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## TRANSIENT ANALYSIS OF JOURNAL BEARINGS OPERATING WITH NON-NEWTONIAN LUBRICANTS UNDER DIFFERENT LOADING CONDITIONS

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### ABSTRACT

This paper examines the effect of roughness in hydrodynamic journal bearings operating with non-Newtonian lubricants under different operating conditions. A modified Reynolds equation for finite journal bearings with rough surfaces with Gaussian distribution (longitudinal, transverse and isotropic roughness) has been solved using the non-linear transient approach. An analytical expression for average film thickness is obtained and introduced in the modified Reynolds equation. The resulting differential equation is then solved by the finite difference method with a successive over-relaxation scheme, while the equation of motion is solved by the fourth-order Runge-Kutta method. The results are compared with established results for Newtonian lubricants. It has been found that both non-Newtonian and roughness effects have a vital significance in the stable running of a rotor bearing system under different loading conditions.

### INTRODUCTION

Journal bearings are extensively used in high speed machineries in modern industries. The efficient performance of these bearings is very crucial for achieving the optimum productivity from these machineries. The necessity of high speed has made the role of bearings very crucial. An improvement in the performance of bearings however small, is very vital and many researchers have focused their attention on these factors. Consideration of non-Newtonian and roughness effects in the analysis of bearings is very essential since both these factors have their own significance in the performance of bearings. Most studies considers only static load on journal bearings which makes the analysis simple at the cost of accuracy because the journal bearings are frequently subjected to dynamic loads. Another important factor considered here is the different types of loading system which are very common in journal bearing applications.

### METHODOLOGY

The modified Reynolds equation for non-Newtonian lubricants considering roughness parameters is solved by finite difference technique with Gauss-Siedel iteration. The pressure distribution is obtained by a successive over-relaxation scheme. Since the pressure distribution is symmetrical about the bearing mid-plane, only one-half of the bearing is considered. Non-linear transient simulation of the bearing system is performed using the equation of motion to obtain the journal center trajectories under different roughness configurations and loading conditions. The variation of mass parameters and whirl ratio (measure of stability) are plotted for different eccentricity ratios, L/D ratios and power law indices (measure of non-Newtonian behaviour) to obtain the influence of non-Newtonian and roughness characteristics.

### RESULTS AND DISCUSSION

The influence of surface roughness on the stability of journal bearings is more prominent with non-Newtonian lubricants than for Newtonian lubricants. Transverse roughness tends to increase the stability whereas the isotropic roughness tends to decrease it in most cases. Different operating conditions also have a vital influence for stable running of journal bearing system.

### REFERENCES

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