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OPTIMIZATION OF THE SHAPE OF PENDULUM VIBRATION ABSORBERS AND CURVED TRACK PATTERNS TO MINIMIZE VIBRATION

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An efficient design optimization method has been newly developed to maximize the absorbing capability of torsional vibration on the basis of the eigenvalue optimization coupled with a NURBS (nonuniform rational B-spline) curve equation and finite element analysis. The optimum curved track pattern along which a pendulum moves is determined using knot vectors and weighting factors of NURBS curves as design variables to maximize absorption of torsional vibration, using the genetic algorithm. In addition, to increase the damping effect, the optimum shape of a pendulum was calculated in a way to minimize the angular velocity of a rotor. The proposed method was applied to improve the vibrational damping effect of the pendulum in the automotive lock-up clutch as shown in Fig. 1. A recent need for a thinner torque converter requires the optimization of a lock-up clutch system to fit a slender torus and to satisfy working conditions while maximizing its cost effectiveness. A robust optimization for seeking a global minimum must adopt a strategy where a higher order of a function is acceptable under some conditions. Genetic algorithm provides such a strategy.

The degree of fluctuation in rotor angular velocities is shown in Fig. 2 with and without pendulum optimization based on DOE (design of experiments) and GA (genetic algorithm). The maximum amplitude of the rotating structures is 0.836 when there is no pendulum in the clutch. The maximum amplitude of the rotating structures is 0.042 when there is a pendulum not optimized in the clutch. The maximum amplitude is 0.025 in the case of a pendulum optimized using DOE or GA. The amplitude was significantly reduced by about 97% when the optimum pendulum was applied compared with an initial design.

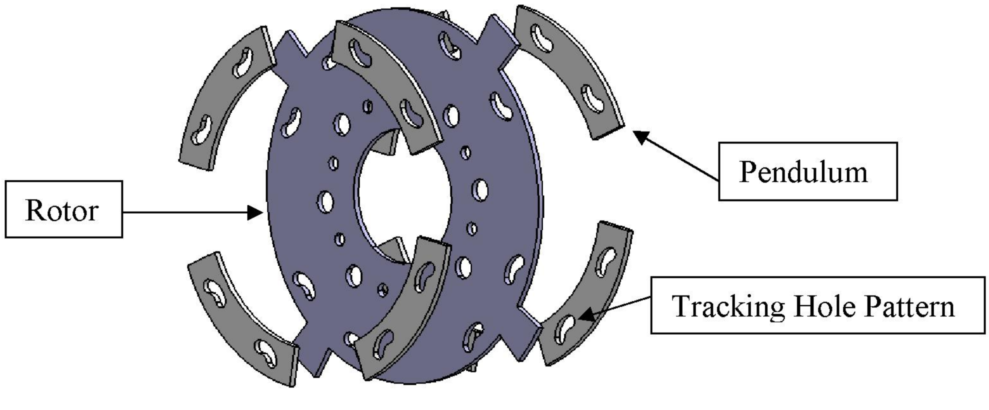

Fig. 1 Pendulum absorbers and a rotor consists of an automotive lock-up clutch system

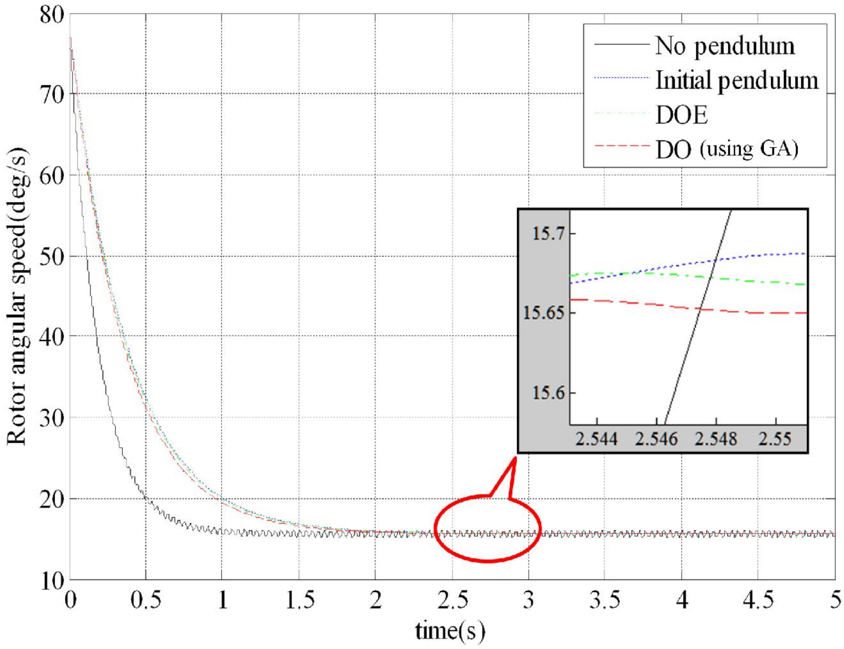

Fig. 2 The degree of fluctuation in rotor angular velocities with and without pendulum optimization

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