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Selected Cases of Vehicle Routing – From a Real World Application to a Machine Learning Based Approach

Nikolaus Furian

(Institut für Maschinenbau- und Betriebsinformatik, TU Graz)

We first report on a real world case study of vehicle routing. Patient transits in the Auckland City Hospital are carried out by so called orderlies that transfer patients from and to appointments within the hospital complex. For some transits the assistance of a nurse is required. Ad-hoc dispatching of staff members, nurses and orderlies, to transits has been identified as one major source for delays. We present automated, optimized dispatching algorithms which rely on a network formulation which is strongly related to an established approach for the VRP with soft time windows. However, the need to synchronize the routes of staff members of different types (nurses and orderlies) adds a whole new layer of complexity to the problem, as routes cannot be assessed independently. We present a set of algorithms with varying complexity, ranging from simple heuristics to the use of critical path methods to combine mixed integer formulations for the separated orderly and nurse problems. To address a transit service's stochasticity, volatility and the resulting need for constant re-optimization, we embed the optimization algorithms in a discrete event simulation to evaluate their performance under realistic circumstances. Some elements of the underlying structure of the above outlined problem have not been explicitly addressed by the literature on vehicle routing. We present machine learning models and some preliminary results on the predictability of optimal solution structures for a sampled version of the VRP with time windows that can be found in numerous applications. Further, we outline some possibilities to make use of such predicted solution structures within heuristics methods, as well as exact algorithms for vehicle routing.

Eranda Dragoti-Cela und Bettina Klinz