On-Line Management of a Multi-Layered Personal Transit System

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Abstract

A Multi-Layered Personal Transit System (MLPTS) is an innovative last-mile on-demand public transit system consisting of convoys of electric vehicles. Each convoy is composed of a human-driven head vehicle followed by one to several cabins that can autonomously travel short distances at the proximity of stations. That is, cabins can attach and detach from head vehicles as they pass nearby stations while heads cycle non-stop in the system. A passenger completes his/her entire journey on-board the same cabin, while the cabin may switch between several heads along its path. These features generate strong dependencies between the head-cabin-passenger layers. Namely, passenger movements are restricted by cabin movements, which in turn are restricted by head movements. Operationally, this results with a complicated routing and assignment problem. In this study, we introduce the MLPTS planning problem and examine various on-line operational policies. For this purpose, we developed a detailed event-based simulation that consists of several operating modules, including passenger assignment, vehicle routing, empty cabin relocation, etc. Specifically, we formulate a static head routing problem as an MILP and solve it using Benders decomposition. Through simulation, we compare the results to some benchmark routing policies and demonstrate the effectiveness of our solution.

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