A fully coupled air foil bearing model considering friction – Theory & experiment – DTU Orbit (24/08/2019)

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The dynamics of air foil bearings (AFBs) are not yet fully captured by any model. The recent years have, however, seen promising results from nonlinear time domain models, and simultaneously coupled formulations are now available, avoiding the previous requirements for undesirably small time steps and temporal convergence studies.

In the present work, an alternative foil structure model is substituted for the simple elastic foundation model to avoid its inherent limitations. The new foil model is based on a truss representation from the literature, but incorporates the foil mass and a dynamic friction model. As a consequence of the friction model's velocity dependency, the foil mass is included to obtain a set of differential equations that can be coupled to the rotor and fluid domains while allowing a simultaneous solution.

Considerations leading to a practically applicable implementation are discussed and numerical results are compared with experimental data. The model predicts natural frequencies and mode shapes well, but it is not yet capturing the unbalance response when friction is considered. Possible causes for this discrepancy are discussed and it is suggested that sticking is a more prevalent state than previously assumed.

General information
Publication status: Published
Organisations: Department of Mechanical Engineering, Solid Mechanics
Contributors: von Osmanski, A. S., Larsen, J. S., Santos, I.
Pages: 660-679
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Journal of Sound and Vibration
Volume: 400
ISSN (Print): 0022-460X
Ratings:
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.2 SJR 1.36 SNIP 2.089
Web of Science (2017): Impact factor 2.618
Web of Science (2017): Indexed yes
Original language: English
Keywords: Air foil bearing, Rigid rotor, Transient simulation, Nonlinear analysis, Friction
Electronic versions:
DOIs:
10.1016/j.jsv.2017.04.008
Source: FindIt
Source-ID: 2358095193
Research output: Contribution to journal › Journal article – Annual report year: 2017 › Research › peer-review