

Railway Optimization

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Among railway optimization problems, the most relevant ones concern the main phases that are needed in the planning and operational processes related to railway systems. In particular, we present our research on the Train Timetabling Problem and on the Train Unit Assignment Problem.

We consider the customary formulation of Non-cyclic Train Timetabling, calling for a maximum-profit collection of compatible paths in a suitable acyclic network. The associated ILP models look for a maximum-weight clique in a(n exponentially-large) compatibility graph. By taking a close look at the structure of this graph, we analyze the existing ILP models and propose some new stronger ones, all having the essential property that both separation and column generation can be carried out efficiently.

The Train Unit Assignment Problem, given a set of timetabled train trips, each with a required number of passenger seats, and a set of train units, each with a given number of available seats, calls for an assignment of the train units to the trips, possibly combining more than one train unit for a given trip, that fulfills the seat requests. We present a successful heuristic approach, based on an ILP formulation in which the seat requirement constraints are stated in a “strong” form, derived from the description of the convex hull of the variant of the knapsack polytope arising when the sum of the variables is restricted not to exceed two.

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