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Effect of cabin seat stiffness and damping on chaotic vibration of a nonlinear full vehicle model

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In recent years, the study of nonlinear dynamics gets more attention. The objective of nonlinear dynamics is to clarify the mechanism of complex dynamic phenomenon and study system response under variation of system parameters. As a kind of highly integrated industrial product, automotive dynamics become more important recently. In studying the dynamic response of ground vehicle, vehicle model is assumed to be linear by a number of researchers. However, in practice, automotive suspension system possesses immanent nonlinear factors as it consists of suspension, tires, and other components that have nonlinear behavior. Therefore, the chaotic response may appear when the vehicle moves over a bumpy road.

The objective of this study is to detect chaos and to optimize system parameters in order to minimize the vibration of passenger's cabin. Therefore, it is necessary to develop a model so that the response of passenger seat can be observed. The common application in modeling the vehicle with a passenger seat is to add only one passenger seat preferably in the driver seat position. Hence, in this paper using a nonlinear eight degree-of-freedom model, the dynamic behavior of a ground vehicle is examined. The nonlinearity occurs due to suspension dampers and springs. The disturbances from the road are assumed to be sinusoid and the time delay between the disturbances is considered. Using bifurcation phenomenon, the chaotic motion is detected and confirmed with the Poincare´ maps. Results show that changing system parameters can be used as an instrument to easily eliminate the chaos or minimize the vibration to the passenger seat. The results can be applicable in dynamic design of a vehicle.

Biography

Hamed Samandari, received the BSc. degree in Mechanical Engineering from Isfahan University of Technology, Isfahan, Iran, in 2008, and the MSc degrees in Automotive Power Train from the University of Tabriz, Tabriz, Iran, in 2011, where he was ranked 1st between Automotive Power Train graduate students. Currently, He is studying PhD degree at Middle East Technical University, Ankara, Turkey. He has been working as a Research Assistant at the Department of Mechanical Engineering, since spring of 2011. His areas of interest include Dynamics, Modal Analysis, and Nonlinear Vibrations.

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