Abstract ID 428

TRAIN PLATFORMING PROBLEM

Giovanni Luca Giacco, Sveva Marcocci

Trenitalia spa

g.giacco@trenitalia.it, s.marcocci@trenitalia.it

Keywords: platform allocation, pedestrian travel time

Summary: Efficient passenger transfers between connecting trains at busy train stations are a critical component of rail transport systems. One of the most significant challenges is ensuring that passengers have enough time to transfer between trains, especially in high-traffic stations where platform availability and train schedules are tightly constrained. The research addresses this problem by developing an optimization algorithm to maximize the total time available for passengers to transfer between connecting trains. The goal is to minimize missed connections and congestions, thus improving overall travel efficiency and passenger satisfaction.

The challenge is not just about improving punctuality but also about optimizing the use of available resources, specifically the allocation of platforms and tracks for arriving and departing trains. The difficulty lies in balancing the need for efficient platform usage with the unpredictable nature of train delays and the logistical constraints of passenger movement between platforms. The research aims to solve this issue by modeling the problem as a Mixed-Integer Linear Program (MILP), where train schedules and platform allocations are optimized with respect to passenger transfer times.

The objective function is designed to maximize the time passengers have to transfer between connecting trains. The function is a summation over all trains (i and j), where each term represents the number of passengers transferring between two specific trains multiplied by the difference between the scheduled connection time and the time actually required for the passengers to transfer. This maximization is critical in ensuring that passengers have adequate time to move between trains and platforms, reducing the likelihood of missed connections.

The boundary conditions ensure that the model respects logistical constraints like platform availability and spacing between arriving and departing trains. These constraints account for the physical layout of the station, such as platform distance, and real-world train punctuality data. Specifically, the time required for passengers to transfer between platforms is calculated assuming a walking speed of 3.5 km/h, ensuring that transfers are physically feasible within the allocated time.

To accommodate real-world variability, the scheduled connection time is adjusted based on delays. Delays are modeled using an empirical probability distribution derived from historical punctuality data for each train. This probabilistic adjustment ensures that the model can account for the uncertainties inherent in train schedules.

The optimization algorithm is expected to yield an optimized allocation of platforms for arriving and departing trains, improving the efficiency of passenger transfers. The result is a schedule where the time passengers spend transferring between trains is maximized, reducing the likelihood of missed connections.

A key outcome is a more efficient use of station infrastructure, where platform occupancy is managed dynamically based on the passenger flow between trains. This results in fewer bottlenecks at busy platforms, particularly during peak travel times. The algorithm produces visual outputs that illustrate optimized platform allocations over time, with occupancy time visualized against the backdrop of the station’s layout.