Projet 3A

SpacecraftSim : open-source modular spacecraft simulator

About SpacecrafSim

The complexity and diversity of the preliminary design of space missions call for a rapid prototyping simulation environment to test particular configuration parameters, and provide a quick and early feedback. At ISAE, we [1] developed SpacecraftSim, an open-source modular spacecraft simulator. This simulator is academic and research oriented. SpacecraftSim combines Orekit (low level space dynamics open-source library) for the simulation of spacecraft kinematics, Celestia (free Astronomy software) for 3D real-time visualization, and can host third party software (e.g. Matlab/Simulink, C applications or actuators like a Joystick) that models the control loop of the spacecraft.

SpacecraftSim relies on the following modules :
– The simulation configuration mechanism to configure the kinematics solver from Orekit, based on the spacecraft parameters (mass, inertia, orbit), but also the shape of the spacecraft represented as a 3D mesh model and texture.
– The mission planner for controlling the relevant parameters of the mission (reference frames to use, initial orbit and time, initial spacecraft mass, preset maneuvers triggered by time...). The simulation configuration (step time, duration and speed of the simulation) is included inside the mission definition ;
– The mission controller, it is an AOCS hosted by Matlab/Simulink or a third party code that interacts through socket communication with the simulator ; the user can control the attitude and perform simple maneuvers using a joystick ;
– The visualization clients, Matlab or Celestia, to plot analytical data or represent the simulation in three dimensions respectively.

This software gives a free best-effort real-time simulator. This simulator is modular and can be distributed using sockets connections to maximize performances and allow the testing in Hardware-in-the-Loop with On-Board CPUs.

Objectives for 2014-2015

SpacecraftSim has been extended to support both Model-in-the-Loop (using Matlab) and Hardware-in-the-Loop (using a low-cost development board). We now would like to extend the project and support mission plannings. This means
– add support for ASN.1 standard to support definition of ICDs used for the TM/TC stack ; and add provision to enable integration in the existing simulation cycle ;
– add a GUI for testing interactions with the cubesat. This GUI would be generated from a description of TM/TC from the previous item ;
– add definition of mission scenario in the framework ;
– extend the actuation part of the simulation cycle ;
– extend documentation and tests.

This project will focus mainly on using Java and some advanced frameworks like Orekit, Apache Harmony to extend a simulation frameworks. The objective of this framework is to support various cubesat missions under preparation at ISAE.

Mentors

– Jérôme Hugues, ISAE/DMIA
– Stéphanie Lizy-Destrez, ISAE/DMIA
– Jérémie Chaix, ISAE/CAS

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1. Xavier Gibert Gonzalez and Marc Alomar from DNM AESS