TOLOSAT: A student cubesat for Iridium relay and gravimetry

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Abstract

TOLOSAT is a student-led 2U cubesat project from Toulouse, France. The team is composed of students from engineering schools but the bulk of the members come from two associations: Club Cubesat Supaero from ISAE-SUPAERO and Astre from INSA Toulouse. There are currently around 30 students working on the cubesat. The project also benets from technical support and experts of CSUT: Centre for nano Space systems at the University of Toulouse. It also receives help of experts from CNES, ISAE-SUPAERO and Observatoire Midi-Pyrénées.

The mission has 2 objectives: it will first explore the possibilities offered by using the Iridium Next constellation as a relay to communicate with the ground. This is complementary to a ground station and should allow communication with the cubesat even when he is not visible. It should allow the spacecraft to transmit more data per day with the ground. It can even work as a backup communication system if there is any problem with the ground station or the main antenna. Such technology is already implemented in ISAE-SUPAERO’s cubesat EntrySat, which launched in April 2019. This payload will also establish a bi-directional connection for Telemetry and telecommand. A secured link will also be established using asymmetrical encryption like the SSH protocol. This method would create an innovative way to initiate a fully encrypted communication with a spacecraft.

The second mission objective is to map the Earth gravity field using a precise GNSS positioning. This position would then be derivated two times to derive the acceleration of the cubesat. Accelerometers will measure the non-conservative forces and allow us to extract the acceleration due to gravity. This method was used on ESA’s SWARM mission but it was not purposely built to do it. To achieve this, the system will mainly rely on the Galileo constellation.

The main advantage of this method is its simplicity and low-cost implementation. An outcome of this mission would be to study the feasibility of a cubesat constellation providing near real-time data of the earth’s gravity field.

The TOLOSAT project is to reach the end of preliminary design phase by July 2019. This project is also an opportunity for students to apply directly into a concrete project the knowledge they have and also to learn to work in a reasonably big team. Some of the subsystems will be conceived by students, such as the payload boards and the structure.

Further reading about the project:
http://www.astre-toulouse.com/projets/

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