Dynamic Centralised Fleet Management of Waterborne Vessels for Heterogeneous Services

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The integration of mobility and logistics in a transport network has caught interest in addressing issues in urban transportation. It is expected that water transit will be a major means of urban transportation where abundant waterways are available, and combining mobility and logistics in the urban waterborne vessel system has the potential to provide more efficient urban transportation. To investigate the potential of such a system, this study develops a dynamic fleet management model that optimises the operation of waterborne vessels, considering an electric waterborne vessel system for heterogeneous on-demand service that serves stochastic passenger and parcel requests. The model dynamically optimises the operation of vessels by applying a rolling horizon framework and updates the operation plan every time a new request is received. We propose a mathematical model to solve a variant of the pick-up and delivery problem for heterogeneous services at each time step in the time horizon. An insertion heuristic is proposed to solve the problem at each time step. Numerical experiments are conducted in the city of Fredrikstad in Norway. We evaluate the solving performance of the exact approach and the proposed insertion heuristic through a series of experiments. We compare the efficiency and service level of the mixed-purpose transport system by comparing with the conventional fixed-purpose vessels under different demand scenarios in the dynamic setting. The results suggest that the proposed insertion heuristic can provide good solutions in a significantly shorter computational time compared to the exact approach. Mixed-purpose vessels resulted in higher efficiency and service levels for all demand scenarios than those of fixed-purpose vessels.

Link to the thesis: https://repository.tudelft.nl/record/uuid:750990c5-2911-406c-9db9-89904b1520c7