

- **An executive summary**

AEROFAST is a Mars aero-capture feasibility demonstration performed by twelve European companies lead by AST-SAS 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 (A/C) 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 (GN&C), 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.

After two years of studies, the overall mission has been defined and the initial conditions required to perform each phase (cruise, pre-A/C, A/C, post-A/C) established. Mission and systems studies have contributed to generate specifications towards the sub-systems (GNC, communication, power, etc...). The spacecraft architecture has been optimized accordingly leading to a coherent design wrt all disciplines.

GNC algorithms have been implemented within a simulator for NRT (non real time) and RT (real time) tests within a laboratory environment and spacecraft performance has been successfully assessed through an end-to-end mission simulation.

Therefore, AEROFAST study confirms the feasibility of an aerocapture manoeuvre:

- Mission is fulfilled even when considering the worst cases (robust GNC strategy)
- Budgets have been established (mass, power...), coherent each others

No show stopper has been identified, demonstrating the interest of an aerocapture manoeuvre.

In addition, this collaboration of the 2.5 years between all the partners of the project has allowed to build a very good team, in a good spirit, efficient and acting in the interest of the project.