LitSat mission – past and future projects

Lithuania/Kaunas
Algis Karpavicius[1], Vidmantas Tomkus[2]
[1]*Kaunas University of Technology, Lithuania;* [2]*Lithuanian Space Association, Lithuania*
Point of Contact: Vidmantas Tomkus
algis.karpavicius@ktu.edu

Keyword: LitSat-1, Cubesat, piezoreaction

The project LitSat-1 was the first step towards the curiosity and ideas, accumulated at Kaunas University of Technology (KTU) and Lithuanian Space Association during last decade, implementation and tests in space. For the mission it was decided to choose a basic frame and system of CubeSat which was seen financially acceptable and technically perspective option. The casing of 1U was used.

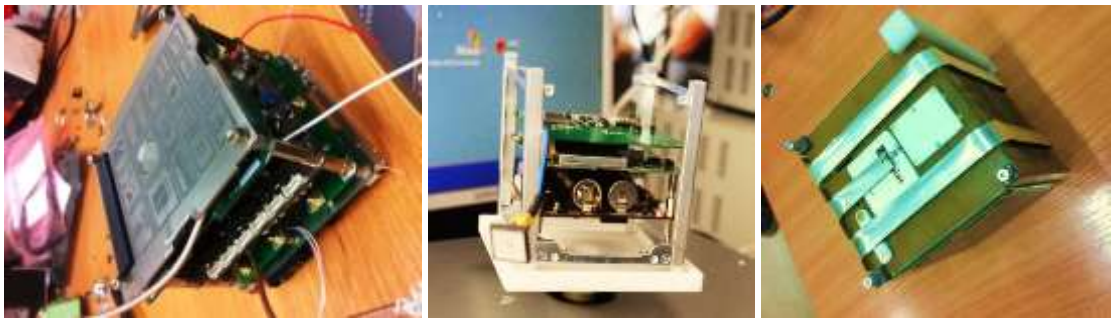

Fig. 1. Cubesat LitSat-1 development views

The system consisted of two communication, two power and one main processor modules. For this project satellite's solar panels, frame, main processors module, commutation module, passive magnetic orientation, safety switches construction and antennas refolding system were designed and made locally in collaboration with Lithuanian Space Association (LSA) and Space Science and Technology Institute (SSTI). Also the software of the main computer and adjustments of other modules where made at KTU. During and after the assembly of satellite vacuum and mechanical tests were performed using university equipment. In order to receive data from the satellite, an infrastructure has been created. It included two Earth communication stations equipped with automated satellite tracking and data reception systems.

Acquired data basically consisted of three types: power, satellite's rotation and satellite's tracking with GPS/Glonass systems. In satellite four out of five panels were made of GaAs and one of silicon, which allowed to test a sample of our supporters in Lithuania manufactured silicon solar panel. During flight the satellite had not faced any troubles with the lack of power. So it was concluded that the system could be extended with more modules and power consumptions can be increased.

Satellite's rotation was monitored with light sensors, gyroscope, magnetometer and accelerometer. The main purpose of multi sensors usage was to increase reliability and also to have a better view of satellites position in respect of earth magnetic field and the Sun.

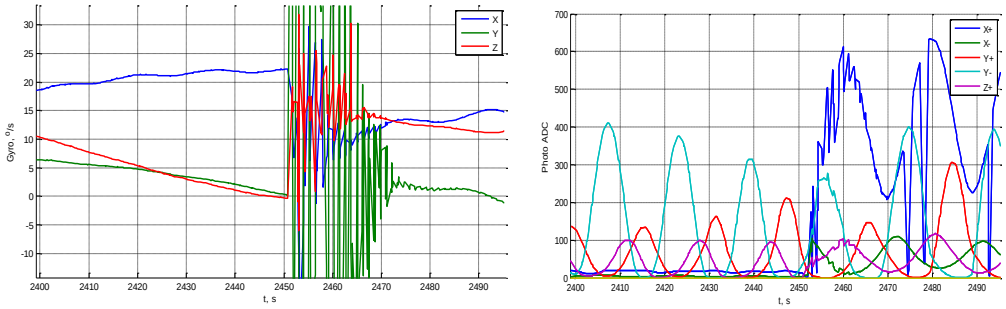

Fig. 2. Antennas refolding moment: registered with gyroscope; registered with light sensors

In figure 2, the data from the gyroscope and light sensors is shown. This is an event of antenna refolding moment which occurred at ~2450s after the satellite was deployed. The sun sensors here show the change in satellite rotation caused by antenna refolding. As a result, the satellite started to rotate around a different axis. We were lucky because at the time of refolding (~2450s after the launch), our satellite was flying over the illuminated part of the Earth.

Another interesting event monitored on the board of satellite was it's morning. This was easy to monitor due to the solar sensors. As the satellite passes from the dark to the bright side of the Earth the way the illumination starts increasing can be followed (fig. 3.).

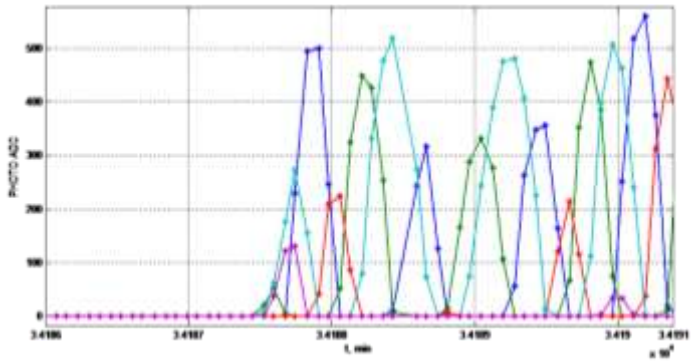

Fig. 3. Satellite's morning

A difference between GPS module and Norad data sets has been detected. The data comparision showed the error between Norad and Glonass made of ~270km. On the picture (fig.4) the yellow pins represent Glonass coordinates set while red pins – Norad.

Fig. 4. Norad vs. Glonass

The second prospective step is expected to be a piezoreaction gear experiment in space. For this experiment, tested communication and data gathering system on 2U casing will be made. Currently the system is on development phase and experimental mission should take place in 2015. This gear module will be designed to be used as a part of satellite positioning system. This would be a compact three degrees of freedom gear to orient satellite in either direction by spheres precise rotational displacements. This is expected to increase resolution of satellite positioning and also will be a novel type of gear in nano-satellites.

Current students project is an alternative piezoreaction gear workbench development which will provide a better control and tests of the gear in laboratories. This system development is educational project at KTU and is being implemented with the help of university researchers.