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The aerodynamics of dart AMIT PAWAR, KUMAR SANAT RANJAN, ARNAB ROY, SANDEEP SAHA, Indian Institute of Technology Kharagpur — Throwing darts is a popular sport, but very little is known about the aerodynamics of dart which enables the dart to pierce the board. We study the dart trajectories with high-speed imaging which reveals the delicate in-flight stabilization effected by the wings. Further investigation of the aerodynamic loads and the flow field around the dart is conducted using wind tunnel tests and numerical simulations. The aerodynamic force increases significantly with the angle of attack and is used for determining stability derivatives required for trajectory prediction using the equations of motion. The predicted trajectories agree quantitatively with the high-speed imaging footage. The laser-sheet flow visualization at different sections reveals multiple pair of counter-rotating vortices which strengthen with increasing angle of attack and eventually, the onset of vortex breakdown leads to a stall. The stabilizing moment generated by the wings is the key to maintaining equilibrium in the pitching plane and the dart landing at an apt angle to pierce the target. In addition, we observe that the spin on the dart has a negligible effect on the trajectory.

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