SOME CONSIDERATIONS ON CYCLIC SYMMETRY IN ROTORDYNAMICS

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It is well known that axial symmetry plays a very important role in rotordynamics: when either the rotor or the stator of a rotating machine are axially symmetrical it is possible to write the equations of motion in the form of constant-coefficients equations using a suitable reference frame (inertial frame for axi-symmetrical rotors and rotor-fixed frame for axi-symmetrical stators) [1, 2].

If on the contrary both rotor and stator do not possess such symmetry characteristics (or more than one rotor with no axial symmetry exists) a periodic-coefficient equation of motion must be used to model the dynamic behaviour of the machine. Although Floquet theory guarantees that a unique solution exists (in the case of linear systems), such a solution cannot be found in closed form and reaching an approximated solution involves computations which are much more complex than in the case of constant coefficients equations.

Many non axy-symmetrical rotors have a cyclic symmetry. In this case the simple one-dimensional models (beam-like models) are of the same type as those of axi-symmetrical rotors, since the elasticity and inertia properties of a linear object with cyclic symmetry of order 3 or more are equivalent to those of an object with symmetry of order infinity. A complete 3-d modelling of the rotor however loses this property and apparently an equation of the same type of that typical of unsymmetric rotors is found.

Aim of the present paper is to show that the modes of such a rotor are nevertheless the same as those of an axy-symmetrical rotor and consequently the equations written in modal coordinates show a symmetry not apparent when ‘physical’ coordinates are used. This allows to resort to constant-coefficients equations even in the case in which either the stator or the rotor have cyclic symmetry, while the other one is unsymmetrical.

BIBLIOGRAPHY

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