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Optimal control and Hamilton-Jacobi-Bellman equations: Numerical methods and Applications

Exploitation of the value function in a bilevel optimal control problem

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Abstract: The talk discusses bilevel optimal control problems with optimal control problems at both levels. Such a problem is typically approached either by treating the lower level problem as an abstract nonlinear (and in general nonsmooth) function that depends on the variables of the upper level or by replacing the lower level problem by its necessary conditions of optimality, which leads to an optimal control problem with complementarity constraints. A third option, which is to be explored in this talk, is to exploit the value function of the lower level optimal control problem. To this end it is possible to reformulate the bilevel problem as an equivalent single level optimal control problem. A minimum time optimal control problem will be presented for which the value function can be computed analytically. For more complex problems, numerical methods are required to approximate the value function, provided the state dimension is low enough. Direct discretization methods are then used to solve the single level optimal control problem together with some smoothing of the value function. Finally, extensions towards bilevel scheduling problems will be presented.