OPEN CALL FOR INTEREST FOR A STUDENT INNOVATION

CHALLENGE ON NANOSATELLITES

Introduction

UPC (Barcelona) is an active partner in the CBI program at IdeaSquare at CERN. During a visit to UPC in 2015, a visit was organized to their Laboratory of Small Satellites and Payloads. Mutual interest was expressed to combine the idea of their technical student projects around designing, testing, launching and operating small nanosatellite(s), combining it with the human centric, science-society driven CBI-projects at IdeaSquare.

Potential common project ideas

In order for such initiatives to fit within the scope of IdeaSquare activities at CERN, such common projects should include a related physics research aspect (e.g. study of cosmic background radiation distribution, cosmic ray coincidence measurements using multiple satellites etc[1]). In parallel, a societal, user-experience driven aspect is also to be incorporated within the given boundary conditions of cube/nanosatellites. For the latter, one could contemplate – but not limiting ourselves to – topics such as:

1) based on dedicated sensors, obtaining early warning of earthquakes or volcanic eruptions;
2) detecting suitable underground water streams to drill wells for accessing drinking water in remote areas;
3) optimizing use of crop pesticides in remote areas etc.;
4) temperature anomalies for water mapping (SDG 6);
5) open data for data for young entrepreneurs in developing countries (SDG 9)
6) agriculture production (vegetation) over small island states (SDG 2)

The collaborative principles above will rely on principles of open science and open innovation[2].

Technical challenges

Cube/nanosatellites are typically 1 – 10 kg in weight and occupy a volume of up to a few ten cube centimeters[3]. Due to their simple design and low cost, they are limited in terms of their manoeuvrability (no accurate gyroscopes of complete retrofiring) and power consumption (limited solar power collection and communication capabilities). These constraints impose strong design and testing challenges and require dedicated labs in the universities. Moreover, as these satellites orbit the Earth in some 90- minutes (in LEO configuration), the communication coverage in a given area is just a few minutes, unless a dedicated, shared data receiver network is in place.

Organizational challenges – call for interested universities

[1] One example: http://www.thelangtonstarcentre.org/lucid/
[2] Example of CERN's open hardware repository, see: http://www.ohwr.org/
[3] Satellite enthusiasts talk already about an order or two smaller objects, pico and femtosatellites

Several technical universities have the capabilities, such as UPC above, to design, test and operate nanosatellites as part of their educational programs. Currently these offerings are often university specific, only, and focused on testing new technologies rather than integrating also society-driven (educational) activities. Thus, the potential offered both in terms of (cross) functionality and effective uplink time to the satellite(s) is rather limited. Thus, there may be an interest for a geographically distributed and multi-disciplinary university (and/or NGO) network of which IdeaSquare could be part of.

It is understood that such a student offering must be well integrated into the teaching curriculum of each participating university. This requires planning and setting up a MOOC/MOOP platform structure in a way that universities can use to monitor and credit the contributions of their students (e.g. online courses and exams completed; material submitted and shared[4]). Moreover, the project will require a tree-structure in which the leading universities will need to sub-coordinate at the top level: for example, work packages on design, assembly, integration, launch preparation, controls, communications and data collection etc. After running the project for two years and having collected all input and variations (for example, based on some choices given as a function of its weight), the university staff involved on the top level will at the end integrate and converge on the actual final deliverable.

Focusing on collaboration design and providing a MOOC/MOOP platform, IdeaSquare therefore wishes to explore the potential interest for such a common student undertaking and would be interested in understanding better the necessary requirements such an online platform should take into account.

Contact information:

Markku Kivikoski markku.kivikoski@tut.fi

Latest version:

April 16, 2019

[4] As an example for sharing (course) material, see http://wikitolearn.org/