Operational Parameters Optimization to Improve Railway Vehicle Performance Using Virtual Homologation

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Abstract

Contrarily to regular automotive vehicles, which are designed to travel in different types of tracks, railway vehicles travel in the same track during their life-cycle. To accept the dynamic performance of a railway vehicle, a homologation procedure is required according to the local standard regulations. In Europe, the norm EN 14363 is applied for railway vehicle acceptance, which requires on-track tests and/or numerical simulations [1]. However, high costs are associated to homologation procedures and the operational parameters, for example the speed, are ensured to be acceptable, but they are not optimized. In addition, the numerical simulations are used only to reduce the number of experimental tests. In this paper, two optimization approaches are used, not only to improve the dynamic performance of a railway vehicle, but also to compare their performance. Here, a simple multibody model of a railway vehicle is used [2]. The design variables include the stiffness and damping parameters of the suspension elements and the service velocity. The dynamic performance of the vehicle is quantified by post-processing dynamic results as described in the norm EN 14363. For this purpose, characteristics values related to running safely and ride characteristics are calculated. After a preliminary study of the post-processing procedure and of the design variables, two optimal problems are formulated and solved, namely a uni and a multi objective problem. The optimization results are discussed focussing, not only on the performance of the two optimization approaches, but also on their advantages in realistic operation scenarios.

References

[1] EN 14363, "Railway applications - Testing for the acceptance of running characteristics of railway vehicles - Testing of running behaviour and stationary tests," ed, 2005, pp. CENELEC European Committee for Electrotechnical Standardization, Brussels, Belgium.

[2] J. Pombo, "A Multibody Methodology for Railway Dynamics Applications," PhD Dissertation, IDMEC/Department of Mechanical Engineering, Instituto Superior Técnico, Lisbon, Portugal, 2004.