MODELING DISK BRAKES WITH RESPECT TO SQUEAL

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Abstract. Considerable effort is spent in the design and testing of disk brakes of modern passenger cars. This effort can be reduced if refined mathematical-mechanical models are used for studying the dynamics of these brakes before prototypes are available. The present paper is devoted to the modeling of a floating caliper disk brake, special regard being given to squeal. A new model developed in Darmstadt for the dynamics of a floating caliper disk brake is presented. The model includes the brake rotor, housing, piston, yoke, and friction pads. In this nonlinear model all the prominent features of squeal are reproduced, such as e.g. independence of the frequency on the speed, etc. For a moderately wide frequency range (1 - 5 kHz) the transverse vibration of the disk plays a significant role in squeal and the disk is therefore modeled as a flexible rotating plate. The pad stiffness and damping are modeled by distributed nonlinear springs and linear dampers, respectively. The floating nature of the caliper has also been taken into account. In a test rig built in Darmstadt the model is validated. In addition, the set-up also permits active control of some of the brake's parameters. So far all the experimental results seem to agree very well with our model.
Keywords. Brake, modeling, squeal