Contribution ID: **14** Type: **Talk**

Orekit, high end flight dynamics accessible to small cubesat teams

Tuesday, 25 September 2018 11:20 (20 minutes)

Cubesat missions are often driven by small teams focusing on a single goal. There is generally only one instrument on-board, performing one specific measurement, in contrast with large Earth Observation platforms that hosts half a dozen instruments provided by several laboratories in an internationally coordinated project.

The small team main interest is gathering the data. Its members are often by themselves the end users of their own system, just as in open-source the developers of a program are users "scratching their own itch", as the saying goes. Flight dynamics is a necessary chore for the success of the mission, but not a goal by itself. There are generally no resources available for this topic, neither in terms of skills nor in terms of tools. As a result, many cubesat projects end up using the public TLE provided by SpaceTrack and some on-line path predictors to schedule their connection to spacecraft for telemetry retrieval. TLE are notoriously low accuracy (it is a simplified analytical model, and measurements for a given object are not refreshed as often as the owner would like). This is sufficient (and widely used) for simple access prediction, but clearly not enough for more ambitious missions.

As cubesat missions address more and more needs, they reach a state where spacecraft location should be known with better accurary, for example to improve the geo-location of the measurements performed by the instrument, and therefore improving the scientific model resulting from the mission.

Orekit is a free software space flight dynamics library that has been available under the terms of the Apache License V2 since 10 years. It is widely used by many major space actors, including agencies, industry, research and academics. It is used for operational systems, mission analysis, studies and training. As an open-source library, it can be used to build any kind of system, from simple ones performing only prediction using TLE to highly accurate ones managing constellations with station keeping maneuvers and precise orbit determination. As cubesat now can have on-board GNSS receivers, it is possible for a cubesat project to perform its own orbit determination by downloading the data (either high level position-velocity or low level pseudo-range or carrier-phase) and processing it on ground with a small Orekit-based program. Orekit as a large community of space flight dynamics experts that can help smaller teams to set up their own systems.

This talk will present a selection of the features in Orekit that can be used for cubesat missions with limited resources.

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Session Classification: Talks

Track Classification: Space Science Data and Software