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Multidisciplinary Design and Analysis of the Direct Drive Aerostatic Slideway

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Abstract

Direct drive aerostatic slideways are working in the multidisciplinary environment coupling with the electrical actuation, heat, force and pressured airflow conditions. In this paper, the relationship on multidisciplinary coupling data within the design and analysis of the direct drive aerostatic slideway has been investigated, and the corresponding multidisciplinary design and analysis platform has been developed so as to obtain the optimal performance of the slideway at nanometric accuracy in dynamic working conditions. The fluctuate characteristics of slideways together with load, multiple heat sources and gas fluid environment have been investigated using the platform. Microscopic deformations of the slideway interacted with varied film thickness and temperature have been identified. Main difference caused by multidisciplinary interaction in design nominal value is analyzed and compared with non-coupling design and test data. The analytical approach used in the research together with the predicted results is in accordance with reality in case study. It shows that the proposed investigation scheme is efficient in identifying the transient deviation on bearing capacity, stiffness of slideway, micro-morphology of floating surface and its magnitudes such as thermal deformation of slideways. The multidisciplinary simulation environment is essential to realize the seamless integrated design and analysis of aerostatic slideways at nanometric accuracy.

Keywords: Aerostatic slideways design; multidisciplinary simulation; precision machine dynamics; integrated design and analysis environment