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A numerical method for solution of the discharge coefficients in externally pressurized gas bearings with inherent orifice restrictors

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Abstract: To study the discharge coefficients of aerostatic bearings, a new numerical method which combines the method of "separation of variables" for solution of laminar boundary-layer equations and analytical solution of Reynolds equation is proposed. The discharge coefficients are suitable for solution of Reynolds equation. The influences of flow and geometry parameters on discharge coefficients are investigated and the results indicate that there exists parameters insensitive and sensitive regions in discharge coefficient analysis. Further research shows that flow and geometry parameters affect discharge coefficient by influencing the pressure ratio (p_r/p_s) and discharge coefficient tends to be constant when pressure ratio is approximately less than 0.6, which is the reason that there exists the parameters insensitive and sensitive regions.

Keywords: Aerostatic bearing; Discharge coefficient; Reynolds equation

1. Introduction

With high stability of lubrication medium, low motion errors and relatively low friction resulting in low heat generation, aerostatic bearings are widely applied to high-speed rotating and high precision machines, such as air compressors, the drills and high precision measuring machines, etc. [1-6].

In general, the finite difference method (FDM) is used to solve Reynolds equation and then analyze the characteristics of aerostatic bearing. There are three kinds of boundaries in the solution of Reynolds equation busing FDM, i.e. atmosphere boundary, coincidence boundary and mass flow rate balance boundary [2]. The key of

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