506. Modeling and diagnostics of gyroscopic rotor

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(Received 17 September 2009; accepted 27 November 2009)

Abstract. Study of dynamics of heavy impeller rotor and failure diagnostics of tilting-pad journal bearings is the object of this paper. Induced rubbing process in the bearings at resonance and increased rubbing phenomenon in both bearings was identified experimentally in situ by measuring radial gaps. Rotational speed was established when gravitational force became dominant over rotor gyroscopic force. Rotating system model was designed, simulated and verified.

Keywords: gyroscopic rotor, tilting-pad journal bearings, vibration, diagnostic

Nomenclature

Names	Description	Names	Description
$\{q\}$	The nodal element displacement vector	L_r, L_s, L_μ	Inductive reactance of stator and rotor
$[N]$, $[N_\vartheta]$	The matrices of shape functions	w_s	Angular velocity of voltage
$\{\dot{\vartheta}\}$, $\{\omega\}$	Angular velocity	U_{nom}	Voltage
$\{\psi\}$, $\{\dot{\psi}\}$	Flux space vector and time derivative	M_e	Torque of EM
I_e	Inertia mass moment of rotor	pol	Number of EM pole
$\{B_\psi(t,\psi,\dot{\varphi}_e)\}$	Vector of nonlinear functions	$[M(q)]$	Mass matrix
$[A_\psi]$	Matrix of resistors and inductive reactance of stator and rotor	$[C]$, $[G]$, $[K]$	Damping, gyroscopic, stiffness matrixes
φ_e	Angle of rotor	$\{F(q,\dot{q})\}$	The load vector of the finite element.
$M_e(\psi)$	Electrical torque	F_b, F_{by}, F_{bz}	Fluid-film force components
$M_r(\varphi_i,\dot{\varphi}_i,p_{Gi})$	Resistance torque	$[K_b]$, $[C_b]$	Stiffness, damping matrixes of bearing
r_s, r_r	Resistor of stator and rotor	$\{q_b\}$	Vector of displacement of bearing.