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# Adapting Mars Entry, Descent and Landing System for Earth

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## Abstract

In 2001 - 2011 an inflatable Entry, Descent and Landing System (EDLS) for Martian atmosphere was developed by FMI and the MetNet team. This MetNet Mars Lander EDLS is used in both the initial deceleration during atmospheric entry and in the final deceleration before the semi-hard impact of the penetrator to Martian surface. The EDLS design is ingenious and its applicability to Earth's atmosphere is studied in the on-going project. In particular, the behaviour of the system in the critical transonic aerodynamic (from hypersonic to subsonic) regime will be investigated. This project targets to analyse and test the transonic behaviour of this compact and light weight payload entry system to Earth's atmosphere. Scaling and adaptation for terrestrial atmospheric conditions, instead of a completely new design, is a favourable approach for providing a new re-entry vehicle for terrestrial space applications.

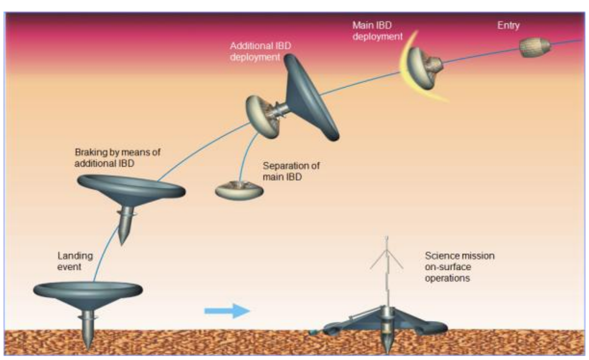


Figure 1: MetNet lander landing scheme.

## 1. EDLS for Earth

The dynamical stability of the craft is analysed, concentrating on the most critical part of the atmospheric re-entry, the transonic phase, i.e. the phase when the speed of the vehicle is decelerated from hypersonic speeds to subsonic speeds. In Martian atmosphere the MetNet Lander's stability during this very turbulent phase is well understood and known. However, in the much more dense Earth's atmosphere, the transonic phase is much shorter and turbulence more violent. Therefore, the EDLS has to be sufficiently dynamically stable to overcome the forces tending to deflect the craft from its nominal trajectory and attitude. Due to the criticality of this phase most of the investigations in this study are focused to this regime. Once the scaling of the re-entry system and the dynamical stability analysis have matured enough, the preliminary design of the inflatable EDLS for Earth can be commenced. The scaled-down design model will be then put to wind tunnel tests, to verify performance of the design in the transonic phase.

## 2. Main Objective

The main objective is to provide a demonstrated and verified EDLS design for the entire relevant range of aerodynamic regimes expected to be encountered in Earth's atmosphere during the entry, descent and landing. Low Earth Orbit (LEO) and Lunar applications envisaged include use of the EDLS approach in return of payloads from LEO spacecraft, from the International Space Station and even from a Lunar base. The verified EDLS would also add an option for the design of European and Russian missions with applications in planetary surface exploration missions to other celestial bodies with significant atmospheres, such as Titan.

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