Description of the work to be carried out by the student at University Gustave Eiffel

Context

The real-time railway traffic management problem (rtRTMP) is the problem of solving time-overlapping conflicting track requests generated by disturbances during the normal course of daily operations. The size of an instance of the problem and the time required to solve it are particularly affected by the number of routing alternatives available to each train.

The real-time train routing selection problem (rtTRSP) chooses a feasible routing subset for each train to use as input for the real-time railway traffic management problem. In particular, the validity of the problem and the impact of its solution have been analyzed in the literature. The analysis has been performed by using a specific mixed-integer linear programming model and the RECIFE-MILP solution approach for the rtRTMP. This solution approach is developed at University Gustave Eiffel and has been tested in many railway traffic situations in the last decade.

The rtTRSP has been solved with an Ant Colony Optimization (ACO) algorithm designed and implemented by Marcella Samà during a visiting researcher period at University Gustave Eiffel (previously IFSTTAR) in 2015.

Work description

The work that the student will carry out at University Gustave Eiffel will aim to the generalization of the results presented in the literature on the rtTRSP. Specifically, in addition to the mixed-integer linear programming model and the RECIFE-MILP solution approach for the rtRTMP, she will consider a different model, objective function and solution approach for the problem.

The AGLIBRARY solution approach will be considered for the generalization. It solves an alternative graph model of the problem to minimize the maximum delay of a train. RECIFE-MILP minimizes, instead, the total delays of all trains. Also the granularity considered for representing the railway infrastructure is different in the two solution approaches.

The student will analyze how changes in the rtRTMP model, in the representation of the railway infrastructure and in the objective function have to be reflected in the rtTRSP. She/He will, first of all, propose algorithmic extensions of the existing ACO algorithm to cope with these changes. If these extension will not prove sufficient to achieve satisfactory results, she will propose a new, more versatile, evolutionary algorithm.

A computational analysis will be performed to assess the proposed algorithms. Two French infrastructures will be taken into account: the line around the city of Rouen and the Lille terminal station area.