landing missions with environment uncertainty. The proposed method is further validated in a simulated Martian environment and the result shows that the vehicle manages to avoid the large hills and reach the pre-defined landing site with satisfactory fuel consumption.