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Predictive traffic regulation model for railway mass transit lines equipped with continuous communication systems

A. Cidoncha González; A. Fernández Cardador; A. Fernández Rodríguez; A.P. Cucala García

Abstract-

Centralized traffic regulation systems are crucial in railway mass transit lines to automatically control the trains to recover delays and provide headway regularity. Traditional traffic regulation systems send control action to trains just at stations, through beacons, when they arrive or depart. The present paper proposes a new predictive traffic regulation model for railway mass transit lines equipped with CBTC (Communications Based Train Control) signalling system. This model takes advantage of continuous communications between the centralized control centre and trains, to send control actions at any moment. The proposed regulation system consists of two modules. The first one is a mathematical predictive control algorithm, which generates the running time and dwell time control actions by an optimization model based on the quantified delays of the trains and the operational constraints. The second module receives the control actions (target times) from the first one and generates in real-time the automatic driving commands to be sent to each train. This allows trains to modify their speed profile to speed up or slow down according to updated target times, at any point along their route. Finally, a traffic simulator based on a real Spanish metro line has been developed to verify the effectiveness of the proposed approach. Simulation results under normal operating conditions, considering random delays, show that adherence to the schedule and nominal headway improves by 33% and 49% respectively, and energy consumption is reduced by 5.4%.

Index Terms- ATO, ATR, CBTC, mass transit railway, railway traffic regulation.

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