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Integrated Performance Optimization for Wheeled Combat Vehicle by Using Model-Based Design Approach

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Abstract

The performance of a combat vehicle should be evaluated in various standards and, thus, the modelling and the design of a combat vehicle is a time consuming process. Moreover, since these performances relate to each other, it is hard to define the integrated system and to solve the optimization problem for the combat vehicle. This paper proposes a model-based design approach for obtaining the optimal design specifications of a combat vehicle considering the mobility and the firepower. The integrated analysis model of the combat vehicle is constructed by using the representative parameters of the armament and vehicle sub-system for improving the efficiency of the optimization process. To predict the practical driving condition of a combat vehicle, the in-wheel motor component with torque-speed characteristics and driveline system apply to construct the mobility analysis model. The firing range and the recoil force of armament system are calculated by using an empirical formula for interior and exterior ballistic analysis with a number of parameters. The important design variables for determining the performances of the combat vehicle are selected by using the analysis of variance and the kriging surrogate model of the mobility and the firepower is employed to optimize them. The optimization problem is formulated to minimize the firing settling time with design constraints for the bump acceleration and the vehicle speed. A design example of the 6-wheeled combat vehicle will be provided to demonstrate the effectiveness of the proposed method and to find an optimal combination of the vehicle parameters.