Development of advanced multilevel solution for journal paths including bearing deformation

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Abstract:

In bearing analysis for compressor design traditionally the Mobility Method is used to predict the bearing pressure field in the journal path computation. This is a very reliable, and easy to use, computationally cheap method. However, in view of today's increasingly severe operating conditions this method has significant limitations hampering further design optimization. For example, under extreme loads the effect of the bearing deformation on the film thickness cannot be accounted for. To face the current design challenges a novel approach has been developed based on full numerical simulations of the pressure field from the Reynolds equation incorporating a complete description of the bearing shape. Owing to the use of optimally efficient Multigrid/Multilevel solution techniques detailed simulations with dense grids and small time steps can be carried out on small scale computers which are commonly available in a design environment. The bearing deformation in response to the loading can be incorporated in the form of pre-computed elliptic shapes or taken from detailed FEM analysis. The efficiency of the approach even allows taking into account the effects of groove patterns on the journal path and the analysis of the effects of surface defects. The method is very flexible which also allows the calculation of translational slider bearings (crosshead) and 3D asymmetric bearing shapes. In this paper the approach is described and detailed results are presented illustrating the accuracy, efficiency, the flexibility of the method and its suitability for modern bearing design.