Wake Modes of Rotationally Oscillating Cylinders at low Re
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Vortex shedding from bluff bodies is important in various engineering applications
because the wake can have many effects, including exciting vibrations in structures
and altering convective heat transfer. While vortex shedding from cylinders in cross-
flow and cylinders undergoing transverse and in-line oscillations has been studied
extensively, only limited data is available for rotational oscillations and is mainly
limited to spectral analysis of the wake. Water tunnel experiments were carried
out at Re = 150 to investigate the wake of a rotationally oscillating cylinder for
oscillation frequencies from 0.67 to 3.5 times the natural shedding frequency and
peak-to-peak oscillation amplitudes up to 320°. DPIV was used to study both the
near and far wake within this parameter space. Well-defined patterns of wake vor-
tices were observed in distinct regions of the parameter space, similar to the wake
modes of transversely oscillating cylinders in cross-flow. In portions of the parameter
space for which information exists in the literature the wake modes are well-related
to spectral data. Variants of modes in previously unexplored regions are explained
in terms of harmonics. The initial application of these results to understanding heat
transfer enhancement from rotationally oscillating cylinders will also be addressed.