INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : **T. Moasunep Jamir**

Roll Number : **10610318**

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Thesis Title:
"**Gas Foil Bearing: Effect of Foil Materials and Stability Analysis Using Different Models for Foil Structure"**

Name of Thesis Supervisor(s) : **Prof. S. K. Kakoty and Dr. K. Kalita**

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SHORT ABSTRACT

Gas foil bearings (GFBs) are compliant surfaces, self-acting hydrodynamic bearings typically constructed from several layers of sheet metal foils. These foils rest on elastic support structure and their performance largely depends on this support structure. A commonly used such foil structure consists of bump strips and the smooth foil rest on top of these strips.

The widespread usage of GFBs includes turbomachinery applications such as in turbo-generators, turbines, IC engines, compressors, pumps, light weight business aircraft engines etc. and a comprehensive numerical modelling verified with the available test data enables this usage.

This work sets out a structured and formal approach for the steady state analysis and the stability analysis of GFBs by mounting on a rotor bearing system. A literature review is carried out to assess the state of the art regarding both theoretical and experimental studies about GFBs. Based on the review, an attempt has been made to study several aspects of GFBs as mentioned hereunder in brief.

The compliant foil structure is modelled using the finite element method. Three different numerical models viz. One-dimensional (1D) beam element model, two-dimensional (2D) Classical Plate Theory (CPT) model and 2D Shear Deformation Theory (SDT) plate model were considered for modelling the compliant structure. The foil deflections calculated from the structural model using finite element analysis is coupled to the hydrodynamic gas film model governed by Reynolds equation to predict various characteristics of GFBs.

The steady state analysis of the GFBs are then carried out to predict various parameters such as load carrying capacity, effect of bump compliance coefficient etc. with different numerical models of the compliant foil structure.

Stability of the GFBs is also investigated using nonlinear time transient analysis with different numerical models of the foil structure by mounting the GFBs in a rotor bearing configuration. This study predicts the stability characteristics of the rotor motion, by tracing the journal centre trajectories at different locations of the rotor. The predicted results for each numerical model have been compared and an assessment of the models has been made to ascertain the best model for prediction. Also the conservative model is identified from the viewpoint of bearing designers.

The bump foil materials play a vital role in the load capacity performance of GFBs. Therefore, an attempt has also been made to explore the possibility of using different bump foil materials other than structural steel and the effect of compliance coefficient by estimating the load capacity performance of the GFBs.