# EXPERIMENT ESTIMATION OF BEARINGS ROTORDYNAMIC PARAMETERS: A STATE OF THE ART

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## EXTENDED ABSTRACT

Ever-increasing demand for high power and high speed with uninterrupted and reliable operation in most of the modern industries requires the accurate prediction and control of the dynamic behaviour increasingly important. The machine elements that allow relative motion between the rotating and the stationary machine elements i.e. *the bearings* is the most crucial part of such large machinery. Since the dynamic characteristics of rolling element bearings, fluid-film bearings (journal and thrust; hydrostatic, hydrodynamic, hybrid, gas-lubricated and squeeze-film), magnetic, foil bearings together with seals, have some common features hence in the present paper they are referred as bearings.

In actual test conditions obtaining reliable estimates of the bearing operating conditions is difficult and this leads to inaccuracies in the well-established theoretical bearing models. To reduce the discrepancy between the measurements and the predictions physically meaningful and accurate parameter identification is required in actual test conditions. Inverse engineering problems in structural dynamics involves the identification of system model parameters by knowing the response and force information. This is called modal testing (as shown in Figure 1). The present inverse engineering problem of identifying bearing dynamic parameters, with partial knowledge of the system parameters (i.e. of the beam model) along with the force and corresponding the response (displacements/velocities/accelerations), falls under the *grey system.*


Figure 4(a) Standard modal testing

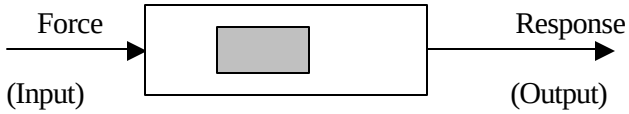


Figure 4(b) Grey system (model updating)

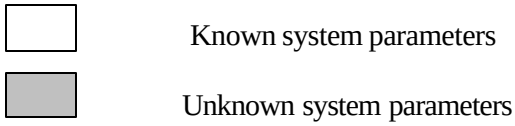


Figure 1. An abstract representation of system parameter identification procedures

A state of the art of experimental estimation of bearings rotordynamic parameters is documented in this paper. Vibration based estimation methods is the major theme. The state of the art includes descriptions of experimental measurement techniques, mathematical modelling, parameter extraction algorithms and uncertainty in the estimates applied to a variety of bearings. The experimental techniques include descriptions of test rigs, instrumentation for data collection and methods and types of data collection from the test rigs. The parameter extraction algorithms include identification methods both in time and frequency domains. The uncertainty in the bearing dynamic parameters includes both due to numerical calculations and due to the measurements. The identification methods have been classified based on excitation methods used to excite the system. Based on the state of the art in the bearings identification, conclusions are made and future directions are suggested.