A modular active bearing for noise reduction of rotating machinery

Wim Symens 1, Steven Devos 1, Bert Stallaert 2, Gregory Pinte 1,2, Paul Sas 2, Jan Swevers 2
1Flanders’ Mechatronics Technology Center
Celestijnenlaan 300 D, 3001 Heverlee, Belgium
2Department of Mechanical Engineering, Division PMA, Katholieke Universiteit Leuven
Celestijnenlaan 300 B, 3001 Heverlee, Belgium
Email: wim.symens@fmtc.be

1 Introduction

Traditionally, active control of structural radiators has approached the problem through integrating sensors and actuators on or into the structure. In such an approach, the goal is to modify the system’s response to disturbance, rather than influence the disturbance path to the radiating structure. Many practical issues exist, which ultimately limit the effectiveness of such an approach. A general problem in industry is noise radiation from a structure housing a rotating device, where the rotating device creates the disturbance. We have attacked the problem by seeking to reduce the force transmission in the path rather than the vibration on the radiating surface itself.

2 Implementation and results

A setup on lab scale has been built (Fig. 1), such that in the frequency range of interest, up to 1 kHz, several plate resonances, frame resonances and the shaft resonance show up. Next, a modular active bearing was designed that uses piezo stacks for actuation and both force and acceleration measurements as sensing signals. A repetitive controller was also implemented and this further reduces the radiated noise. As in the frequency region below 500 Hz, the achievable reduction with the force feedback is limited, a repetitive control using the frame acceleration was implemented. Figure 2 presents the achieved noise reduction using only feedback control and feedback control combined with repetitive control (i.e. hybrid control) in the frequency range of 400-900 Hz. This result shows the effectiveness of the selected approach.

In the presentation a general overview of the work conducted will be given. Details on bearing design and controller implementation can be found in [1] and [2] respectively.

Figure 1: Setup with active bearing

Figure 2: Noise reduction with feedback and hybrid (feedback+repetitive) control

References