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Self-sustained oscillations of a sinusoidally-deformed plate DIEGO F MURIEL, EDWIN A COWEN, Cornell University — Motivated by energy harvesting, the oscillatory motion of a deformed elastic material with aspect ratio Length/Width=2, immerse in an incompressible flow is studied experimentally. To induce the wave-like deformation a polycarbonate sheet is placed under longitudinal compression with external forcing provided by equispaced tension lines anchored in a frame. No additional constrains are placed in the material. Based on quantitative image-based edge detection, ADV, and PIV measurements, we document the existence of three natural states of motion. Bellow a critical velocity, a stable state presents a sinusoidal-like deformation with weak small perturbations. Above a critical velocity, instability appears in the form of a traveling wave with predictable dominant frequency accompanied by higher-order harmonics. As the flow velocity increases the instability converges faster to its limit cycle in the phase plane (e.g., vertical velocity and position), until the stable oscillatory mode transitions to chaos showing a broad energy spectrum and unstable limit cycle. The underlying objective is to induce the onset of the instability at lower critical velocities for higher bending rigidities, promoting possible energy extraction and increasing the range at which stable oscillations appear.

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