A dynamic programming approach for optimizing train speed profiles with speed restrictions and passage points - DTU Orbit (20/02/2019)

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This paper considers a novel solution method for generating improved train speed profiles with reduced energy consumption. The solution method makes use of a time-space graph formulation which can be solved through Dynamic Programming. Instead of using uniform discretization of time and space as seen previously in the literature, we rely on an event-based decomposition that drastically reduces the search space. This approach is very flexible, making it easy to handle, e.g., speed limits, changes in altitude, and passage points that need to be crossed within a given time window. Based on solving an extensive number of real-life problem instances, our benchmarks show that the proposed solution method is able to satisfy all secondary constraints and still be able to decrease energy consumption by 3.3% on average compared to a commercial solver provided by our industrial collaborator, Cubris. The computational times are generally very low, making it possible to recompute the train speed profile in case of unexpected changes in speed restrictions or timings. This is a great advantage over static offline lookup tables. Also, the framework is very flexible, making it possible to handle a number of additional constraints on robustness, passenger comfort etc. Selected details of the method and benchmark are only described at a high level for confidentiality reasons.

General information
State: Published
Organisations: Department of Management Engineering, Management Science, Operations Research, Cubris ApS
Contributors: Haahr, J. T., Pisinger, D., Sabbaghian, M.
Pages: 167-182
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Transportation Research Part B: Methodological
Volume: 99
ISSN (Print): 0191-2615
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 5.09 SJR 3.109 SNIP 2.607
Web of Science (2017): Impact factor 4.081
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 4.57 SJR 2.844 SNIP 2.477
Web of Science (2016): Impact factor 3.769
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 5.15 SJR 3.149 SNIP 2.84
Web of Science (2015): Impact factor 3.769
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 4.21 SJR 3.054 SNIP 3
Web of Science (2014): Impact factor 2.952
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 4.64 SJR 3.223 SNIP 3.47
Web of Science (2013): Impact factor 3.894
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 3.3 SJR 3.22 SNIP 3.181
Web of Science (2012): Impact factor 2.944
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes