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Complex motions of vesicles and capsules in flow PETIA VLAHOVSKA, Dartmouth College, YUAN-NAN YOUNG, NJIT, CHAOUQI MISBAH, UJF-Grenoble, France — Membrane-bound particles exhibit rich dynamics when placed in flow. For example, in simple shear flow, vesicles made of lipid bilayers tank-tread or tumble. Capsules and red blood cells also show oscillations in the tank-treading inclination angle, called swinging. This motion originates from membrane shear–elasticity and non–spherical unstressed shape. We develop an analytical theory that quantitatively describes the swinging dynamics. Our analysis takes into account that the membrane is deformable, incompressible, and resists bending and shearing. Analytical results for the shape evolution are derived by considering a nearly-spherical particle shape. The phase diagram is constructed and compared to previous models which assume fixed ellipsoidal shape. Dynamics in quadratic and time-dependent flows is also discussed. Floquet analysis is conducted to investigate the vesicle dynamics and conditions for chaotic shape and flow dynamics are established.

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