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Deformations, forces and flow field around a compliant membrane disk ASIMANSHU DAS, VARGHESE MATHAI, KENNETH BREUER, School of Engineering, Brown University — Highly compliant membranes exhibit large scale deformations and can alter the nature of the flow with which they interact. We focus on understanding the kinematics and dynamics of circular compliant membranes with varying shear modulus, G, placed head-on in a uniform flow. The experiments were carried out in a closed-loop low-speed wind tunnel with Reynolds number in the range of $10^4 - 10^5$. We measure the average and fluctuating properties of the compliant structure, including its deformation and drag forces. The membrane deforms into parachute-like shapes depending on the value of a dimensionless number - the Aeroelastic number, Ae - which measures the relative importance of elastic and aerodynamic stresses. With decreasing Ae (either higher speed, or a softer membrane), the membrane evolves from a flat circular disk-like shape to a nearly hemispherical shape. The drag coefficients vary from $1.1 - 1.4$. We provide comparisons with the flow-induced forces on rigid shells of similar shape.

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