



# A controllable elastic support/dry friction damper for vibration control of rotor systems

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## Abstract

A controllable elastic support/dry friction damper (CESDFD) with an electromagnet as actuator is presented at first, and its application to the vibration suppression of a rotor system with the switch control scheme is investigated theoretically and experimentally. Both the suppression of the resonant vibration around the first critical speed and the suppression of the large response caused by the sudden unbalance are considered. It is proven that the theory is rational and correct by comparing it to the experimental results. In addition, the damper with the switch control scheme is very effective in reducing rotor vibration, and has the merits of fast response, easy control and low energy consumption.

**Key words:** Rotor vibration, Controllable elastic support/dry friction damper (CESDFD), Switch control, Sudden unbalance

## 1. Introduction

The elastic support/dry friction damper (ESDFD), a new type of damper, is developed for the application in aero-engines (Fan and Liao, 2003; Yang and Ye, 2005; Zhang *et al.*, 2006). It consists of an elastic support similar to the support of squeeze oil film dampers, a friction disk and mechanism pressing the friction disk on the surface of end cross section of the elastic support. The friction disk is fixed in the casing in radial direction, but can move in axial direction. It is pressed onto the end cross section of the elastic support. If the elastic support moves (in the radial direction), due to rotor vibration, then a relative motion between the support and the friction disk will occur. This will lead to a dry friction dissipating the vibration energy. The dry friction damper works on this principle. The

dry friction force depends upon the force pressing the friction disk on the end cross section of the support and the friction coefficient associated with surface roughness and materials. Hence the damper can actively be controlled by changing the pressing force.

In this paper, a controllable elastic support/dry friction damper (CESDFD) with an electromagnet as actuator is designed, and its application to the vibration suppression of a rotor system with the switch control scheme is investigated theoretically and experimentally. Both the suppression of the resonant vibration around the first critical speed and the suppression of the large response caused by the sudden unbalance are considered.

## 2. Structure of the CESDFD and test rig

A CESDFD with an electromagnet as actuator is