DESIGN EXPLORATION AND DESIGN OPTIMIZATION TO IMPROVE BRAKE NVH COMFORT

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ABSTRACT

Brake squealing is the most famous noise generated by brake systems. This phenomenon can be characterized by a number of parameters influencing the occurrence and frequency of the squeal noise like brake pressure, speed, friction, and stiffness of parts and connections. Usually, these parameters are not known in advance like friction between pad and disc, and the stiffness properties of the pad.

The squealing itself is successfully simulated by Complex Eigenvalue Analysis (CEA) and taking into account contact and rotation of the brake disc. In this way, squealing is considered as a friction-induced instability problem, and CEA is the right means to identify the frequencies, where such instabilities occur.

Due to the complexity of the phenomenon, it is of high practical importance to identify the relationship between varying or uncertain parameters and the predicted squeal frequencies. Design exploration (DE) methods are used to establish this relationship in an effective manner. One set of DE methods consists of sampling methods, where many different parameter sets of the brake system are used for CEA and a stability map is generated from the sampling results.

The huge amount of data generated by sampling allows the identification of brake parts, which have the highest influence on the occurrence of instabilities. Then, design optimization (DO) is the next logical step to reduce the tendency for squealing of the brake. Such relevant optimization methods are shape optimization methods, for example, which allow the optimization of the stiffness of brake parts without weight increase. The final optimization result is an updated stability map for the optimized brake system.

The presentation will show the use of CEA, DE, and DO methods integrated in the software system PERMAS. A PORSCHE brake system is used to demonstrate the simulation process.