Reducing disc brake squeal by sawed-groove texturing—A combined approach of complex eigenvalue analysis and dynamic transient analysis

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1. Abstract

Brake squeal is widely accepted by scientists and engineers as a noise caused by friction-induced vibrations, which frequently occurs at frequency above 1 kHz. It is one of the most difficult problems and is a big issue in the automobile industry [1, 2]. In recent years, squeal noise prediction methodologies using finite element analysis have widely been investigated [3]. This paper proposed a numerical study to investigate the influence of sawed-groove texturing on brake squeal, by a combined approach of complex eigenvalue analysis and dynamic transient analysis. Firstly, the propensity of friction-induced vibrations and noise of a simplified traditional brake model was predicted using the finite element complex eigenvalue method. Secondly, a dynamic transient analysis of the model is carried out using the ABAQUS/Explicit. Then, an improved brake model including sawed-groove texturing on the brake disc was created to investigate the brake squeal propensity. Comparing the numerical results obtained from both the improved model and the traditional model, it is found that the brake squeal propensity can be significantly reduced by introducing sawed-groove configurations on the surface of brake disc. According to the calculated results of complex eigenvalue analysis and dynamic transient analysis, the traditional brake model was found to generate more dominant frequency of squeal than the improved model. This prediction showed that the exist of sawed-groove on the surface of brake disc would reduce the propensity of brake squeal, which may be useful in the design stage of disc brake to reduce the propensity of squeal.

Key words: Disc brake squeal; Finite element analysis; Surface texturing; Complex eigenvalue analysis; Dynamic transient analysis

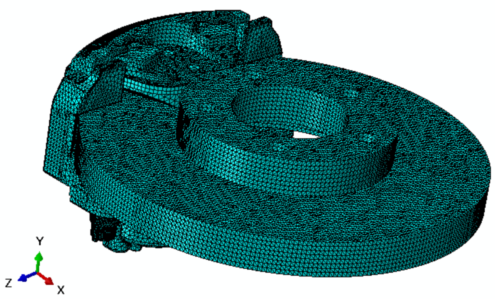
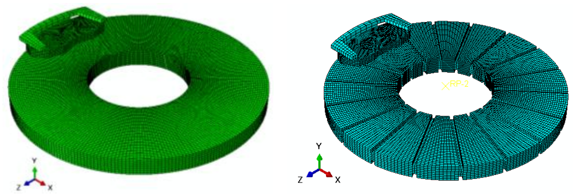
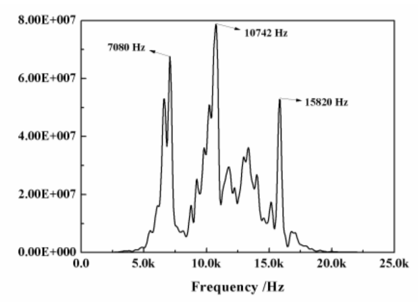


Fig.1 Finite element models of a disc brake model

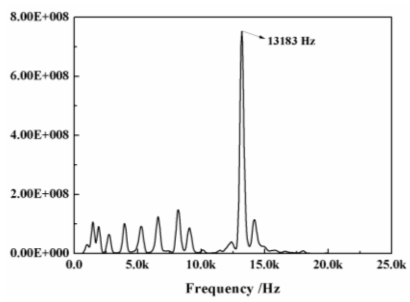


(a) (b)

Fig.2 A simplified traditional disc brake model (a) and an improved disc brake model (b)



(a)



(b)

Fig.3 Calculated dominant frequency of squeal obtained from a simplified traditional disc brake model (a) and an improved disc brake model (b)

2. References

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