

AEROFAST: MARTIAN AEROCAPTURE FOR FUTURE SPACE TRANSPORTATION – MISSION OVERVIEW (IPPW-8)

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ABSTRACT

AEROFAST is a Mars aero-capture feasibility demonstration performed by twelve European companies led by AST-ST as prime, and funded under seventh framework programme of the European Commission. This study planned over 2.5 years will end in June 2011.

An aero-capture is a flight manoeuvre that takes place at very high speeds within a planet's atmosphere that provides a change in velocity using aerodynamic forces (in contrast to propulsive thrust) for orbit insertion. This aero-breaking technology becomes really attractive with respect to propulsion technology when the delta-V necessary for orbit insertion becomes greater than 1 km/s, which is the case for most of the future solar system exploration missions.

Aero-capture is a very challenging system level technology where compromises have to be found between individual disciplines such as system analysis and integrated vehicle design, aerodynamics, aero-thermal environments, thermal protection systems (TPS), guidance, navigation and control (GNC), instrumentation... all these disciplines needing to be integrated and optimized as a whole to meet the mission specific requirements.

Currently, Technology Readiness Level (TRL) of aero-capture technology in Europe is assessed at TRL2 to 3 whereas a TRL6 is mandatory to envisage the aero-capture technology for operational missions while mitigating development risks. The AEROFAST study fits with this goal, being dedicated to increase the TRL level of aero-capture technology up to TRL4 through a complete mission study of a Martian aero-capture.

The objectives of AEROFAST project are:

- **OBJ1:** Define a project of aero-capture demonstration.
- **OBJ2:** Make a significant progress in space transportation by increasing the TRL of the planetary relative navigation and the aerocapture algorithm up to 5.
- **OBJ3:** Build a breadboard to test in real time the pre-aerocapture and aerocapture GNC algorithms,
- **OBJ4:** Demonstrate/prototype the thermal protection system for such a mission
- **OBJ5:** Define on-board instrumentation for aero-capture phase recovery.

The proposed paper will be dedicated to present an overview of the mission and to point out the improvements and results gained at the end of the study wrt challenging topics:

- A description of the overall mission architecture will be proposed including the pre aero-capture phase (Earth to Mars transfer), aero-capture phase and post aero-capture phase (transfer to orbit).
- The spacecraft design based on a composite architecture made of several modules will be depicted, with aero shape, aero thermal behaviour and budgets justified.
- A specific emphasis will be put on the GNC concerns, algorithms validation implemented within a simulator for NRT and RT test being a key factor for success.
- Meantime, in order to improve robustness wrt mass & centring concerns during critical aero-capture phase, results of innovative TPS improvements and testing will be presented.