Stochastic Optimization for Steady State ProductionProcesses based on Deterministic Approximations

We consider steady-state production processes that produce a product and have feasibility constraints and metrics of cost and throughput that are stochastic functions of process controls. We propose an efficient stochastic optimization algorithm for the problem of finding process controls that minimize the expectation of cost while satisfying deterministic feasibility constraints and stochastic steady state demand for the output product with a given high probability. The proposed algorithm is based on (1) a series of deterministic approximations to produce a candidate set of near-optimal control settings for the production process, and (2) stochastic simulations on the candidate set using optimal simulation budget allocation methods. We demonstrate the proposed algorithm on a use case of a real-world heat-sink production process that involves contract suppliers and manufacturers as well as unit manufacturing processes of shearing, milling, drilling, and machining, and conduct an experimental study that shows that the proposed algorithm significantly outperforms four popular simulation-based stochastic optimization algorithms.