Accepted Manuscript

Numerical research of pressure depression in aerostatic thrust bearing with inherent orifice

Jianbo Zhang, Donglin Zou, Na Ta, Zhushi Rao

PII: S0301-679X(18)30154-3

DOI: 10.1016/j.triboint.2018.03.009

Reference: JTRI 5153

To appear in: *Tribology International*

Received Date: 2 January 2018

Revised Date: 4 March 2018

Accepted Date: 12 March 2018

Please cite this article as: Zhang J, Zou D, Ta N, Rao Z, Numerical research of pressure depression in aerostatic thrust bearing with inherent orifice, *Tribology International* (2018), doi: 10.1016/j.triboint.2018.03.009.

Numerical research of pressure depression in aerostatic thrust bearing with inherent orifice

Jianbo Zhang[a] , Donglin Zou[a] , Na Ta[a] , Zhushi Rao[a,b,*]

[a]Institute of Vibration, Shock and Noise, State Key Laboratory of Mechanical System and Vibration, Shanghai Jiao Tong University, Shanghai 200240, P.R. China;

[b]Collaborative Innovation Center for Advanced Ship and Deep-Sea Exploration, Shanghai 200240, P.R. China

Abstract: The undesirable pressure depression in aerostatic bearing will cause the loss of aerostatic bearing load capacity. Therefore, the method of “separation of variables” (MSV) for solution of laminar boundary-layer equations is utilized to investigate the pressure depression. The influences of supply pressure, orifice diameter, film thickness and pressure ratio on the pressure depression are studied. The results manifest that pressure depression is weakened with decreasing supply pressure and film thickness and increasing orifice diameter. The increase of pressure ratio which is determined by the flow and geometry parameters will weaken the inertial effect and then results in weakening the pressure depression. What’s more, when pressure ratio is larger than the critical value 0.9409, the pressure depression will disappear.

Keywords: Aerostatic bearing; pressure depression; inherent orifice

1. Introduction

With free of oil pollution, low noise, low friction resulting in low heat generation, high stability of air lubrication in the extreme condition and low motion error, gas bearings are widely applied to the high-speed rotating and high precision machines, such as dental drills, micro-turbomachinery and the high precision measurement machines, etc. [1-5]. Aerodynamic bearings have poor load capacity due to the low viscosity when rotary speed is low. However, gas bearings with orifice restrictors, known as aerostatic bearings, use external high pressure gas to generate extra load capacity. There exist abundant literatures on the characteristics of aerostatic bearings published in the past. With merit of remarkable computational efficiency, the

* Corresponding author. Tel./fax: +86 021 34206813-808.

E-mail address: zsrao@sjtu.edu.cn (Z. Rao).