

Internship Proposal: System Identification and Control of Flexible Space Structures

Company: ISAE-SUPAERO Employment Type: Internship Experience Level: Student Job Type: Full Time (5/6 months)

The company

ISAE-SUPAERO is the French top ranking National Institute of Higher Education in Aerospace Engineering. ISAE-SUPAERO is involved in projects with several European companies and agencies of the space sector and has a strong experience in high-accuracy robust pointing control, in-orbit servicing and control-structure codesign.

Job Description

Recent collaborations between NASA and the European Space Agency (ESA) highlighted the need in the Space industry to have preliminary design tools which are able to guarantee spacecraft robust control performance in very early design phases [1].

ISAE-SUPAERO developed a tool, the Satellite Dynamics Toolbox library (SDTlib), which is able to build a generic flexible spacecraft in a modular way by taking into account all the possible uncertainties in the attitude control synthesis. With this tool, it is nowadays possible to cope with the modeling, synthesis and linear analysis tasks.

Moreover, the DCAS department has recently put in place the new laboratory PASTAVIBES (PlAteforme de STabilisation Active de VIBrations d'Engins Spatiaux) for the experimental validation of active controlled flexible structures. The main goal of this research project will be to develop in SDTlib and experimentally validate a multi-body flexible structure in open and closed-loop.



Figure 1: PASTAVIBES Laboratory

The Satellite Dynamics Toolbox library (SDTlib) is a MATLAB/Simulink library developed by ISAE-SUPAERO able to model complex multi-body space flexible structures [2]. This tool has been developed in the last ten years thanks to several collaborations with the European Space Agency (ESA) and many European aerospace companies. The main applications of the toolbox are: modeling of large flexible spacecraft [3], modeling of fine mechanism [4], modeling of stratospheric balloons [5], design and analysis of robust control law for flexible Space structures and fine pointing missions [6], control/structure co-design [7].

Work to be performed

A preliminary bibliographic study is required to be familiar with the multi-body modeling of flexible Space structures in the Two-Input Two Output Port (TITOP) framework [8] and its implementation in the last version of the Satellite Dynamics Toolbox library (SDTlib) [2].

The technical work to be performed will consist of:

- Getting familiar with the SDTlib and the robust control and analysis tools;
- Set up an experimental bench in PASTAVIBES lab for active control of vibrations on a flexible structure
- Model the experimental bench in SDTlib;
- Assess the model identification routine for the experimental setup;
- Validate the SDTlib model with the real flexible structure in open loop;
- Design a closed-loop control law with the help of the SDTlib model
- Validate the synthesized controller on the experimental bench
- producing a rigorous documentation.

Your Profile

You are preparing a Master degree in Aerospace Engineering. You have the following skills:

- Good knowledge in System Dynamics
- Good knowledge in Control Theory
- Good knowledge of Matlab/Simulink

How to apply

If interested in this opportunity, please send us your CV and motivation letter to the following mail addresses:

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References

 C. Dennehy and O. S. Alvarez-Salazar, "Spacecraft micro-vibration: a survey of problems, experiences, potential solutions, and some lessons learned," 2018.

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