An Analytical and CFD Combined Method on Performance Analysis of Aerostatic Bearing with its Application to Parametric Design Optimization

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ABSTRACT

On mechanical performance analysis of aerostatic bearings, the tranditional analytical method is of convenience but poor precision, while the CFD method is relatively precise but inconvenient due to big numerical model scale and difficulty of modeling and calculation convergence. To overcome the demerits and make use of the advantages of the two methods, an analytical and CFD combined method to solve mechanical performances of aerostatic bearings is developed. To demonstrate the application and analyze the effectiveness of the developed method, the calculations on a certain radial aerostaic bearing are performed by using the traditional analytical method and the analytical and CFD combined method, respectively, meanwhile, a related experimental measurement is also carried out. Through the calculations and experiment, the radial load carrying capacity and stiffness of the aerostaic bearing are obtained. The comparison of the calculated and experimented results indicats that the analytical and CFD combined method is much more precise than the traditional analytical method. More over, as an application example, the parametric design optimization for the radial aerostatic bearing is carried out and the optimal result is obtained by use of the analytical and CFD combined method where the objective is to achieve the maximum radial stiffness and the design variables are the orifice number and diameter and the radial clearance.

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