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Aeroelastic Deformation and Buckling of Inflatable Wings under Dynamic Loads ANDREW SIMPSON, SUZANNE SMITH, University of Kentucky, JAMEY JACOB, Oklahoma State University — Inflatable wings have recently been used to control a vehicle in flight via wing warping. Internal pressure is required to maintain wing shape and externally mounted mechanical actuators are used to asynchronously deform the wing semi-spans for control. Since the rigidity of the inflatable wing varies as a function of inflation pressure, there is a need to relate the wing shape with aerodynamic loads. Via wind tunnel tests, span-wise deformations, twist and flutter have been observed under certain dynamic loading conditions. Photogrammetry techniques are used to measure the static aeroelastic deformation of the wings and videogrammetry is used to examine the dynamic shape changes (flutter). The resulting shapes can be used to determine corresponding aerodynamic characteristics. For particular inflation pressures, buckling can be induced at sufficiently high dynamic loads either through high dynamic pressure or large angle of attack. This results in a set of critical loading parameters. An inflatable winged vehicle would require operation within these limits. The focus of the presentation will be on defining and exploring the unsuitable operating conditions and the effects these conditions have on the operation of the wing.

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