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Dynamic Investigation of Brake Squeal Problem in The Presence of Kinematic Nonlinearities

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Abstract : In automotive brake systems, brake noise has been a major problem, and brake squeal is one of the critical ones which is an instability issue. The brake squeal produces an audible sound at high frequency that is irritating to the human ear. To study this critical problem, first a nonlinear mathematical model with three degree of freedom is developed. This model consists of a point mass that simulates the brake pad and a sliding surface that simulates the brake rotor. The model exposes kinematic and clearance nonlinearities, but no friction nonlinearity. In the formulation, the friction coefficient is assumed to be constant and the friction force does not change direction. The nonlinear governing equations of the model are first obtained, and numerical solutions are sought for different cases. Second, a computational model for the squeal problem is developed with a commercial software, and computational solutions are obtained with two different types of contact cases (solid-to-solid and sphere-to-plane). This model consists of three rigid bodies and several elastic elements that simulate the key characteristics of a brake system. The response obtained from this model is compared with numerical solutions in time and frequency domain.

Keywords : contact force, nonlinearities, brake squeal, vehicle brake
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