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The Performance Improvements of Train Suspension Systems with Mechanical Networks Employing Inerters

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Abstract

This paper investigates the performance benefits of train suspension systems employing a new mechanical network element called an inerter. An inerter is a true mechanical two-terminal element with the applied force proportional to the relative acceleration across the terminals. Until now, ideal inerters have been applied to car and motorcycle suspension systems, for which a significant performance improvement was reported. In this paper, we discuss the performance benefits of train suspension systems employing inerters. The study was carried out in three phases. First, fixed suspension structures were applied to train suspension systems, and optimised for two performance measures. Secondly, this optimization was further carried out using linear matrix inequality approaches to discuss the achievable performance of passive networks. The resulting networks can then be realised by synthesis methods, such as the Brune and Bott–Duffin realisation. Finally, the nonlinear properties of inerter models and their impact on system performance were discussed. From the results, the inerter was deemed effective in improving the performance of train suspension systems.