Development of spaceborne Hyperspectral sensor for small satellites by Space-Science Industries Program

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The Space-Science Industries Program has a goal which is building some businesses on space. The program was kicked off in 2003 by the volunteer group that consists of students, researchers and engineers. In the program, we are planning to launch Micro-satellite as the demonstration for the space industries models. The earth observation micro-satellite TAIKI is 50 kg satellite which has low-cost and small bus-subsystem for remote sensing. The bus-subsystem will be developed as manufactured products and keeps a lid on development cost to within 1 million dollars. In 2006, we also have successfully launched pico-satellite HIT-SAT which has mission of demonstrated bus-subsystem using COTS (Commercial-Of the Shelf) components for TAIKI. TAIKI is characterized by a low-cost spaceborne small hyperspectral sensor HSC-III. The mission objectives are summarized in the following: 1) To provide hyperspectral image for agricultural remote sensing, 2) To acquire visualization of the effect of climate change on plant distribution. The hyperspectral sensor acquires more spectral information from objects with a high spectral resolution compared with conventional multispectral sensors. The hyperspectral sensor enables to distinguish a targeted object with a high accuracy, and give us lots of important information. HSC-III is targeted at the performances of 30 m ground sampling distance, VNIR (Visible and Near Infrared) wavelength range, 10 nm spectral resolutions, 61 spectral bands and 10 kg weight. HSC-III consists of the telescope, the imaging spectrometer, mission data handling unit (MDHU), the on-orbital calibration equipment (OCE) and IRU. The telescope has a pupil diameter of 0.2 m, and has two mirror configuration of Ritchey-Chretien type. The spectrometer has the transmitting grating with the slit and relay lens unit, and array sensor using back-illumination type CMOS image sensor. As a SNR model of HSC-III, we did some calculations and concluded that SNR is approximately 340. Thus, HSC-III will be utilized for practical application of agricultural remote sensing. We have successfully developed the breadboard model of HSC-III optical unit, and we obtained result of more requirement specification. Also, we have developed MDHU data logger (MDHU-DL) and the OCE. MDHU-DL employs the FPGA and Camera Link Standard as the communication interface between detector and MDHU, so it is realizing the high speed data control. OCE is characterized by LED as calibration radiance source. OCE consists of 6 high-intensity visible LEDs, an infrared LED. It achieved 0.2 nm of spectral calibration accuracy compared with mercury spectral lamp.