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# A Mathematical Model for Ballast Tamping Decision Making in Railway Tracks

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**Abstract**

Ballast tamping is considered as an important maintenance process for railway infrastructures and has a large influence on the capacity of any railway networks. But optimizing the plan of that process is a complex problem with a high cost. This paper discusses optimizing tamping operations on ballasted tracks to improve the track geometry and reduce the total maintenance cost. A mathematical model for this problem in the literature is improved here by including the restriction on the resources (tools, workers and budget) in the model and including constant/variable values for track possession cost and available resources. The optimal solutions obtained for all instances are found by using the global optimization. Besides, a numerical study is presented to test and evaluate the model performance. The results show that the proposed model can be adopted by the infrastructure manager (IM) to make suitable tamping scheduling decisions under normal or private conditions; however, the private conditions lead to an increase of the final cost compared to that of the normal ones.

*Keywords:* Ballast; Tamping; Track Possession; Decision Making; AMPL; CPLEX.

## 1. Introduction

Ballast tamping is considered to be an important maintenance operation for railway infrastructures and has a big influence on the capacity of railway tracks because of its private requests such as possessing a track for a long time, heavy equipment involved, planning difficulties, etc. [1]. Furthermore, tamping process is too expensive [2], therefore an optimal scheduling for this process is required to minimize the total cost as much as possible (Famurewa et al. 2015 [1]; Miwa 2002 [3]; Oh et al. 2006 [4]; Macke and Higuchi 2007 [5]; Andrade and Teixeira 2011 [6]; Heinicke et al. 2015 [7]).

In this paper, the problem of optimal planning of ballast tamping tasks on a railway track is presented, and the aim is to get the optimum plan for them minimizing the discounted total cost (DTC) in a given horizon. Some assumptions and considerations are explained as the following:

- The track in concern is composed by a series of sections of 200 m of length,

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