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Streamwise vortex-induced and galloping-like vibrations of a rotating cylinder REMI BOURGUET, DAVID LO JACONO, IMFT / CNRS — The flow-induced vibrations of an elastically mounted circular cylinder, free to oscillate in the direction parallel to the current and subjected to a forced rotation about its axis, are investigated numerically at a Reynolds number equal to 100. The cylinder is found to oscillate up to a rotation rate close to 2 (first vibration region), then the body and the flow are steady until a rotation rate close to 2.7, where a second vibration region begins. Each vibration region is characterized by a specific regime of response. In the first region, the oscillation amplitude follows a bell-shaped evolution as a function of the reduced velocity (inverse of the natural frequency) and the vibration develops under a condition of wake-body synchronization: such behavior resembles the vortex-induced vibrations previously described in the absence of rotation. In the second region, the vibration amplitude increases unboundedly with the reduced velocity and may become very large, higher than 2.5 body diameters in the present parameter space. Such galloping-like responses were not observed when the body was restrained to oscillate in the cross-flow direction. They cannot be predicted through quasi-steady analysis and it is found that body oscillation and flow unsteadiness remain synchronized.

Remi Bourguet
IMFT / CNRS

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