СЕКЦІЯ 5. МОДЕЛЮВАННЯ РОБОЧИХ ПРОЦЕСІВ В ТЕПЛОТЕХНОЛОГІЧНОМУ, ЕНЕРГЕТИЧНОМУ ОБЛАДНАННІ ТА ПРОБЛЕМИ ЕНЕРГОЗБЕРЕЖЕННЯ

AEROELASTICITY ANALYSIS OF ROTOR BLADES IN TH FIRST TWO STAGES OF AXIAL COMPRESSOR

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A bird strike can cause damage to stationary and rotating aircraft engine parts, especially the engine fan. This paper presents a bird strike simulated by blocking four stator blade passages. It includes the numerical results of the unsteady low-frequency aerodynamic forces and the aeroelastic behaviour caused by a non-symmetric upstream flow affecting the first two rotor blade stages in the axial compressor of a jet engine. The obtained results show that disturbances in the engine inlet strongly influence the level of unsteady forces acting on the rotor blades. With a partially blocked inlet the whole spectrum of low-frequency harmonics is observed. Such harmonics can lead to rotor blade damage. The low-frequency amplitudes are higher in the first stage rotor blades than in the second stage. In both rotor blades stages flutter appeared as a result of bird strike.

Foreign objects entering aircraft engines are a perennial problem. Mathematical analysis and computer simulations can provide information on component stresses already in the design phase. Foreign objects (e.g. a bird) were characterized as a water-like hydrodynamic response by Wilbeck and Rand in their tests [1]. Storace et al. [2] developed a computer program to predict structural response due to soft body impact. Heidari et al. [3] developed rotor dynamics as a nonlinear transient analysis for a propulsion system during bird strike induced fan blade loss. Experiments were carried out on SO-3 compressor first stage rotor blades to initiate a crack by placing rectangular blocks on the stator blades, simulating birds engulfed in the engine. The Fluent code was used to analyze the low frequency excitation caused by inlet blockage of 1.5 stages of an SO-3 engine, but it did not take into account rotor blade vibration. Aeroeleastic behavour of rotor blade 1.5 first compressor stage was analyze by Rzadkowski et al. [4]. In this paper the unsteady forces acting on rotor blades will be calculated for a 3D non-viscous ideal gas flow through 2.5 compressor stages using an in-house code and taking into account rotor blade vibration.

References:

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