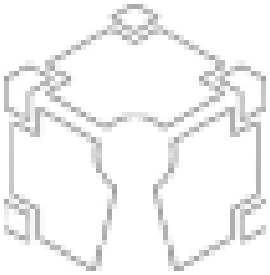

Contribution ID: **10** Type: **Talk**

CubeSat, 3D Printing & COTS

Tuesday, 25 September 2018 12:40 (20 minutes)

General Objectives
Encourage the regional development of space applications for social-economic purposes based on CubeSat technology.
Specific Objectives
To foster the approach between the academic field and the aerospace environment, particularly to undergraduate students. To conceptualize, design, produce, test and start a set of CubeSats with academic purposes making use of the FDM 3D printing technology and Commercial Off-The-Shelf (COTS) components, maximizing the use of the state of the art of the involved technologies, focusing the efforts in the development of interfaces, software, systems integration and above all in the development of an application-proposal to fill a not only locally but regionally vacancy area.

Articulation and short-term implementation and use
Encourage the professional and academic articulation of the project. Call local and regional institutions interested in CubeSat standard-based Smallsat technology, for a hands-on training with an academic approach, by means of the developed 3D Printing & COTS CubeSat engineering model replicas. A general block diagram showing the complete architecture of a mission based on CubeSat can be seen on Fig.2. Creating these type of satellites aims to train and attract undergraduate students towards science and technology in aerospace matters, focussing efforts on satellital standards growing worldwide. Therefore the CubeSat replicas will be built with 3D printing fused deposition modeling and COTS electronics, based mainly on Open-source hardware (e.g. Arduino).

Strengths
- The group currently working on this project, has been developing activities linked to the robotics field with educational purposes in High Schools and Colleges.
- Availability of 3D printers.
- Self-funding network for minor developments.
- Technical coaching in aerospace matter and access to GomSpace and ISIS CubeSat specs (from CONAE Academic Laboratories).

Technology involved
The Arduino platform was chosen for the development due to its low cost, local availability and work philosophy. The 3D Printing & COTS CubeSat project include:
- On board Computer (Arduino Mega 2560).
- One camera module (C439).
- Digital Accelerometer (ADXL345).
- Light sensor (TSL2561).
- NetWork Communication module (NodeMCU,NRF2104).
- Up/Down Link RF module.
- Solar Panels (18V/40mA).
- Expansion boards FFPC104.
- Battery module (ICR18650 pack).

FDM 3D printing technology is employed for the structure development, achieving a CubeSat replica for academic practice. The structure can be seen in Fig.3 wherein the modules

involved are exposed.

Space Segment

The space segment is composed of 6 general subsystems:

- Energy subsystem (EPS): its implemented with a rechargeable cell array ICR 18650 (3.7v/4800mAh) they supply 7.2V/9600 mAh to the system. A solar panel array collect the energy to charge the batteries by a TP4056 module.
- Communication subsystem: The Cubesat Network use a NodeMCU (master hub) and RF24L01 Wifi receptors, to the communication between each space segments. One configured as Master Hub and the others as Slaves.
- Telemetry, telecommand and (TT&C) control: The data download and remote control from the ground station use RF transmission modules working at 433MHz. Also it has a radio beacon which transmit the EPS status at 144Mhz to isolate it from the principal frequency.
- Position Subsystem: To know the orientation of the cubesat and maintain the direction of the antennas always to the Earth and the solar panels to the sun, use a 3 axis one accelerometer and one light sensor.
- Payload: A 1.3 Mp camera module, it's the principal payload.
- OBC: Use a Mega 2560 Arduino Board to check, manage and store the data from all subsystems.

Ground segment

This segment simulate a real Ground station. Consist in:

- RF(433 Mhz) reception module with antenna.
- Nano Arduino Board integrated to the receive data from the space segment (downlink) and remote control (uplink) to make manoeuvre.

Mechanical Model

The Space Segments have 2U standard cubesat unit. Each are build using plastic by FDM 3D printing technology and L shape aluminium profile all attached with M3 threaded rod, bolts and nuts (Fig.4). That material mixture provides greater mechanical rigidity than use only plastic like previous versions. In this way an educational engineering model similar to one for commercial purposes is achieved.

Firmware

Currently running with V1 version that integrates all the involucrated modules in the subsystems mentioned previously.

This version provides a minimum necessary code to obtain through ground segment, orientation, energy status and the cubesat beacon. The V2 version is being developed, it will be incorporate the telecomands, general system optimization and camera manipulation for images acquisition (payload).

Primary authors: MOLINA , Martín Ezequiel (Universidad Tecnológica Nacional Facultad Regional Córdoba-Argentina); PAEZ , Hernán (Universidad Tecnológica Nacional Facultad Regional Córdoba-Argentina); REYNA, Marco A. (Comisión Nacional de Actividades Espaciales (CONAE))

Co-author: BESSONE , Talia (Universidad Tecnológica Nacional Facultad Regional Córdoba-Argentina)

Presenters: MOLINA , Martín Ezequiel (Universidad Tecnológica Nacional Facultad Regional Córdoba-Argentina); PAEZ , Hernán (Universidad Tecnológica Nacional Facultad Regional Córdoba-Argentina); REYNA, Marco A. (Comisión Nacional de Actividades Espaciales (CONAE)); BESSONE , Talia (Universidad Tecnológica Nacional Facultad Regional Córdoba-Argentina)

Session Classification: Talks

Track Classification: CubeSat Subsystems