The Dynamic Electric Dial a Ride on a Fixed Circuit

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Autonomous vehicles are set to transform urban mobility by embracing mobility as a service, presenting opportunities for cost reduction, diminished vehicular ownership, and enhanced road safety. Despite these advantages, shared autonomous mobility services face harsh restrictions, often confining them to fixed circuits and schedules. In the electric dial-a-ride problem on a fixed circuit (eDARP-FC), a fleet of electric shuttles provide on demand services while performing multiple laps on a designated circuit consisting of recharging depots and passenger stations. While such an operation has been investigated in the literature in a static setting, the challenges of a dynamic context have not been addressed so far. Therefore, we focus on the implications of dynamically arriving requests on both modeling aspects and solution techniques. This setting, requires making iterative decisions on request acceptance, assignment to vehicles and battery management. The objective function consists of several weighted components, including the number of accepted requests, users' total journey time, and the total number of vehicle laps. Our approach explores several online policies, employs an event-based simulation framework for high-resolution representation, and integrates a reinforcement learning model to solve large-scale instances effectively. The goal is to derive explainable dynamic operational policies that provide better balance between operational costs and the quality of service.