

Coupling MPC and DP methods for optimal control problems

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Abstract: We consider the approximation of an infinite horizon optimal control problem which combines a first step based on Model Predictive Control (MPC) in order to have a quick guess of the optimal trajectory and a second step where we solve the Bellman equation in a neighborhood of the reference trajectory. The direct global solution approach via the Bellman equation can be rather expensive since we have to set the problem in a domain containing all the possible initial conditions x for the dynamics. Moreover, we have to impose (and choose) the appropriate boundary conditions for the Bellman equation. The main feature of MPC methods is to compute an approximate feedback control for the dynamics starting at a given initial condition x by solving a sequence of finite horizon optimal control problems. Therefore, it seems natural to first solve the problem for a given initial condition via MPC and then compute the value function in a neighborhood of that trajectory in order to reduce the global size of the computational problem. The second step is also necessary to allow for a more stable solution since we use the informations around the reference trajectory and not only those on the reference trajectory. We will present the main features of these new technique, and illustrate some numerical tests in order to show the effectiveness of this coupling.

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