

Passive Mechanical Control with a Special Class of Positive Real Controllers: Application to Passive Vehicle Suspensions

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Abstract

This paper presents an efficient H₂ optimization method for passive mechanical control problems with a special class of positive real controllers. In particular, the problem of designing passive vehicle suspensions based on a full-car model is taken as an example, where both the positive real constraint and the constraint imposed on the static stiffness are considered. An unconstrained nonlinear programming problem is formulated by using the structured H₂ optimization framework, and the Lagrange matrix multiplier method is employed to derive a set of necessary conditions for the optimization so that the time-efficient gradient-based algorithms can easily be implemented. The proposed method can also effectively deal with the fixed static stiffness optimization problem and it is shown in the numerical examples that the proposed method cannot only recover the existing fixed-structure configuration, but also introduce new (optimal) configurations with respect to the specific weighting factors, which demonstrates the effectiveness of the proposed method.