Dynamics of Rotating Flexible Blade-Disc-Shaft Assemblies Application to a Turbomolecular Pump Rotor

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ABSTRACT

It is now increasingly necessary to predict accurately, at the design stage and without excessive computer costs, the dynamic behavior of rotating parts of turbomachines, in order to be able to avoid resonant conditions at operating speeds. In this study, the global non-rotating mode shapes of flexible bladed disc–shaft assemblies are used in a modal analysis method for calculating the dynamic characteristics (frequencies and mode shapes) of the corresponding rotating system. Non rotating mode shapes are computed using a finite element cyclic symmetry approach. Rotational effects, such as centrifugal stiffening and gyroscopic effects are accounted for, and all possible couplings between the flexible parts are allowed. The proposed model is applied to a turbomolecular pump rotating assembly. The influence of coupling between shaft and blades is clearly highlighted and illustrates some of the limitations of classical uncoupled rotordynamic and bladed-disc approaches.

Keywords: rotor, bladed assembly, disc shaft coupling, vibration