

## Optimal Scheduling of Trains in Complex National Scale Railway Networks

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**Abstract :** Optimal Schedule Generation for a large national railway network operating thousands of passenger trains with tens of thousands of kilometers of track is a grand computational challenge in itself. We present heuristics based on a Mixed Integer Program (MIP) formulation for local optimization. These methods provide flexibility in scheduling new trains with varying speed and delays and improve utilization of infrastructure. We propose methods that provide a robust solution with hundreds of trains being scheduled over a portion of the railway network without significant increases in delay. We also provide techniques to validate the nominal schedules thus generated over global correlated variations in travel times thereby enabling us to detect conflicts arising due to delays. Our validation results which assume only the support of the arrival and departure time distributions takes an order of few minutes for a portion of the network and is computationally efficient to handle the entire network.

**Keywords :** mixed integer programming, optimization, railway network, train scheduling

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