# Solving large-scale railway scheduling problems with automated and assisted driving systems

Busuttil, William; Quaglietta, Egidio; Saeednia, Mahnam; Rigos, Konstantinos; Hoodbhoy, Nadia

**Publication date**
2025

**Document Version**
Final published version

**Citation (APA)**
Busuttil, W., Quaglietta, E., Saeednia, M., Rigos, K., & Hoodbhoy, N. (2025). *Solving large-scale railway scheduling problems with automated and assisted driving systems*. 56-56. Abstract from RailDresden 2025: 11th International Conference on Railway Operations Modelling and Analysis, Dresden, Germany.

## Solving large-scale railway scheduling problems with automated and assisted driving systems

William Busuttil[1], Egidio Quaglietta[1], Mahnam Saeednia[1], Konstantinos Rigos[1], Nadia Hoodbhoy[2]
[1]TU Delft; [2]Network Rail; w.s.busuttil@tudelft.nl

The railway scheduling problem concerns the determination of trains' scheduled departure and arrival times at stops, and the allocation of capacity in the network. The timetable must be both conflict-free given infrastructure constraints, and stable enough for trains to recover from delays that could occur in normal operations. Existing methods for tactical scheduling contain a trade-off between having an accurate (microscopic) representation of signalling constraints, and having a simple-enough (macroscopic) infrastructure representation to scale to real-world problem instances. This creates issues for infrastructure managers looking to run more trains on their infrastructure by migrating to Distance-To-Go (DTG) signalling systems (e.g. ETCS Level 2), and to exploit the capabilities of Connected Driver Advisory Systems (C-DAS) and Automatic Train Operation (ATO) to control trains more precisely. In this paper, we present a methodology for incorporating the capabilities of DTG signalling in conjunction with C-DAS and ATO systems into a disjunctive scheduling model for both periodic and nonperiodic instances. We show that the resulting model has both a microscopic infrastructure representation, and a macroscopic computational complexity, allowing railways to quickly compute conflict-free and stable timetables for large problem instances. The resulting model also accurately represents the computation of the brake indication point for both conventional and DTG signalling as a function of the trains' current speed. Tests on a large-scale periodic scheduling instance in the UK show that the model produces timetables with reasonable computation time.