20th SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Space Systems and Architectures Featuring Cross-Platform Compatibility (7A)

Author: Dr. Toshinori Kuwahara
Tohoku University, Japan, kuwahara@astro.mech.tohoku.ac.jp

Prof.Dr. Kazuya Yoshida
Tohoku University, Japan, yoshida@astro.mech.tohoku.ac.jp
Dr. Yuji Sakamoto
Tohoku University, Japan, sakamoto@astro.mech.tohoku.ac.jp
Mr. Yoshihiro Tomioka
Tohoku University, Japan, tomioka@astro.mech.tohoku.ac.jp
Mr. Kazufumi Fukuda
Tohoku University, Japan, fukuda@astro.mech.tohoku.ac.jp
Mr. Nobuo Sugimura
Tohoku University, Japan, sugimura@astro.mech.tohoku.ac.jp

MODEL-BASED SIMULATION AND VERIFICATION ENVIRONMENT FOR SPACE PLUG-AND-PLAY INSTRUMENTS

Abstract

Space Robotics Laboratory (SRL) of Tohoku University has been very active in the field of small satellite development for years. The first one is the 50kg-class micro-satellite SPRITE-SAT (renamed as RISING-1 after the launch) launched in 2009, and the second one is the CubeSat RAIKO launched by the HTV on Japanese H-IIB launcher and deployed from the ISS in 2012. SRL is also now completing the flight model of the third satellite RISING-2, and is developing the engineering model of the fourth satellite RISESAT, which are both 50kg-class micro-satellites. Along these satellite development activities, SRL has started development of a model-based simulation, verification, and integration environment called MEVIuS for supporting satellite's bus system development, which is actually applied to the real-life micro-satellite project RISESAT. RISESAT stands for Rapid International Scientific Experiment Satellite. RISESAT will carry 6 international scientific payloads from Taiwan, Vietnam, Sweden, Hungary, and Czech Republic. These instruments will include a high-precision telescope with a liquid crystal tuneable filter in visible wave length with 5m GSD, a meteor detection camera utilizing two different wave lengths, an ocean observation camera in three wave lengths, a dosimeter, a particle counter, and MEMS magnetometers. RISESAT employs Space Plug and Play Avionics (SPA) technology for the interface between the payload main computer and each payload instrument, i.e. all payload instruments have the same electrical interface. By applying a virtual system integration technology, remote integration of satellite components spread all over the world via internet becomes possible without getting together at a certain place. In this way the integration of a variety of scientific instruments becomes simple and the effort required can be dramatically reduced. MEVIuS was originally only covering the satellite's bus system such as the main data handling system and attitude control system, etc. Therefore, the environment is extended to deal with SPA compatible instruments. This environment enables software-based simulation and early functional verification of the SPA devices together with the satellite's bus system. Also these software models can be replaced with the real hardware in a step-by-step manner along the project progress. This will improve the rapid and cost-effective development performance of small satellites which introduces SPA technology. This paper will describe the details of implementation of this environment, as

well as the performance verification results of the established environment together with the real payload instruments.