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CAPABILITIES OF 1D CUF-BASED MODELS TO ANALYZE METALLIC/COMPOSITE ROTORS

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Carrera's Unified Formulation (CUF) is here extended to perform free-vibrational analyses of rotating structures. CUF is a hierarchical formulation which makes it possible to obtain refined structural theories by writing the unknown displacement variables using generic functions of the cross-section coordinates (x,z), which are, in this paper, Taylor-like expansions of N-order. The increase of the theory order leads to three-dimensional solutions while, the classical beam models are obtained as particular cases of the linear theory (N=1). The Finite Element method is used to derive the weak form of the three-dimensional differential equations of motion in term of 'fundamental nuclei', whose forms do not depend on the approximation used. Including both gyroscopic and stiffening contributions, structures rotating about either transversal or longitudinal axis can be considered. In particular, the dynamic characteristics of thin-walled composite shafts and blades are investigated in order to predict critical speeds and instabilities. The results reveal that the present one-dimensional approach combines a remarkable accuracy with a very low computational cost compared with the available 2D and 3D solutions. The advantages are especially evident when shafts with deformable discs, thick metallic/laminated cylinders and box beams are analyzed.

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