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The role of Reynolds number in the fluid-elastic instability of tube arrays NICHOLAS KEVLAHAN, ALI GHASEMI, McMaster University —
The onset of fluid-elastic instability in tube arrays is thought to depend primarily on the mean flow velocity, the Scruton number and the natural frequencies of the tubes. However, there is evidence from experiments and numerical simulations that the Reynolds number is also an important parameter, although the available data are not sufficient to understand or quantify this effect. We use a high resolution pseudo-spectral scheme to solve two-dimensional penalized Navier–Stokes equations in order to accurately model turbulent flow through tightly packed tube arrays. To investigate the Reynolds number effect we perform simulations that vary Reynolds number between about 100 and 13,600 independent of flow velocity at fixed Scruton numbers, and then analyze the tube responses. Increasing Reynolds number has a strong de-stabilizing effect for rotated arrays. For in-line arrays, although Reynolds number still affects the instability threshold, the effect is not monotonic with increasing Reynolds number. The main de-stabilizing effect of increasing Reynolds number appears to be broadening of the vortex shedding frequency spectrum. This study increases reduces uncertainties in the experimental data, which usually do not account for the effect of Reynolds number.

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