LOW COST ENTRY, DESCENT, AND LANDING (EDL) INSTRUMENTATION FOR PLANETARY MISSIONS. H. H. Hwang[1], M. M. Munk[2], R. A. Dillman[3], M. Mahzari[4], G. T. Swanson[5], and T. R. White[6]
[1]NASA Ames Research Center, Moffett Field, CA, 94035, helen.hwang@nasa.gov
[2]NASA Langley Research Center, Hampton, VA, 23681, michelle.m.munk@nasa.gov
[3]NASA Langley Research Center, Hampton, VA, 23681, robert.a.dillman@nasa.gov
[4]Analytical Mechanics Associates, Inc., Moffett Field, CA, 94035, milad.mahzari@nasa.gov
[5]Analytical Mechanics Associates, Inc., Moffett Field, CA, 94035, gregory.t.swanson@nasa.gov
[6]NASA Ames Research Center, Moffett Field, CA, 94035, todd.r.white@nasa.gov

Background: Missions that involve traversing through a planetary atmosphere are unique opportunities that require elements of entry, descent, and landing (EDL). Many aspects of the EDL sequence are qualified using analysis and simulation due to the inability to conduct appropriate ground tests, however validating flight data are often lacking, especially for missions not involving Earth re-entry. NASA has made strategic decisions to collect EDL flight data in order to improve future mission designs. For example, MEDLI[1] and EFT-1 gathered hypersonic pressure and in-depth temperature data in the thermal protection system (TPS). However, the ability to collect EDL flight data from the smaller competed missions, such as Discovery and New Frontiers, has been limited in part due to the Principal Investigator-managed cost-caps (PIMCC).

The recent NASA decision to consider EDL instrumentation earlier in the mission design cycle led to the inclusion of a requirement in the Discovery 2014 Announcement of Opportunity which requires all missions that involve EDL to include an Engineering Science Investigation (ESI).[2] The ESI would involve sensors for aerothermal environment and TPS; atmosphere, aerodynamics, and flight dynamics; atmospheric decelerator; and/or vehicle structure.[3] The ESI activity would be funded outside of the PIMCC.

Instrumentation Suite: Several challenges exist for implementing an ESI that will produce high priority data for the EDL community, while maintaining low cost. The data acquisition system (DAS) must be small (mass and volume), able to be incorporated into different vehicle configurations, support a variety of sensor types, and robust to the space flight environment. In addition, installation of in-depth thermocouples in higher density TPS materials such as Heatshield for Extreme Entry Environments Technology (HEEET) will require new integration techniques.

A proposed low cost sensor suite that satisfies the ESI requirement and can be adapted by mission proposers will be presented. An initial assessment of commercially available DAS will also be presented. The overall plan for developing and qualifying the sensor suite so that it can be used by any proposer to either a New Frontiers or Discovery opportunity will be discussed.

References:

[1] Munk, M., Little, A., Kuhl, C., Bose, D., and Santos, J., (2013) *AAS 13-310*, [2] NASA Announcement of Opportunity Discovery 2014, NNH14ZDA014O, released Nov 2014, [3] NASA Entry, Descent and Landing (EDL) Instrumentation Engineering Science Investigation (ESI) Goals and Objectives, Version 1.0, June 2014.