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”JJCAB5#1 - Characterization of the dynamic behavior of laminated electric rotors”

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The rotors of traction motors have a direct impact on reliability and vibrational stability of the whole system. The rotors of Alstom electric motors are composed of a shaft onto which magnetic sheets are assembled. The sheets are held in position by a shrink fit on the shaft and are held under axial pressure by clamping plates. The vibrational behavior of this complex assembly, due to its nature and method of assembly, is difficult to predict to date. Therefore, mastering the mechanical properties of these complex assemblies and the development of appropriate dynamic models are a major challenge for the Alstom company. The vibration of rotors has a direct impact on the following issues: the design of rotating parts under torsional excitation; the design of rotors with respect to increasingly stringent acoustic criteria; the design of rotors for increases in rotational speed that induce new vibrational risks. The objectives of the thesis are focused on the mechanical modeling of rotating parts in the presence of significant unknowns. In particular, the thesis should allow: a finer characterization of the mechanical behavior of the laminated sheet assembly as a function of residual mounting pre-tension through testing of sub-assemblies and elementary numerical models; validation of the approach within the framework of a simplified academic case (including, in particular, a calculation/test correlation and the consideration of non-linearities); the establishment of a methodology for predicting the vibrational behavior of the laminated rotor based on mounting conditions; validation of the approach within the framework of an application to synchronous and asynchronous machine rotors; integration of this methodology into a rotor optimization approach. The integration of unknowns into such complex simulations, incorporating realistic behaviors of technological components, is both a scientific challenge for the laboratory and a strong methodological contribution for industrial design offices

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