Subcritical dynamics of axisymmetric rotor-stator flow

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Rotor-stator flows have been studied extensively in the past. There have been many experimental observations of coexistence of both circular rolls and spiral arms [Schouveiler et al. (1998)]. The origin of the latter is well understood [Gelfgat (2015)] while that of the former is not. Such rolls display chaotic and sometimes transient dynamics [Lopez et al.(2009)]. Linear stability analysis performed by [Daube and Le Quéré(2002)] for the height/radius ratio of 0.1 revealed a Hopf bifurcation around $Re = 3000$, value much higher than found experimentally, and the existence of the subcritical branch. We revisit this transitional flow using numerical simulation and dynamical systems tools. New results concerning the first axisymmetric Hopf bifurcation will be presented. For lower values of Re, at least three flow regimes are identified - base flow, turbulent state and an edge state separating the two. This edge state features several incommensurate frequencies, involves inertial waves and, contrary to the expectations, does not originate directly from the Hopf bifurcation point.

Références

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