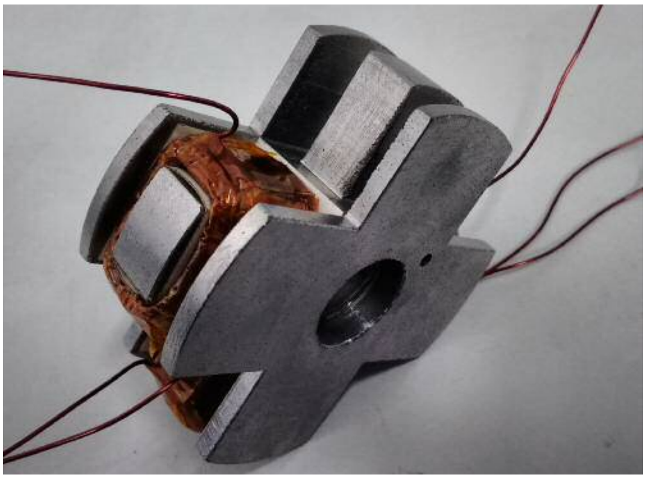
The Centre for
Power Transmission
and Motion Control

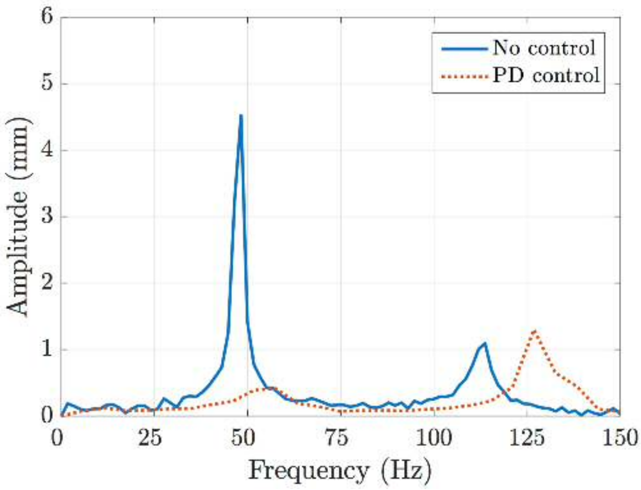
UNIVERSITY OF BATH

Research Project

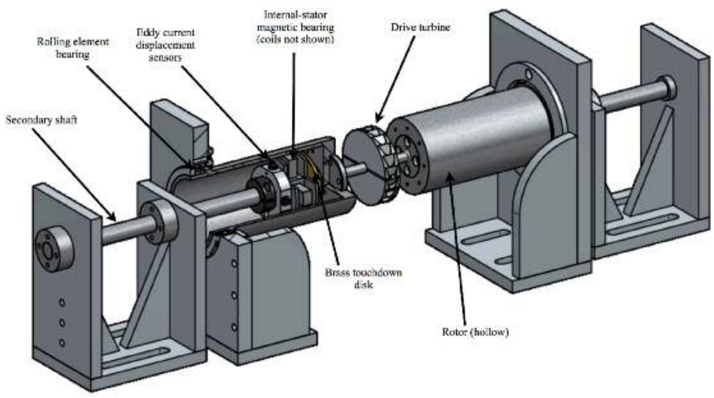
ROTOR VIBRATION REDUCTION VIA FLEXIBLY-MOUNTED INTERNAL-STATOR MAGNETIC BEARINGS



Internal-stator homopolar magnetic bearing design



Impulse frequency response of test rig with and without magnetic bearings active



Overview of test rig built for project

Motivation

Rotors are used in a vast array of industrial machinery in all field of engineering and technology. Common examples include pumps, generators, compressors and flywheels. One of the key limits on the performance of such machines is the occurrence of damaging vibrations. Therefore techniques to reduce the vibration in such systems are of the first importance to improving performance.

Magnetic Bearings

Since the 1970s, significant work has been undertaken on the task of implementing magnetic bearings in rotor systems. These bearings replace traditional bearings (e.g. rolling-element or oil-film) and levitate the rotor in a magnetic field. As actively controlled devices, magnetic bearings offer significant scope for influencing system characteristics, and thus reducing vibration. Many rotor systems incorporating magnetic bearings share a similar geometry to one another – they use large, rigidly mounted external-stator bearings. This research project explores the possibility of using a novel system topology with small, flexibly-mounted internal-stator magnetic bearings.

Test Rig

A test rig has been designed and constructed to assess the principle. The rig is based on a rotor constructed from a pair of hollow steel tubes linked by a thin, solid central section. The rotor is driven by an air-powered impulse turbine mounted on the central section. Into each end of the rotor is inserted an internal-stator, homopolar magnetic bearing, mounted on a cantilever supported independently of the rotor. The magnetic bearings are fabricated from Soft Magnetic Composite (SMC), and are controlled based on displacement signals provided by eddy current sensors mounted adjacent to the bearings.

Results

Experimental results achieved show a good match with predictions made via numerical modelling. It is shown alteration of the rotor dynamic characteristics is possible through the use of the magnetic bearings. Results achieved include impulse frequency responses and rotor run-down tests.

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