



Cairo University

**OPTIMUM DESIGN OF HYDRODYNAMIC JOURNAL
BEARINGS USING MULTI-OBJECTIVE GENETIC
ALGORITHMS**

By

Khaled Mohamed Gamal El-Din Mohamed Kotb El-Shafee

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Mechanical Design and Production Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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Title of Thesis:

Optimum design of hydrodynamic journal bearings using Multi-Objective Genetic Algorithm

Key Words:

Journal bearing; Optimization; Multi-objective Genetic Algorithm

Summary:

This work presents the design and optimization of a hydrodynamic journal bearing. The multi-objective Genetic Algorithms technique is used to find the optimum design. Two objective functions are considered and four design parameters are chosen to be the design variables. The results show the optimum design according to an applied load and a rotating speed. The results of this thesis are compared with other researches results to show the improvements of the used objective functions.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Khaled Mohamed Gamal El-Din Mohamed

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Dedication

This work is humbly dedicated to all my valuable treasures in life:

To my grandfather and grandmother

Prof. Dr. Abou Dahab Mohamed and Mrs. Fahima Mostafa

To my parents and brothers

**Eng. Gamal El-Shafee, Mrs. Hayam Abou Dahab, Eng. Ahmed, Omar and
Nour**

To my wife

Dr. Rana Mohamed

To my beloved daughters

Lily and Lara

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Nomenclature

| | |
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| A: Cross-sectional area | m^2/s |
| C: Radial clearance | m |
| C_{max} : Maximum radial clearance | m |
| C_{min} : Minimum radial clearance | m |
| C_p : Specific heat of lubricant | J/kg.K |
| D: Journal diameter | m |
| D_H : Hydraulic diameter | m |
| e: Eccentricity | |
| F_j : Friction force | N |
| G_θ : Correction coefficient | |
| h_c : Film thickness at transition point | m |
| h_{min} : Minimum oil film thickness | m |
| L: Bearing length | m |
| n: Journal rotational speed | rpm |
| N: Length of the bit string | |
| P: Load per unit of projected bearing area | kg/m^2 |
| P_{max} : Maximum generated pressure | kg/m^2 |
| Q: Supplied oil quantity | m^3/s |
| Re : Reynolds number | |
| Re : Average Reynolds number | |
| $Re_{critical}$: Critical Reynolds number | |
| r: Journal radius | m |
| S: Sommerfeld number | |
| U: Velocity | m/s |
| U_x : Velocity in x-direction | m/s |