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Predictive traffic regulation for metro loop lines based on quadratic programming

A. Fernández Cardador; A.P. Cucala García; B. Vitoriano Villanueva; F. Cuadra García

Abstract-

This article proposes a predictive traffic regulation model for metro loop lines on the basis of the optimization of a cost function along a time horizon. The regulation strategies typically compensate timetable and headway deviations modifying the train run times. The existing optimization methods are based on simplified traffic models with analytical solutions or based on more realistic models (usually non-linear) that have real-time computational limitations. A quadratic programming model is proposed here, suitable to include in an efficient way the main operation constraints: minimum interval, limits in the control actions, and the typical operation criterion of preventing the actuation of signalling systems between platforms. Efficiency is measured by the computing time required to solve long-term predictive models with standard optimization tools. Long-term prediction improves regulation performance and stability and simplifies the tuning of regulation parameters according to the operation requirements. The use of standard optimization tools improves the implementation of the proposed regulator and its maintainability. Although the proposed method is valid for both timetable and headway operation, the analysis in the article is focused on headway operation. In this case, it is possible to observe the offered commercial speed and to adjust the quality criteria that will measure the performance of the headway operation.

Index Terms- Railway traffic control, optimization, quadratic programming

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