ADEPT for secondary payloads. B. Smith[1], A. Cassell[1], and E. Venkatapathy[1],
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Abstract: Deployable entry vehicles provide an enabling capability for large payloads at destinations across the solar system [1][2]. The primary advantage of such systems derives from the fundamental limitation of available launch vehicle shroads preventing tried-and-true rigid aeroshell technology from being applied. However, little mission-pull exists for deployable entry vehicle technology for missions where the entry vehicle is the primary payload and can fit within available shrouds. The propensity toward applying rigid aeroshell technology is logical given that deployable concepts are higher risk and provide no marginal scientific benefit for missions where a rigid aeroshell is an option.

A movement toward flying smaller spacecraft has emerged in recent years and is revealing novel applications for deployable entry vehicles as secondary payloads. Secondary payloads must minimize interference with the primary payload in order to ease accomodation. Advancements in small spacecraft technology have caught the attention of government entities who are now recognizing the high value proposition of small spacecraft for frequent, incremental technology development and science return rather than the traditional high cost and infrequent big-bang approaches. Worldwide, well over 200 small satellites (mass < 180 kg) have launched in recent years for such purposes as eduation, technology development, science, commerce, and defense [3].

The Adaptable Deployable Entry and Placement Technology (ADEPT), a mechanically-deployable entry vehicle technology, has been under development at NASA since 2011. An Ames Center Innovation Fund (CIF) proposal was recently awarded to study ADEPT for EDL of small payloads [4]. The unique capability of ADEPT for small science payloads comes from its ability to stow within a slender volume and deploy passively to achieve a mass-efficient drag surface with a high heat rate capability. The low ballistic coefficient results in entry heating and mechanical loads that can be met by a revolutionary three-dimensionally woven carbon fabric supported with rib structures. This carbon fabric has test-proven capability as both primary structure and payload thermal protection [5].

This presentation will inform the EDL community of the capability of ADEPT for delivery of small secondary payloads as well as provide status of on-going technology development activities. Results of a mission applications study for secondary payloads to Mars and Venus will be presented. A primary goal of these mission design activities is to integrate high-value verification approaches wherever possible. For example, for some mission applications it is possible to test in NASA arc jet facilities at full-scale. This enables end-to-end thermostructural requirement verification with a single test.

Another important challenge that needs to be solved is the reliability of the decelerator to achieve the desired shape using simple passive mechanical actuators (such as springs) that do not require power from the primary payload for deployment. A configuration of ADEPT is being prototyped and used to evaluate the functionality and reliability of the deployment mechanism through bench-top testing. The prototype will then be tested in a low speed wind tunnel in late 2014 to evaluate aerodynamic load-carrying capability and deflected shape. Results of the deployment testing and status of wind tunnel test plans will be discussed.

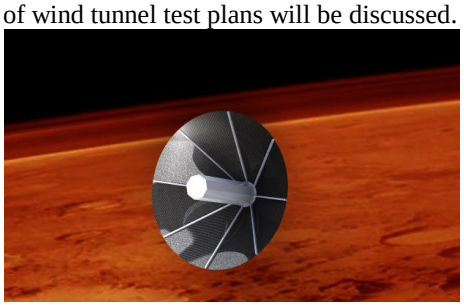

Figure 1. ADEPT with payload approaching Mars

References:

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