The Dynamic and Stochastic Shortest Path Problem with Anticipation

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Abstract

Mobile communication technologies enable truck drivers to keep abreast of changing traffic conditions in real-time. We assume that such communication capability exists for a single vehicle traveling from a known origin to a known destination where certain arcs en route are congested and that we know the likelihood, as a function of time, that congested arcs will become uncongested and thus less costly to traverse. Using Markov decision processes, we then model and analyze the problem of constructing a minimum expected total cost route from an origin to a destination that anticipates and then responds to service requests, if they occur, while the vehicle is en route. We provide structural results and illustrate the behavior of an optimal policy with several numerical examples and demonstrate the superiority of an optimal anticipatory policy, relative to a route design approach that reflects the reactive nature of current routing procedures.