

# STUDENT-BUILT STAR TRACKER FOR THE ESMO MOON ORBITER

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## General outline

ESMO (European Student Moon Orbiter) is the third mission within ESA's Education Office, built upon the experience gained with SSETI Express and ESEO (the European Student Earth Orbiter). SSTL is the prime contractor, whereas each of the 20 universities involved is responsible for a sub-system. The student teams are expected to provide most of the spacecraft sub-systems, payload and ground support systems. Ideally, students will also manage operations. ESMO is currently proceeding with the PDR to end Phase B. Launch is planned for 2014. In this frame, the "Institut Supérieur de l'Aéronautique et de l'Espace" (ISAE) will provide the spacecraft's star tracker, as a student's project.

The star tracker team which involves more than 10 undergraduate students as well as graduate students, is designing, manufacturing and validating the Star Tracker subsystem. This task provides them with valuable, hands-on space project experience, teaching them to mature into a well qualified workforce for future missions.

As a support to the star tracker project, the school provides mentorship in a large variety of domains: Optics, Mechanics, Electronics and Software. The student team works continuously throughout the academic year and is supervised by professors and lab experts. A flexible organization enables PhD and specialized master students to join the project, adding advanced skills and innovative ideas. A software test platform and a Bread Board Model are currently being used for testing in preparation of an Engineering Qualification Model planned for late 2011.

Dimensions	< 90x130x169 mm
Field of view	20°
Detector / pixel size	750x750 (20µm)
Consumption	4 +/-1 W
Mass	1.3 +/-0.4 kg
Angular precision	< 0,1°
Processing time	≈ 1 s (Tracking mode)

Figure 1 : Star tracker main characteristics

## Hardware Overview

The key component of the star tracker is the APS750 CMOS sensor developed at the CIMI lab in Supaéro for which the team is in charge of designing the adequate optics and baffle. The star tracker design also features an original electronic architecture comprising a LEON processor implemented as an IP Core inside a Virtex FPGA. Although separate processor chips are generally preferred for such applications, the team intends to make full use of the tools and experience of the Supaéro SCAN lab in FPGA-based applications in order to accelerate the development of the electronic boards.



Figure 2 : Star trackers mounted on the ESMO orbiter

## Software Overview

As for the Star Tracker Software design, the team took the opportunity to develop procedures for auto-generated embedded code. This way, more efficient and less consuming algorithms for star matching could be used in the shortest delays. Furthermore, students working for the Star Tracker software have the opportunity to experience complex interfaces between space subsystems. It gives them the real value and challenge of collaborative missions, as the Star Tracker is also involved in the other major ESA student project: the European Student Earth Orbiter (ESEO).

## References

- [1] Star tracker team, D. Mimoun, S. Lizy-Destrez 2009. STR: a student developed star tracker for ESA led ESMO moon mission.
- [2] ESMO mission description [http://www.esa.int/esaMI/Education/SEML0MPR4CF\\_0.html](http://www.esa.int/esaMI/Education/SEML0MPR4CF_0.html) (retrieved 01/04/2011)