

Structural Analysis for Aerial Deployment of Planetary Balloons

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The Jet Propulsion Laboratory is currently investigating the use of high performance and extremely lightweight superpressure balloon systems for planetary exploration. The class of balloons currently being investigated is constructed of Mylar polyester film and has a diameter of 10m. One mission scenario calls for the deployment and subsequent inflation of the balloon system while under parachute descent through the planet's atmosphere. Mechanical shock loads during balloon deployment present a serious, if not the critical, loading condition for the balloon. Our simulation efforts in support of this program are focused on developing predictive analysis tools that can estimate parachute-balloon-payload system performance during deployment, estimate the balloon's design margin (ratio of capacity to load), and be used to extrapolate to larger balloons or systems of different design.

The analysis of these deployment events is fraught with difficulties in the form of large geometric nonlinearities, uncertainties in material properties, material quality, and possibly flaw sizes and distributions, low temperature effects, strain rate effects, and inherent limitations on which variables can be measured during experimental deployments. This poster will describe the essential mechanics of the deployment process, illustrate the computational models currently being used to predict balloon internal forces, describe some tests results, and show correlations with the computational models.

* Preference for a poster