

Eco-driving in railway lines considering the uncertainty associated with climatological conditions

M. Blanco Castillo; A. Fernández Rodríguez; A. Fernández Cardador;
A.P. Cucala García

Abstract-

Eco-driving is a keystone in energy reduction in railways and a fundamental tool to contribute to the Sustainable Development Goals in the transport sector. However, its results in real applications are subject to uncertainties such as climatological factors that are not considered in the train driving optimisation. This paper aims to develop an eco-driving model to design efficient driving commands considering the uncertainty of climatological conditions. This uncertainty in temperature, pressure, and wind is modelled by means of fuzzy numbers, and the optimisation problem is solved using a Genetic Algorithm with fuzzy parameters making use of an accurate railway simulator. It has been applied to a realistic Spanish high-speed railway scenario, proving the importance of considering the uncertainty of climatological parameters to adapt driving commands to them. The results obtained show that the energy savings expected without considering climatological factors account for 29.76%, but if they are considered, savings can rise up to 34.7% in summer conditions. With the proposed model, a variation in energy of 5.32% is obtained when summer and winter scenarios are compared while punctuality constraints are fulfilled. In conclusion, the model allows the operator to estimate better energy by obtaining optimised driving adapted to the climate.

Index Terms- eco-driving; energy efficiency; fuzzy logic; simulation; railway operation; high-speed railway

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