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Computational fluid dynamic analysis of a vibrating turbine blade
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Abstract
This study presents the numerical fluid-structure interaction (FSI) modelling of a vibrating turbine blade using the commercial software ANSYS-12.1. The study has two major aims: (i) discussion of the current state of the art of modelling FSI in gas turbine engines and (ii) development of a "tuned" one-way FSI model of a vibrating turbine blade to investigate the correlation between the pressure at the turbine casing surface and the vibrating blade motion. Firstly, the feasibility of the complete FSI coupled two-way, three-dimensional modelling of a turbine blade undergoing vibration using current commercial software is discussed. Various modelling simplifications, which reduce the full coupling between the fluid and structural domains, are then presented. The one-way FSI model of the vibrating turbine blade is introduced, which has the computational efficiency of a moving boundary CFD model. This one-way FSI model includes the corrected motion of the vibrating turbine blade under given engine flow conditions. This one-way FSI model is used to interrogate the pressure around a vibrating gas turbine blade. The results obtained show that the pressure distribution at the casing surface does not differ significantly, in its general form, from the pressure at the vibrating rotor blade tip. © 2012 Osama N. Alshroof et al.

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