Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MTT06-01 Room:A01 Time:May 25 12:00-12:30

Mission Status of RISING-2

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RISING-2 is a 50kg microsatellite successfully launched with the H-IIA rocket piggybacked on the ALOS-2 mission in May 2014. It is the result of a synergic joint collaboration between Hokkaido University and Tohoku University. Mission instruments consist of a VLF receiver, bolometer camera, wide field camera, lightning and sprite imager and a high precision telescope (HPT). This last comprises a reflecting telescope of 5m ground sample distance followed by two optical channels - visible and near infrared, respectively coupled with RGB filters and a liquid crystal tunable filter (LCTF).

The onboard LCTF is a compact (30mm cube) and light weight (80g) component developed by Hokkaido University, and as the world's first space LCTF, its spectral features are promising for the multi and hyperspectral data community, with configurable bands within 650-1050nm, 1nm/step, 10 to 30nm bandwidth.

We demonstrate the RISING-2 HPT-LCTF imagery pre-processing chain as well as its spatial and spectral capabilities, comparing its performance to existing systems. Quality metrics used for this analysis are Noise to Signal ratio, Modulation Transfer Function and Normalized Difference Vegetation Index comparison.

Keywords: microsatellite, remote sensing, Earth Observation, hyperspectral, LCTF

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MTT06-02 Room:A01 Time:May 25 12:30-12:45

Liquid crystal tunable filter technology for multispectral remote-sensing by micro-satellites

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New types of optical remote-sensing instruments for 50-kg class micro-satellites have been developed at Hokkaido University and installed on micro-satellites developed under international collaboration. For example, the High Precision Telescope (HPT) on the RISING-2 micro-satellite achieved a spatial resolution on the ground of approximately 5 m and represented the world's highest level of performance for small satellites in the 50-kg class. The HPT employs advanced technology including a liquid crystal tunable filter (LCTF) that was applied for the first time in the world to a space-borne multispectral sensor. The LCTF is a kind of optical band pass filter with the center wavelength electrically controlled at 1 nm intervals in the visible and near infrared regions. Compared to conventional multispectral sensors, the advanced sensor using the LCTF has the great advantage of enabling multispectral observations with hundreds of bands. The LCTF can also reduce size, weight, and power consumption of multispectral sensors and the advanced sensors using the LCTF are suitable for small and dynamically unstable satellites. This technology will change the utilization of micro-satellites that previously have not been applied to the multispectral and hyper spectral Earth observation, such as ocean color observation, tree species classification, and mineral resource exploration.

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MTT06-03 Room:A01 Time:May 25 14:15-14:45

Vietnam Micro satellite development program

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Since 2006, after [The Strategy for Research and Application of Space Technology towards 2020] was approved by the Prime Minister of Vietnam, space technology especially the development of earth observation satellite in Vietnam has seen a massive change in all aspects. To achieve the most challenging goal - building up capacity in terms of critical infrastructure and human resource to produce satellite domestically by 2020, Vietnam National Satellite Center (VNSC), a national research agency operating under Vietnam Academy of Science and Technology (VAST), was established in 2011 following the Decision of the Prime Minister. VNSC's mission is to develop satellite technology and applications. VNSC is responsible for managing and implementing the Vietnam Space Center project, the objective of which is to build capacity to self-produce satellites for the benefits of disaster and climate change countermeasure.

To train the young researchers of VNSC to meet the development requirement, 36 researchers of VNSC planned to five Japanese universities (The University of Tokyo, Keio University, Tohoku University, Kyushu Institute of Technology, and Hokkaido University) with 22 researchers are already studied in Japan. They are taking master courses about satellite technology in order to work for Vietnam Space Center when it is completed. During the time in Japan, they also participate in an educational satellite project.

The result of this project will be the first Vietnamese micro satellite called MicroDragon. It is developed by VNSC researchers under instruction of the Japanese professors. The main missions of MicroDragon is assessing coastal water quality of Vietnam to develop aquaculture and locating living resources that are associated with specific thermal features in the oceans by observing ocean colour. MicroDragon weights 50Kg with 50cm cubic size, it is now in design progress which intended to equip with 3 cameras: Space-borne Multispectral Imager (SMI), Triple Polarization Imager (TPI) and Infra-Red Imager (IRI). The development of MDG itself is planned to be finished by the end of 2017.

Keywords: Microsatellite

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MTT06-04 Room:A01 Time:May 25 14:45-15:00

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

Japan Geoscience Union Meeting 2015
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MTT06-05 Room:A01 Time:May 25 15:00-15:30

The Development of the Philippines First Microsatellite for Earth Observation: PHL MICROSAT 1

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By 2016, the Philippines will launch its first Earth-observing microsatellite, PHL-MICROSAT-1. This is under the program, ”Development of Philippine Scientific Earth Observation Microsatellite (PHL-MICROSAT)”, funded by the Philippines’ Department of Science and Technology (DOST). It is a collaboration among scientists, engineers and professors from the University of the Philippines, the Advanced Science and Technology Institute (ASTI) of the DOST, and from Japan, the Hokkaido University and Tohoku University. The aim is to build, launch and effectively utilize the Philippines’ first microsatellite for multi-spectral, high precision earth observation, focusing on applications in land and aquatic resource monitoring and assessment, and disaster risk management. It addresses the need to develop capacity through intensive study leading to the development of the microsatellite.

The components of the PHL-MICROSAT program include (1) the microsatellite bus development in Japan and the Philippines; (2) the establishment of the ground receiving station in the Philippines; (3) the creation of a data access, archiving and distribution mechanism and facility; (4) calibration and validation of remote sensing instruments and (5) development of remote sensing products from the microsatellite images.

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MTT06-06 Room:A01 Time:May 25 15:30-15:45

Roles of Asian Micro-satellite Consortium

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Micro-satellite with a weight of 50-100 kg has various merits compared to middle and large sized satellite, that is, 1) low cost fabrication compared to middle or large sized satellite, namely, few M EUR including BUS and mission payloads. The launch cost will be about 2 M EUR as piggyback, 2) quick fabrication: about one or two years for flight model would be sufficient, enabling application of the latest technologies, 3) on-demand operation, taking detail information at a point of interest, and 4) the low cost and quick fabrication make us possible to launch not a small number of satellites, which is called as constellation flight.

We would discuss the possible roles of international organization, Asian micro-satellite consortium (AMC), which promotes and accelerates the micro-satellite development and the discussion of data utilization. AMC will consist of domestic working group in each country. The each working group is composed of 3 parts: BUS development team, payload development team and data user team, involving various field scientists or engineers, such as forestry, agriculture, fishery, forest fire, bio-diversity, flood, meteorology, climate change, ionospheric / magnetospheric science, etc. Also in AMC we will discuss the possibility of future projects, such as on-demand operation or super constellation involving more than tens of microsatellites and unmanned air vehicles (UAVs) under international collaboration.

AMC will be started officially in the very near future probably involving about 10 countries in SE-Asia as the founding member.

Keywords: Asia, micro-satellite, consortium

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MTT06-P01 Room:Convention Hall Time:May 25 18:15-19:30

Science Missions and Payload Specifications of Philippines' First Earth-Observation Microsatellite

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On average, there are eighteen to nineteen typhoons entering the Philippines' area of responsibility in a year. It is also situated in the pacific ring of fire making it vulnerable to earthquakes and volcanic activities. Driven by these natural hazards, the Philippines, under the Department of Science and Technology (DOST), funded the program, "Development of Philippine Earth Observation Microsatellite (PHL-MICROSAT)", which aims to launch the Philippines' first Earth-observation microsatellite, PHL-MICROSAT-1, by 2016.

The microsatellite will be launched from the International Space Station with an expected altitude of 400 km and a near circular orbit similar to that of the ISS. It aims to provide robust and efficient near real-time status of the country's environment particularly for applications on disaster risk management, land-use and aquatic resource assessment and monitoring. On-board the microsatellite are four science and engineering payloads: (1) High Precision Telescope (HPT) with a 3 m GSD and the capability to capture images in the visible and near infrared region which will be used in determining the extent of damages from natural hazards such as typhoons, earthquakes and volcanic eruptions; (2) Space Borne Multi-Spectral Imager (SMI) with Liquid Tunable Filter (LCTF) which can capture images at 80 m GSD with a spectral range of 420-1050 nm. This payload will be used in determining the health and composition of the Philippine oceans; (3) a panchromatic Wide Field Camera (WFC) with a field of view of 180?x134? which will be used to capture images of cloud patterns and distribution as well as weather disturbances such as tropical cyclones; and (4) a colored Middle Field Camera (MFC) with 185 m GSD which will assist in the microsatellite's attitude determination.

Keywords: microsatellite, science missions, payload specification

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MTT06-P02 Room:Convention Hall Time:May 25 18:15-19:30

Development of MicroDragon for ocean color observation

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[1]Hokkaido University

MicroDragon is the first 50 kg class microsatellite of Vietnam National Satellite Center (VNSC). It is being developed by VNSC researchers under instruction of the Japanese professors come from five universities including Hokkaido University, The University of Tokyo, Keio University, Tohoku University and Kyushu Institute of Technology. Hokkaido University has been responsible for the development of the science payloads based on the demands and requirements from the scientific point of view.

Vietnam has a long coastal line with about 7% households in the fishery. Seafood plays an important role in developing Vietnam economics. However, with increasing exploitation, natural aquatic resources are decreasing quickly. Development of aquaculture is necessary for a sustainable economics. To do this, Vietnam needs an effective system which is an integration of remote sensing and sea water sampling to monitor coastal water quality. Therefore, Mission of MicroDragon is ocean color observation to provide data to researchers in fishery field and scientists in oceanography for assessing water quality and locating living resources. We will use three imagers being composed of Space-borne multispectral Imager, Infra-Red Imager, and Triple Polarization Imager onboard and Fluoro probes in the sea for the missions.

Keywords: Microsatellite

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MTT06-P03 Room:Convention Hall Time:May 25 18:15-19:30

Spaceborne Hyperspectra Imaging Development in Malaysia

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The remote sensing activities in Malaysia began in 1990s with concentration on the theoretical modeling of scatterers. Later on, Malaysia started the sensor development and measurement which included the development of anechoic chambers as well as ground based multifrequency and multiporalized scatterometer. In 2000s, the design and development of airborne remote sensing sensor such as synthetic aperture radar (SAR) and optical sensor was initial. Plan to developed own airborne SAR and multisepctra camera as well as collaboration with overseas research institute was took place. In year 2012, sensors on board UAV (both SAR and EO) have been successfully developed and tested, several high resolution images are obtained. In order to obtain larger coverage of the illumination footprint, the spaceborne remote sensing is necessary. A spaceborne Hyperspectra imaging sensor development project has been identified and initial by Centre of Remote Sensing and Surveillance Technologies, Multimedia University and Astronautic Technology (M) Sdn.Bhd. In this project, a small nano-class satellite with onboard Liquid Crystal Tunable Filter (LCTF) Hyperspectra Camera will be designed and constructed. LCTF hypersepectra camera will be designed to fit in the 10cm x 10 cm x 30cm nano-class satellite as well as confined to others electrical and mechanical constraint of spaceborne platform.The LCTF camera module consists of LCTF, Closed-circuit Television (CCTV) lens and Charge-couple device (CCD) board. LCTF sensor utilizes electronic controlled LCTF which allows rapid and vibrationless selection of wavelength from visible to IR range spectrum. The major advantages of this LCTF sensors are light weight (approximate 250g for sensor), larger number of band selection (about 600 bands) and lower cost compare to conventional multispectral camera. Therefore, it enables the usage of smaller space platform and further reduce the development cost and launching cost of satellite.Due to the large amount of data generated by the hyperspecta camera, it is necessary to reduce the size of the data so that the acquired data can be downloaded to the earth station during every satellite pass. An onboard FPGA-based multispectral image compression subsystem will be developed in this project to alleviate the memory and communication bottleneck of the small satellite.

Keywords: Hyperseptra Imaging, Spaceborne, LCTF