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Viscous flow around a rapidly collapsing cylinder as a model of animal locomotion GABRIEL WEYMOUTH, SMART, MICHAEL TRIANTAFYLLOU, MIT — A large body of experimental research indicates that shape change is instrumental in the locomotion of many animals from basilisk lizards to swifts and ducks. As a two dimensional model of such body shape changes, we examine the changes in force, energy, and vorticity induced by two manners of rapidly reduced cylinders; a "deflating" cylinder with prescribed kinematics, versus a prescribed "melting" cylinder similar to the problem of the vanishing disk considered by Taylor in 1953. Using large-scale viscous flow simulations, we show that the dynamics of the two cases generate fundamentally different flow fields. The deflating cylinder practically erases the memory of the original larger cylinder flow, with the excess kinetic energy being recovered at the body boundary, and opposite-sign vorticity cancels the excess boundary layer vorticity. In contrast, the melting cylinder case shows instantaneous and global shedding of the vorticity, which rapidly form into two strong vortices that contain the excess kinetic energy. Both the shrinking and melting body conditions are then used to demonstrate the effect of shape changing appendages in a set of simple two-dimensional maneuvering problems.

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