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Fast Sweeping Scheme for the Infinite Horizon Optimal Control Problem in Continuous and Hybrid Systems

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Abstract

We implement an efficient algorithm to approximate the solutions to the Hamilton-Jacobi (HJ) equations arising in an infinite horizon optimal control problem. The fast sweeping method approximates the viscosity solution of the Dirichlet problem for HJ equations. The static HJ equation is discretized according to a monotone scheme, Godunov or Lax-Friedrichs, and the solution is approximated iteratively by using a Gauss-Seidel nonlinear updating process. The fast sweeping method have been extensively applied to a class of HJ PDEs, namely the eikonal equations. Through the Dynamic Programming Principle and convexity assumption on the control variable on the Hamiltonian, we derived a coupled HJ equations for continous-time systems. The sweeping algorithm is applied to solve the coupled PDEs in a Newton iterative fashion for the optimal cost and optimal control. In addition, the corresponding HJ equation for hybrid systems is solved in the similar way. We have numerical examples in both systems.