Nonlinear Dynamics and Control in an Automotive Brake System

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ABSTRACT
Brake squeal is a manifestation of friction-induced self-excited instability in disc brake systems. This study investigated non-smooth bifurcations and chaotic dynamics in disc brake systems and elucidated a chaotic control system. Decreasing squeal noise which is dependent on chaos, increases passengers comfort; consequently, suppressing chaos is crucial. First, synchronization was used to estimate the largest Lyapunov exponent to identify periodic and chaotic motions. Next, complex nonlinear behaviors were thoroughly observed for a range of parameter values in the bifurcation diagram. Rich dynamics of the disc brake system were studied using a bifurcation diagram, phase portraits, a Poincaré map, frequency spectra, and Lyapunov exponents. Finally, the proposed technique was applied to a chaotic disc brake system through the addition of an external input that is a dither signal. Simulation results demonstrated the feasibility of the proposed approach.

Keywords: Disc brake; Synchronization; Nonlinear; Lyapunov exponent; Dither

REFERENCES