Toulouse, Monday, November 19^{th}, 2018
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Internship Proposal
SEMAT dev : a research tool for orbit generation and trajectory optimization in the Sun-Earth-Moon system

Supervisors : Emmanuel Blazquez, Thibault Gateau
Duration : 4 to 6 months - between January and July 2019
Keywords : Software, Matlab, Python, C, Orbital Mechanics

Job Description :

SEMAT (for Sun-Earth-Moon system in Matlab) is a package of Matlab routines and scripts for the study of the Three and Four-Body problems in the Solar System, with a specific focus on the Earth-Moon, Sun-Earth, and Sun-Earth-Moon problems. It is mainly used by the mission analysis and astrodynamics teams of the SACLAB research group at ISAE-Supaéro [1,2]. The package has been provided (as an encapsulated code) to the DLR to assist them in cislunar mission analysis. Restricted versions of the implementation are also used by our students to carry on research projects related to orbital dynamics and mission design in non-Keplerian environments.

The main goal of the internship is to migrate the SEMAT package to a more robust environment (Python is the most likely candidate, C++ and Java under consideration) to considerably enhance the performance of the libraries and to eliminate our dependency on Matlab. This would also greatly facilitate parallel development of the code by multiple researchers working on it simultaneously. The end goal would be to provide users with two options : an API compatible with Matlab, exclusively for internal use (research and education), and a Frontend targeting industrial and academic partners of ISAE-Supaero, possibly including a GUI.

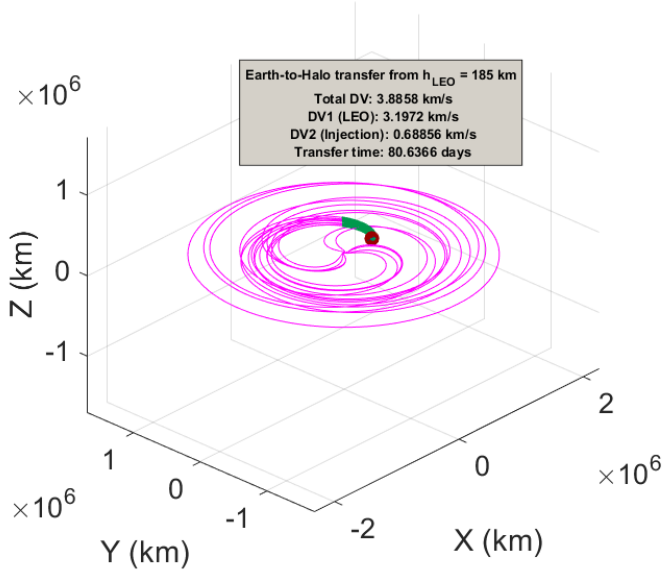

FIGURE 1 – SEMAT's display for an Earth-to-Halo transfer design using exterior manifolds. Source : ISAE-Supaero.

Objectives :

1. Implementation of SEMAT Backend
2. Testing and Validation
3. Implementing the Frontend
4. Implementing an API compatible with Matlab

Required skills

- Advanced programming skills (Python, C, Java, Matlab, ...) and methodology (Unit tests, Integration tests, Code versioning...)
- Strong background in applied mathematics and algebra
- Ability to work autonomously, and to be able to communicate with different teams working on the same software
- Initiative, critical thinking and adaptability
- Scientific curiosity and a demonstrated interest in the space industry
- Some experience with orbital mechanics / astrodynamics would be apreciated

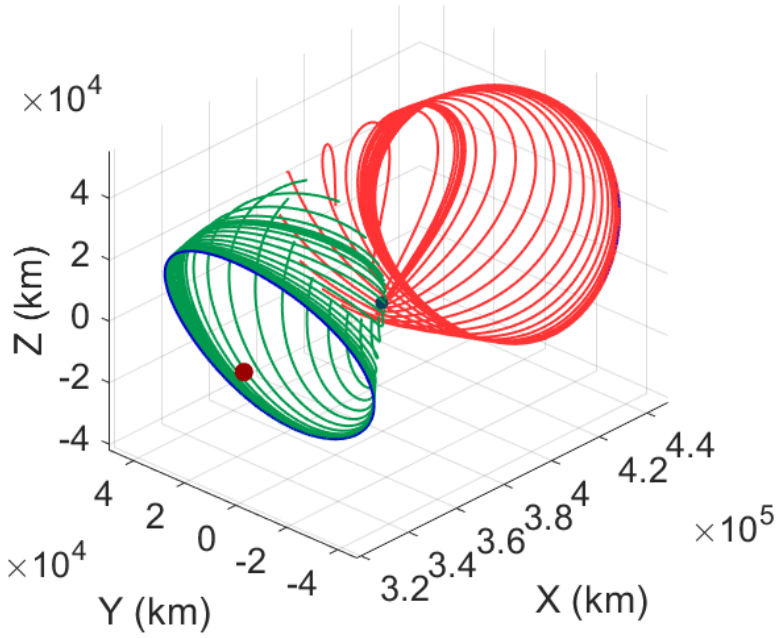

FIGURE 2 – Earth-Moon L2-to-L1 Heteroclinic transfer design using SEMAT Source : ISAE-Supaero.

References

[1] S. Manglavitia, A. Campolo, S. Lizy-Destrez, and B. Le Bihan, "Safety analysis for near rectilinear orbit close approach rendezvous in the cislunar realm," in *68th International Astronautical Congress, IAC*, 2017.

[2] Bastien Le Bihan, *Study of dynamics about and between libration points of Sun-Earth-Moon coherent models*, Ph.D. thesis, 2017.