ExoMars Atmospheric Mars Entry and Landing Investigations and Analysis (AMELIA)

Conference or Workshop Item

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The entry, descent and landing of *ExoMars* Descent Module (EDM) offer a rare (once-per-mission) opportunity to perform an *in situ* investigation of the martian environment over a wide altitude range. The ExoMars AMELIA team seeks to exploit the Entry Descent and Landing System (EDLS) engineering measurements for scientific investigations of Mars' atmosphere and surface.

From the measurements recorded during entry and descent, using similar methods and analysis employed on previous entry probe missions (e.g. ESA Huygens at Titan, NASA Mars PathFinder, Mars Exploration Rovers and Phoenix) we will retrieve an atmospheric vertical profile along the entry and descent trajectory. Within the AMELIA team, different approaches, algorithms and methods will be used for simulation and reconstruction of the EDM trajectory and attitude during the entry and descent phases in order to retrieve and validate the most accurate atmospheric profile.

A near-real-time reconstruction of the trajectory will be performed using the radio communication link between the EDM and the radio receiver on board the orbiter and by the carrier signal detection by ground telescopes. Atmospheric vertical profiles of density, pressure and temperature, will be derived by several methods including: direct inversion from deceleration measurements; by matching an atmospheric standard model with Extended Kalman filtering (EKF) of a 6 DoF EDM dynamic model; and from hypersonic dynamic pressure data recorded during entry.

The dynamical behaviour of the EDM during the descent under parachute will be modeled, simulated and reconstructed using different data, methods and data assimilation (e.g. IMU, radio link, radar, imaging and auxiliary data). Wind profile along the entry probe path will be retrieved by using the Doppler shift in the radio link between the Descent Module and a radio receiver and by modeling the dynamic response of the pendulum system composed by the EDM and the parachute line.

In order to study the atmospheric dust load, AMELIA aims tentatively to investigate aerosols from frontshield ablation and by the analysis of the EDm back-cover sun sensors to derive opacity as function of altitude during the period of operation.

Scientific analysis of the landing measurements will be aimed at the determination of the landing site context (e.g. surface mechanical characteristics, geomorphology, etc.), its characterization and assessment also in combination with remote sensing imaging.

ExoMars 2016 will provide the opportunity for new direct *in situ* measurements during the martian statistical dust storm season. These data will contribute to exploring an altitude range and a vertical resolution not covered by remote sensing observations from an orbiter, providing a surface and atmosphere "ground truth" for remote sensing observations and imposing important constraints on the validation of Mars atmosphere models.

The experience and lessons learned in the framework of the Huygens project, Mars probes, and expertise in Mars observations and modelling will be put in perspective for the ExoMars Entry, Descent and Landing (EDL) science experiment.