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**Optimized train speed profiles**

**Prof. Pisinger David**

(DTU Management Engineering, Technical University of Denmark)

Abstract

We present a novel solution method to generate energy-efficient train speed profiles. As opposed to previous analytical methods, we propose a graph representation of the problem, making it possible to generate pareto-optimal train speed profiles by use of Dynamic Programming (DP) Instead of using uniform discretization of space, time or speed we rely on an event-based decomposition that drastically reduces the search space. Moreover, we are able to handle speed limitations, passage point time windows, as well as various measures of robustness (buffer time, number of speed changes). Such additional constraints were difficult to handle by previous approaches. Based on an extensive number of real-life problem instances our benchmark shows that the proposed solution method is able to reduce the energy consumption by 3.3% on average compared to existing solutions. The computational times are very low, making it possible to handle unexpected changes in speed restrictions or timings by recalculating the schedule. This is a great advantage compared to static offline lookup tables.