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Lagrangian Flow Separation in External Aerodynamics[1] BJOERN KLOSE, GUSTAAF JACOBS, San Diego State University, MATTIA SERRA, Harvard University — Kinematic aspects of flow separation in external aerodynamics are investigated by revealing the initial motion of upwelling fluid material from the wall and its relation to the long-term attracting manifolds in the flow field. With direct numerical simulations of a circular cylinder and a cambered NACA 65(1)-412 airfoil, the location of initial fluid upwelling, the so-called spiking point, is determined from the curvature of advected material lines and from high-order numerical derivatives of the wall-normal velocity. While the short-time kinematics are governed by the formation of a material spike upstream of the zero-skin-friction point, over longer times the trajectories of the fluid tracers are guided by attracting ridges in the finite-time Lyapunov exponents once they leave the vicinity of the wall. The combination of initial fluid upwelling, asymptotic separation line, and attracting Lagrangian Coherent Structures draws a comprehensive picture of the mechanics of flow separation in external aerodynamics.

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