45th STUDENT CONFERENCE (E2)
Student Team Competition (3-GTS.4)

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A NEWLY DEVELOPED AND LAUNCHED ANDROID-BASED PICOSAT CARRYING TWO FEMTOSATS

Abstract

The use of ordinary technologies in space system devices has been a trend recently. This student-built PicoSat aims to verify some key supporting techniques and promote the reliable use of COTS (commercial off the shelf) components such as smartphones for space applications. We design the PicoSat platform running the Android operating system (OS) and present a novel architecture that carries two FemtoSats for space environment detection and self-organizing network test. The PicoSat has an overall size of 1U Cube and a total mass of 1.02 kg, involving subsystems of structure, power, communication, attitude determination and control (ADC), onboard data handling (OBDH), thermal control, and payload. A modular design approach is presented for these subsystems to achieve the fast replacement and installation of components. Body-mounted solar cells are designed for 5 external surfaces of the satellite and the sixth surface is used for installing the FetmoSats. The PicoSat contains two communication modes: VHF/UHF with the ground station and 2.4 GHz S band with the two FemtoSats. A three-axis ADC subsystem is developed by incorporating miniaturized sun sensors, magnetometers, and three-axis magnetic torquers and reaction wheels. All on-board functional modules are controlled by a Nexus5 motherboard running the Android OS, which enables more expensive intelligent algorithms and a higher level of integration. Some COTS parts of smartphones are also integrated as payloads, like a SD card, an industrial gyroscope and a 2-megapixel camera. Additionally, the deployed FemtoSat is only 0.03kg with the size of 56mm*66mm*6mm, which may be the smallest satellite launched in the world so far. Through intersatellite separation, the PicoSat was launched from "Tiantuo-3" satellite on September 20, 2015, and then the two FemtoSats were released successfully. Though the design lifetime of the PicoSat is 1 month, it has fully functioned well for more than 150 days and the spatial ad hoc network is still normally operating between the PicoSat and FetmoSat. More than 300 photos taken by the camera have been downloaded and analyzed. Future work plans to make several PhoneSats flying in formation and carry out more scientific experiments.