477d Approximate Dynamic Programming for Stochastic Inventory Control of Refinery Supply Chains

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A computationally efficient approximate dynamic programming (ADP) algorithm is developed for solving finite-horizon stochastic inventory control problems. Traditional multi-period formulations within the rolling horizon framework encounter computational difficulty due to the coupling of periods and scenarios, and can generate very poor solutions due to long lead times. Using high-order polynomial functions to approximate the value functions, the proposed ADP algorithm repeatedly solves single-period single-scenario mixed-integer nonlinear programming (MINLP) problems in a forward manner, and updates coefficients in a backward manner. However, active exploration can generate an infeasible decision. Thus a feasible decision is found through a secondary optimization with the objective to minimize the distance to the closest feasible point. This ADP algorithm is applied to a refinery inventory system with 4-echelons and long lead times. It is demonstrated that this approach can provide near-optimal solutions in a computationally efficient manner for solving a large-scale multi-product refinery inventory problem that includes nonlinear constraints and a large number of integer decision variables.