Numerical Methods for Optimal Controls for Nonlinear Stochastic Systems With Delays

Harold Kushner, Brown University

We are concerned with general nonlinear controlled stochastic dynamical systems, with delays, The Markov chain approximation numerical methods are widely used to compute optimal value functions and controls for stochastic as well as deterministic systems. For the no-delay case, the method covers virtually all models of current interest. The method is robust and the approximations have physical interpretations as control problems closely related to the original one. These advantages carry over to the delay problem.

The path, control, and reflection terms (if any) might all be delayed. When the control and reflection terms are delayed, current algorithms normally lead to impossible demands on memory. We will discuss an alternative dual approach, based on the association of systems with delays with forms of a stochastic wave equation. This leads to algorithms with much reduced memory requirements. The classical Markov chain method will be reviewed, and adapted to the approximation of the optimal value functions and controls for the system with delays. The approach is nonstandard. But the results of numerical computations that will be presented show that the approach has considerable promise. The convergence theorems will be outlined.