Nonlinear Interaction of vortex shedding and oscillating cylinder in vortex-induced vibration

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ABSTRACT

Strong support now exits, both from experimental and analytical studies, to use reduced dynamical systems for open flows expressed by Navier-Stokes equation. One important case is that of vortex shedding in the wake of a cylinder and in the last decade the Karman vortices that are shed have been identified as temporal oscillator due existence of an absolute instability condition. The interaction of these vortex shedding and a flexible cylinder is termed vortex-induced vibration (VIV) which affects many structures from control rods to underwater cables. A nonlinear interaction model for VIV is presented taking into consideration the existence of absolute instability in the wake. The assumed nonlinear coupling leads to a condition of parametric instability and the sychronization or locked in zones are identified with Mathieu tongues. This model captures many traits of the interaction including some very important ones that have remained unexplained to date.