

Research Article

A Dynamic Design Methodology for Large-Scale Complex Nonlinear Systems Based on Orthogonal Decomposition Technique

Qi-Bin Wang ¹, Si-Yang Piao ¹, Ming-Wei Piao ², Peng Dang,³ Qiu-Ze Li,³ and Jing-Ying Ren¹

¹College of Locomotive and Rolling Stock Engineering, Dalian Jiaotong University, Dalian, Liaoning 116028, China

²Mech. Eng. School, Dalian Jiaotong University, Dalian, Liaoning 116028, China

³CRRC Changchun Railway Vehicle Co. Ltd., Changchun, Jilin 130062, China

Correspondence should be addressed to Ming-Wei Piao; m_w_piao@126.com

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HSRS is taken as a typical research case of large-scale complex nonlinear systems, and the re-innovation of associated imported technologies needs to be combined with the particularities of Chinese HSR practices, seeking a more suitable dynamic design methodology to conduct the self-adaptive improved design. Different from the troublesomeness of the primary hunting phenomenon, the self-adaptive improved design can decrease considerably the impact of car body instability on ride comfort merely by applying the semiactive damping technique between intervehicles, to promote scientifically the limit and construction speeds under the rational conditions of wheel-rail matching, i.e., $\lambda_{1,2} \geq \lambda_{\text{limit}}$, $\lambda_{\text{limit}} = (0.00\text{--}0.05)$. The researching viewpoint of hunting kinematics makes the investigations on the geometric nonlinearity of the wheel-rail contacts contrary to the hypothesis of small creepage and no spin. Since the technical prototype of German ICE3 serial bogies has the design default of the primary hunting phenomenon, the improved design of the wheel-rail relationship has simply abandoned the high-quality technical resources of wheel-rail matching conditions at low conicity. On the contrary, the dynamic simulation analyses of MC01-TC02-MC03 three-vehicles trainset show that the semiactive damping technique between intervehicles takes advantage of $I_{\text{ca}} \gg I_{\text{ca}}$ to improve the impacts of car body instability on ride comfort, and the self-adaptive improved design has consequently the ability to achieve the technical goal of uniform wear at low conicity. On the premise of meeting the requirements of crossing over different speed grade dedicated lines and realizing the running operations on three-speed levels of 160/250/350 km/h, the self-adaptive higher-/high-speed bogies can conditionally satisfy the economic repolling requirements of wheelsets through the optimal routing planning.

1. Introduction

The application of a large number of analysis software is one of the main technical characteristics in postindustrial societies. Nevertheless, large-scale complex nonlinear systems such as high-speed rolling stock (HSRS) must also rely on big data mining techniques such as orthogonal decomposition or modal modification so as to carry out the dynamic design. The optimal configuration of higher-/high-speed bogies can be guided instructively with the analysis graphs of full vehicle stability properties and variation patterns,

realizing the goal of scientifically promoting the limit and construction speeds under rational conditions of wheel-rail matching at the minimum cost. Therefore, the HSRS operation and maintenance practice for High-Speed Rails (HSR) has become an incredible engineering in postindustrial societies, which actively boosts the formation and development of dynamic design methodology.

Uniform wear at low conicity should be one of the necessary technical conditions for worldwide HSR practices. The commercial application vision of future HSR transport is necessary to be clarified in the planning for HSR

Methodology For Large Scale Systems

Xiaoyu Wang



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