Abstract

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Stiffness Optimization Study on the Frame of an Electric Motorcycle

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Abstract

One of the most important components of electric motorcycles is the frame, which requires strength to hold the weight of the motorcycle and has been designed to best support ergonomics feathers. Various components of the motorcycle are attached to its frame body. The frame of the electric motorcycle was loaded due to the weight of the passenger, the weight of the motorcycle components, the unevenness of the road and during braking and acceleration. Stiffness is very important objective in the designing a motorcycle frame. Experimental analysis of structure's stiffness of vehicles is very costly and time-consuming, so finite element methods can be used to simulate structure's stiffness tests. In this study, the frame of an electric motorcycle is modeled in Catia and meshed in hypermesh, and then in ABAQUS, the properties of the material and the interactions between the components are defined. In vertical, longitudinal, lateral, and torsional positions, loading is performed on the frame. In the vertical position, the steering shaft and bracket of the fixed shock absorber and vertical force that applied to the passenger seat, in the longitudinal and lateral position, the engine connection brackets are fixed and the longitudinal and lateral loads are applied to the steering shaft column, and in the torsional position, the engine connection bracket is Fix and a coupled force applied to the steering column. In each test, the frame stiffness is calculated by the amount of displacement in each type of load. In the experimental test, the frame of the electric motorcycle vertical loading and its force-displacement results were similar to the results derived by ABAQUS. In this simulation, three levels for four design variables are used for the Taguchi experiment. To define Taguchi design variables, the components were divided into four parts: lower rail, side members, steering column, and reinforcing members. For each, the thickness varies in three levels of 2, 2.5, and 3 mm. The Taguchi method suggests performing 9 experiments. With four modes of stiffness, modal analysis, and weight of frames in equal coefficient mode, frame and optimal weight and stiffness are found.

Biography

Abolfazl Khalkhali received his M.Sc. (Eng.) in Mechanical Engineering in 2005 and the Ph.D. degree in Applied Mechanical Engineering in 2010 from The University of Guilan, Iran. He was faculty member at Engineering Department of the Islamic Azad University, East Tehran Branch from 2007 to 2011. He has served as the Head of Mechanical Engineering Department and also Dean of Engineering Department at the Islamic Azad University, East Tehran Branch. He came to the Iran University of Science and Technology (IUST) in 2011.

He is currently associate professor at the School of Automotive Engineering in IUST. He was Deputy of Chancellor in Research and Education of the School of Automotive Engineering in IUST from 2011 to 2015. He is also the head of Automotive Simulation and Optimal Design research laboratory in IUST. His research interests are automotive body structural design, finite element analysis and simulation, multi-objective optimization, product family and platform design, GMDH-type neural networks, robust and reliability-based design and optimization using evolutionary algorithms.