ISCORMA-4, Calgary, Alberta, Canada, 27-31 August 2007

DETECTION OF ASYMMETRY IN FLEXIBLE ROTATING SYSTEMS FROM THE ZEROS OF SYSTEM-IDENTIFIED MODELS

Yun-Ho Seo, Chong-Won Lee

Center for Noise and Vibration Control (NOVIC), Department of Mechanical Eng., KAIST, Daejeon, Korea

K. C. Park

Department of Aerospace Eng. Science, University of Colorado, Boulder, CO 80309, USA

ABSTRACT

As the reliability and safety of rotating machinery in operation becomes increasingly important, the identification of dynamic properties of rotors draws much attention among researchers these days. Among others, the rotating asymmetry, which often represents damage in a rotating shaft such as a transverse crack, is a critical target parameter for rotor system identification. Directional frequency response functions (dFRFs) have been known as a powerful tool for detecting the presence and degree of asymmetry in a rotating shaft. However, the magnitude of dFRFs successfully indicates the amount of asymmetry in the system as a whole, but it, alone, is not sufficient to reveal the local information such as the location of damage.

In this paper, we propose an efficient estimation method for the location of asymmetry. It uses the change in zeros of the normal dFRFs of the asymmetric rotor compared with those associated with the original isotropic rotor. The principle of the method is that the zeros of normal dFRFs are sensitive to the local parameter changes in a rotor. To utilize the zeros of dFRFs, the eigensystem realization algorithm (ERA), which is an efficient time domain method of finding zeros for closely coupled mode systems, is applied to obtain dFRFs for asymmetric rotor-bearing systems formulated in the complex coordinate system. The effectiveness of the proposed method for detecting the location of rotating asymmetry is demonstrated by numerical examples.

Key words: Location of asymmetry, Directional frequency response function (dFRF), Eigensystem realization algorithm (ERA)