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PHL-MICROSATの衛星バスシステムの開発
Development of the Satellite Bus System for PHL-MICROSAT

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The microsatellite PHL-MICROSAT development started in December 2014. It is a development initiative by the Philippines' Department of Science and Technology (DOST) in partnership with Tohoku University and Hokkaido University. The mission spans across various remote sensing applications such calamity assessment, ocean study, agricultural productivity, and urban planning. In this presentation, a summary of the mission and the system design is reported.

The PHL-MICROSAT is a 50-kg microsatellite planned to be deployed from the International Space Station (ISS) using the Japanese Experiment Module (JEM) ISS-50 Orbital Deployer (ISS-50). This deployer requires the satellite to have a maximum envelope of 550x550x350mm. The orbit will have an inclination of 51.6deg at an altitude similar to the ISS at launch, approximately 415km. The launch rocket has not been decided yet, but the launch date has been planned for 1st quarter of 2016.

The primary mission of PHL-MICROSAT is for earth observation using a 3-meter resolution NIR High Precision Telescope (HPT), 80-meter Space-borne Multispectral Imager (SMI) with two liquid crystal tunable filters (LCTF), and a 7-km resolution Wide Field camera. The PHL-MICROSAT payload has been modified to fit the mission objectives of DOST. A middle-field wide-view CCD camera has been introduced to assist in attitude control and target pointing.

The system design of the PHL-MICROSAT builds upon the existing framework of RISESAT. The major changes came upon the designated specifications of the ISS-50 deployment. The central pillar configuration has been modified into a single central panel structure. The exterior edges of the microsatellite have straight solid rails to act as the slider guide on the ISS-50 deployer.

The PHL-MICROSAT will conduct observation on designated positions by utilizing the three-axis attitude control system consisting of 4-reaction wheels, gyro sensors, sun aspect sensors, and star sensors. One star tracker telescope is angled at 30deg away from earth, to minimize albedo effects during its operation. Coarse attitude control can be conducted using magnetic torquers and magnetometers.

An engineering instrument dedicated for student education is also allotted in PHL-MICROSAT. A small-scale satellite system is being planned to be included as additional payload. This small-scale system will carry out simple attitude determination using magnetometers, sun image sensor, and gyro sensors which are very tiny modules different from main bus units. Also, colored image photography using mobile CMOS cameras can be obtained. The modules to be chosen are lightweight, compact, and low power. This small-scale system has potential influence on future cubesats or small satellites, especially those who will take interest in resource limited, optic-based observation missions.

PHL-MICROSAT is equipped to have 19 strings of Photovoltaic (PV) cells, capable of generating an average power of 39W over the average sunshine time of 54.6 min/rev. on the 400km ISS orbit. This equates to an average charging capacity of 41,900 mAh/day, more than the projected operational discharge capacity average of 24,800 mAh/day of the satellite.

The PHL-MICROSAT is intended to be controlled primarily from the Tohoku University Ground station (CRESST), with a command line on the UHF band. A ground station is being prepared in the Philippines as well. Due to spectrum allocation arrangements in the Philippines, PHL-MICROSAT will have command line access on the S-Band. PHL-MICROSAT Housekeeping (HK) routine data will be sent through the S-band link, while Mission data will be utilizing both the S-band and X-band downlink channels. The PHL-MICROSAT will be equipped with a 1.2kbps UHF uplink antenna, 1kbps S-band Uplink antenna, 100kbps S-band downlink antenna, and a 2.4Mbps X-band downlink antenna.

Keywords: PHL-MICROSAT, microsatellite, International Space Station, High Precision Telescope, Liquid Crystal Tunable Filter