Trajectory Optimization for State-constrained Control Problems Based on Hamilton-Jacobi Approach

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Abstract: In this talk, we will consider some state-constrained deterministic optimal control problems. For such problems, the main tools that have been developed, in the literature, are based on the Pontryaging Maximum Principle (PMP) or the Hamilton-Jacobi (HJ) approach. Both approaches give necessary conditions for the optimal controls and the associated optimal trajectories. They can also give sufficient optimality conditions under some suitable conditions. Usually, each approach is analysed separately and without connection with the other method.

It is known that a relationship between the two approaches exists and it allows to link the adjoint state with the sensitivity of the value function along the optimal trajectory. This relationship is well established when the control problem is without state constraints. In the case of control problems with state constraints, a relationship between the PMP and HJ approach has been also established under strong controllability conditions.

In this talk, we will give a general result for the relation between the PMP and HJ approach for some control problems with state constraints (including the case of end-point state constraint) and without assuming any controllability assumption. We shall then present a new algorithm for computing the optimal trajectories combing both approaches (PMP and HJ). An application to a launcher ascent trajectory problem is then considered. Several numerical simulations will be presented to discuss the relevance of the theoretical results.

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