ACTIVE CONTROL IN ROTATING MACHINERY USING MAGNETIC ACTUATORS: A COMPARATION WITHIN LQR CONTROL

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ABSTRACT

The recent years have seen the appearance of innovative systems for acoustic and vibration attenuation, most of them integrating new actuator technologies. In this sense, the study of algorithms for active vibrations control in rotating machinery became an area of enormous interest, mainly due to countless demands of an optimal performance of mechanical systems in aircraft, aerospace and automotive structures. Also, many critical machines such as compressors, pumps and gas turbines continue to be used beyond their expected service life, despite the associated potential for failure due to damage accumulation. In this way, this paper presents an approach that is numerically verified for active vibration control in a rotor using Active Magnetic Bearings (AMB). The feedback technique is used and the controller gain is obtained by linear quadratic regulator (LQR) by using a discrete state-space formulation. Also, this work compares the LQR control by state-space feedback with by the derivate state-space feedback. The AMB uses electromagnetic forces to support a rotor without mechanical contact. It offers many advantages compared to fluid film and rolling element bearings, such as no wear, the ability to operate in high temperature environments, and no contamination of the working fluid due to the absence of a lubricant in the system. By monitoring the position of the shaft and changing the dynamics of the system accordingly, the AMB keeps the rotor in a desired position. This unique feature has broadened the applications of AMB and now they can be considered not only as a main support bearing in a machine but also as dampers for vibration control and force actuators.