Real Time Adaptive Feedforward Guidance for Entry Vehicles

One of the most powerful analysis tools to deal with entry guidance problems is the possibility to formulate them as optimal control problems (OCPs). Environmental constraints, actuator limits, and strict requirements on the final conditions can be efficiently transcribed, resulting in a discrete, finite-dimension non-linear programming (NLP) problem. However, NLP problems require a computational power, which often exceeds the vehicle's onboard capabilities. Moreover, it is important to ensure that the nominal optimal solution can be adapted to the actual flight conditions, which can significantly differ from the nominal scenario. This paper proposes an approach based on multivariate interpolation to generate entry guidance solutions. The real-time capability is ensured in virtue of the lower CPU efforts required to execute the interpolation operation. The approach is here proposed for initial-conditions variations, but can in principle be applied to every mission parameter, which allows to find a corresponding optimal solution. Results have been generated for SHEFEX-3, an entry demonstrator vehicle scheduled to be launched in 2016.