

Effects of Fluid and Structural Forces on the Dynamic Performance of High Speed Rotating Impellers.

C. Thiagarajan¹, G. Shenoy², B. S. Shenoy³

¹ATOA Scientific Technologies Pvt Ltd, Whitefield, Bangalore, India.

²Department of Mechanical & Manufacturing Engineering, Manipal Institute of technology, Manipal, India

³Department of Aeronautical & Automobile Engineering, Manipal Institute of Technology, Manipal, India

Abstract

Vibration and Dynamic performances of the rotating machinery are conventionally evaluated based on the dominant structural forces such as the centrifugal forces. The increase in rotational speed, miniaturization and performance, demands for improved and accurate evaluation of the vibration performance. The inclusion of coupled effects of fluid and centrifugal forces can contribute significantly to the accurate performance prediction. Multiphysics effects are increasingly used to improve the performance prediction. The development of COMSOL Multiphysics model for the characterization of unforced and forced vibration of a typical rotating impeller will be detailed. The effect of stress stiffening, stress softening, Coriolis forces and damping will also be included. A model to study the coupled fluid and structural forces will be developed. The effect of fluid and structural forces as function of the size of the rotor will be studied. Importance will be given to the coupled effects and rotational speed. In this work, the effects of structural and aero or hydrodynamic forces will be considered. Figure 1 and 2 shows typical results related to structural and vibration performance. In future work, the Structural, fluid and thermal forces will also be included. The relevance of this work in relation to the application to conventional and submersible pumps, turbines and micro power harvesting devices will be highlighted.

Keywords: Vibration, dynamics, turbines, impellers, rotating machinery, coupled fluid structure interaction, centrifugal forces, fluid forces, natural frequency, and vibration performance.

Reference

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Figures used in the abstract

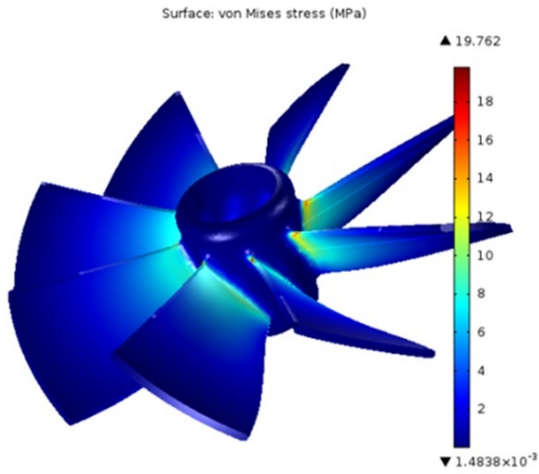


Figure 1 shows typical equivalent stress level contour plots of an impeller due to centrifugal forces.

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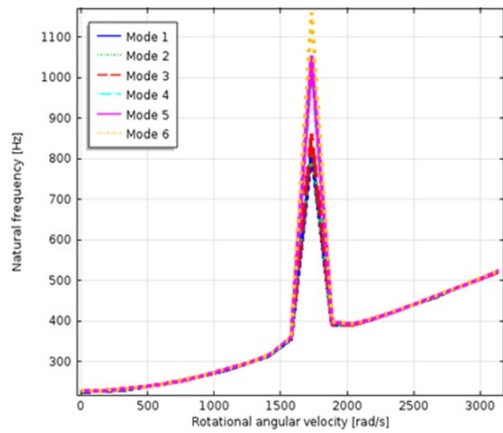


Figure 2 shows typical vibration modes as a function of rotation speed.

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