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A Predictive Maintenance Model for Railway Tracks

For the modern railways, maintenance is critical for ensuring safety, train punctuality and overall capacity utilization. The cost of railway maintenance in Europe is high, on average between 30,000 – 100,000 Euro per km per year [1]. Aiming to reduce such maintenance expenditure, this paper presents a mathematical model based on Mixed Integer Programming (MIP) which is designed to optimize the predictive railway tamping activities for ballasted track for the time horizon up to four years. The objective function is setup to minimize the actual costs for the tamping machine (measured by time). Five technical and economic aspects are taken into account to schedule tamping: (1) track degradation of the standard deviation of the longitudinal level over time; (2) track geometrical alignment; (3) track quality thresholds based on the train speed limits; (4) the dependency of the track quality recovery on the track quality after tamping operation and (5) Tamping machine operation factors. A Danish railway track between Odense and Fredericia with 57.2 km of length is applied for a time period of two to four years in the proposed maintenance model. The total cost can be reduced with up to 50% comparing to the optimization of the number of tamping [2][3], which shows that the model has great potential to support railway tamping planning in practice.

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