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Fractional order PID control of rotor suspension by active magnetic bearings

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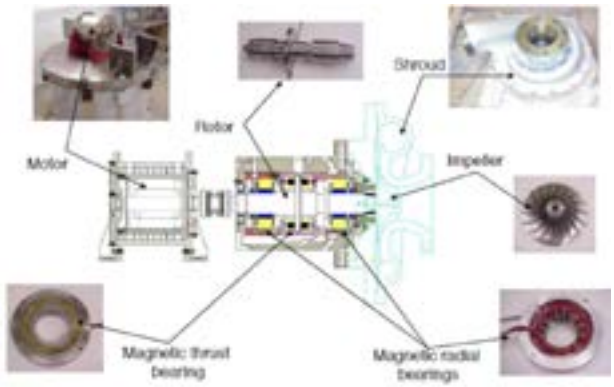
One of the key issues in control design for Active Magnetic Bearing (AMB) systems is the tradeoff between the simplicity of the controller structure and the performance of the closed-loop system. To achieve this tradeoff, this talk proposes the design of a fractional order Proportional-Integral-Derivative (FOPID) controller. The FOPID controller consists of only two additional parameters in comparison with a conventional PID controller. The feasibility of FOPID for AMB systems is investigated for rotor suspension in both the radial and axial directions. Tuning methods are developed based on the evolutionary algorithms for searching the optimal values of the controller parameters. The resulting FOPID controllers are then tested and compared with a conventional PID controller, as well as with some advanced controllers such as Linear Quadratic Gausian (LQG) and H-infinity controllers. The comparison is made in terms of various stability and robustness specifications, as well as the dimensions of the controllers as implemented. Lastly, to validate the proposed method, experimental testing is carried out on a single-stage centrifugal compressor test rig equipped with magnetic bearings. The results show that, with a proper selection of gains and fractional orders, the performance of the resulting FOPID is similar to those of the advanced controllers.



Components of the centrifugal compressor equppied with AMBs

Recent Publications

1. Yoon S Y, Anantachaisilp P and Lin Z (2015) An LMI approach to control of exponentially unstable systems subject to saturation and time-varying delay in the input. Recent Results on Nonlinear Time Delayed Systems, Springer, 4:367-384.

2. Anantachaisilp P and Lin Z (2013) An experimental study on PID tuning methods for active magnetic bearing systems. Int. J. Advanced Mechatronic Systems, 5(2):146-154.

Biography

Parinya Anantachaisilp received his PhD in Electrical Engineering from University of Virginia in 2015. He is now teaching at the Royal Thai Air Force Academy. His research interest includes control design system, fractional order control, active magnetic bearings, rotating machinery, unmanned aerial vehicle, and mechatronics.

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