SOME SOLUTIONS FOR CONVENTIONAL AND HIGH SPEED RAILWAY LINES RELATED TO COST REDUCTION AND SAFETY ANALYSIS. PRACTICAL CASES

by

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Abstract: In the first part of the talk, a non-linear mixed-binary optimization model is presented that permits, on one hand, deciding which segments must be constructed in single or in double track and on the other hand, optimizing the timetables in order to obtain the maximum benefit of the line and satisfying all constraints, including the topology of the line or network, the routes, departure flexibilities, dwell times, safety restrictions, etc. Since the problem is very complex because it contains many thousands of binary variables and constraints, several strategies must be used in order to reduce them without changing the optimal solution and to convert non-linear into equivalent linear constraints. The program has been applied to several testing examples in several countries showing that this solution is generally applicable. In particular it is being applied to the Palencia-Santander line where an initial project joining Santander and Madrid in two and a half hour at a cost of 3200 M€ is being replaced by another one that solves the problem in three hours but at a cost of 350 M€.

The second part of the talk is devoted to describe a model to perform a probabilistic risk analysis of a railway line. The model was developed on the occasion of the July 2013 Santiago de Compostela accident where 80 people were killed. We have had to elaborate a report in order to identify the main causes of the accident and the associated risks. The model consists of a complex Bayesian network that reproduces all and each one of the elements present in the line and the train (infrastructure, light signals, speed limit signals, supervision systems, transitions in tunnels and viaducts, slope stability, etc.). It also includes the driver tireness and attention level behavior during the driving and the statistical dependence among all the variables involved. The model allows estimating the probabilities of accident at all points in the line. This makes the identification of the critical points or elements to be possible, so that required safety improvements can be performed. Finally, a sensitivity analysis allows us to detect those parameters which are relevant and those that can be ignored. The particular case of the Orense-Santiago de Compostela line is used to illustrate the proposed methodology.