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Numerical Investigation of the Laminar–Turbulent Transition of the Flow in a Rotor–Stator Cavity

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Flow in rotting disks systems is not only a subject of fundamental interest but is also a topic of practical importance. Typical configurations are cavities between compressors and turbines disks. Numerous works have been recently devoted to the investigation of the instabilities associated to a single disk flow and to a differentially rotating disks flow. Identification and characterization of mechanisms related to this process should improve the prediction methods and lead to new more efficient control strategies. In the present work the incompressible fluid flow in a stator/rotor cavity (cylindrical and annular) is numerically investigated using direct numerical simulation (DNS) and theoretical method (LSA). The numerical computations (DNS) are based on a pseudo spectral Chebyshev-Fourier method for solving 3D Navier–Stokes equations. The nature of the transition to unsteadiness as well as the influence of the end-walls boundary conditions (the influence of the attachment of the shroud and shaft to the rotor or to the stator and the influence of the approximation of the end-walls azimuthal profiles) on the stability of the flow have been investigated. Moreover, the absolute instability regions are theoretically identified using LSA method.

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