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Unsteady Aerodynamics of Turning Maneuvers in Olympic Class Sailboats[1] SARAH MORRIS, C.H.K WILLIAMSON, Cornell University — In this work, we use a "sports-mimetic" approach to study unsteady sail motion techniques, inspired by bodyweight motions used by Olympic sailors as they maneuver their sailboats when racing. One such technique used to increase a boats propulsion is for sailors to roll the boat about its longitudinal axis. This motion is used especially when turning in light winds, by either "roll-tacking" (upwind sailing) or "roll-gybing" (downwind sailing). When roll-tacking and roll-gybing, sailors dynamically roll the boat to propel their boats faster than using wind alone; this is in contrast to flat-tacking and flat-gybing, wherein the sailor keeps the boat level (and mast vertical) while turning. These motions are characterized in on-the-water experiments using an Olympic Laser sailboat and a 420 sailboat, equipped with a GPS, IMU, wind sensor and GoPro camera array. We study the underlying vortex dynamics using these characteristic motions, along with full-scale flow visualization. Flow visualization experiments are conducted on Cayuga Lake with an Olympic Laser Sailboat, using an Enola Gaye WP40 smoke grenade to visualize large-scale flow features around the sail.

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Sarah Morris
Cornell University

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