# Scheduling synchromodal freight transport using Approximate Dynamic Programming

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**Abstract**

We study the problem of scheduling services and transfers for freight in a synchromodal network, over a multi-period horizon, considering probabilistic knowledge about new freights that arrive each period and their characteristics, and considering transport durations of more than one period. In a synchromodal network, any service (i.e., transport mode and schedule) and any transfer hub can be used to transport a freight to its destination within its time-window. Furthermore, transport plans are dynamic and can be changed at any period, given that period's circumstances. We model this stochastic optimization problem as a Markov decision process and propose a heuristic based on Approximate Dynamic Programming (ADP) to solve it. Since the transport, revenues, and costs are spread over multiple time periods, the one-step look-ahead behavior of traditional ADP designs can make the algorithm flounder and end in a local-optimum. To avoid this, we investigate the inclusion of policy exploration using constructs from Bayesian exploration. The contribution of our investigation is three-fold. First, we show how balancing exploration and exploitation decisions using the Value of Perfect Information (VPI) in different ways can lead to substantial improvements over traditional ADP designs. Second, we provide insights on the performance gains of scheduling transport using our hybrid ADP with VPI design instead of common practice heuristics, for different transport network settings. Finally, we discuss our experience merging VPI into ADP, and specify directions for further research of ADP in scheduling multi-period transport processes such as the ones in synchromodality.

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