to 1.5 MeV. Our result can be applied to estimate solar cell conditions of other satellites.

[Ⅷ-1-8] Neutron Monitor as a New Instrument for KSWPC

Su Yeon Oh[1,2], Yu Yi[1], Yong-Kyun Kim[3], John W Bieber[4], and Kyung-Seok Cho[2]

[1]Department of Astronomy and Space Science, Chungnam National University, [2]Solar and Space Weather Research Group, Korea Astronomy and Space Science Institute
[3]Department of Nuclear Engineering, Hanyang University
[4]Bartol Research Institute, Department of Physics and Astronomy, University of Delaware

Cosmic ray (CR)s are energetic particles that are found in space and filter through our atmosphere. They are classified with galactic cosmic ray (GCR)s and solar cosmic ray (SCR)s from their origins. The process of a CR particle colliding with particles in our atmosphere and disintegrating into smaller pions, muons, neutrons, and the like, is called a cosmic ray shower. These particles can be measured on the Earth's surface by neutron monitor (NM)s. Regarding with the space weather, there are common types of short term variation called a Forbush decrease (FD) and a Ground Level Enhancement (GLE). In this talk, we will briefly introduce our recent studies on CRs observed by NM: (1) simultaneity of FD depending on solar wind interaction, (2) an association between GLE and solar proton events, and (3) diurnal variation of the GCR depending on geomagnetic cutoff rigidity. NM will provide a crucial information for the Korea Space Weather Prediction Center (KSWPC).

■ Session Ⅴ-2 : Orbit 2 / Payloads 2
Thursday, 23 October [10:00-11:15]

[V-2-1] Batch Unscented Transformation for Satellite Orbit Determination Using A Satellite Laser Ranging (SLR)

Kyoung-Seok Seo, Sang-Young Park, Eun-Seo Park, Young-Rok Kim, and Kyu-Hong Choi

Department of Astronomy, Yonsei University

The batch least square filter is widely used for ground estimations. However, in orbit determination (OD) under inaccurate initial conditions and few measurement data the performance by the batch least square filter can lead an unstable results. To complement weak part of the batch filter, the batch unscented transformation without any linearization process is developed by ACL (Astrodynamics and Control Laboratory) in YONSEI University. In this paper, the batch unscented transformation is introduced and applied to satellite orbit determination using Satellite Laser Ranging (SLR) data. Only range of the satellite measured from ground tracking stations is used for measurement data. The results of simulation test are compared with those of the weighted batch least square filter for various initial states errors (position and velocity). Simulation results show that the batch unscented transformation is comparable or slightly superior to batch least square filter in the orbit determination.

[V-2-2] Real-Time Relative Navigation with Integer Ambiguity

Sun-Hwa Shim, Sang-Young Park, and Kyu-Hong Choi

Astrodynamics & Control Lab, Department of Astronomy, Yonsei University, Seoul 120-749, Korea

Relative navigation system is presented using measurements from a single-channel global positioning system (GPS) simulator. The objective of this study is to provide real-time relative navigation results as well as absolute navigation results for two formation flying satellites separated about 1km in low earth orbit. To improve the performance, more accurate dynamic model and modified relative measurement model are developed. This modified method prevents non-linearity of the measurement model from degrading precision by applying linearization about the states from absolute navigation algorithm not about a priori states. Furthermore, absolute states are obtained using ion-free GRAPHIC pseudo-ranges and precise relative states are provided using double differential carrier-phase data based on Extended Kalman Filter. The software-based simulation is performed and achieved meter-level precision for absolute navigation and millimeter-level precision for relative navigation. The absolute and relative accuracies at steady state are about 0.77m and 4mm respectively (3D, r.m.s.). In addition, Integer ambiguity algorithm (LAMBDA method) improves simulation performances.

[V-2-3] Improved Differential Wavefront Sampling algorithm for efficient alignment of Space optical system

Yunjong Kim[1,2], Ho-Soon Yang[2], Yun-Woo Lee[2], and Sug-Whan Kim[1]

[1]Dept. of Astronomy, Yonsei University, Seoul 120-749, Korea, [2]Korean Research Institute of Standards and Science, Daejeon 305-340, Korea

The significant I&T process gain represented by reduction in overall budget expenditure can be obtained from the use of efficient alignment technique for large space optical systems. Such process gain tends to increase rapidly with

an increase in aperture and/or in number of optical elements within the system. However, in practice, the alignment of multiple optical components tends to be rather difficult task because of the multiple coupling effects among the elements within the target system. In order to understand and hence identify the complex interplay of the wavefront coupling effects from the alignment process, the original differential wavefront sampling(DWS) method was presented elsewhere in recent years. DWS uses partial differential of the wavefront of optical component and perturbation value of the optical component against a particular alignment factor. The straightforward application of DWS for an off-axis optical system revealed that it tends to give incorrect estimation of the given misalignment state. In this study, we added off-axis correction terms to the original DWS algorithm and investigated its alignment performance. The performance simulation result for a Korsch type space optical system shows that the modified DWS is capable of bringing the misaligned system into the target alignment tolerance only after 3 iterations. It also shows that this new improved algorithm can be used to estimate the source misalignment as well. We are planning to apply this method for the alignment of a 800mm Korsch type telescope in the near future. We discuss the computational technique, simulation results and implications in details.

[V-2-4] Development of an Earth Observation Optical Payload Simulator

Jong-hoon Lee[1], Jun Ho Lee[1], and Yee-Jin Cheon[2]

[1]KongJu National University, [2]KARI

The importance on the simulation of earth observation optical payloads has been recently emphasized in order to estimate on-orbit imaging performance of the payloads. The estimation should consider all aspects of payload development; design, manufacture, test, assembly, launch and space environment. Until recently several studies have been focused the evaluation of the individual factors rather than the integrated. This paper presents the development of an integrated payload simulator. The simulator analyzes the payload imaging performance based on MTF(Modulation Transfer Function) calculations of the major factors (Diffraction, Aberration, Detector integration, Image motion and etc.) and the simulator can generate realistic artificial earth images as taken by defined earth observation payloads. The simulator is developed for the use of evaluating pre- and post-launch imaging performance and assisting on-board calibration of COMPSAT-3.

[V-2-5] Radiometric performance characterization for breadboard AMON-RA energy channel instrument for deep space albedo measurement

Kiljae Jung[1], Dongok Ryu[1], Ki-Beom Ahn[1], Eun-song Oh[1], Jae-Min Lee[1], Yunjong Kim[1,2], Jinhee Yu[1], Hyun-Su Yi[2] , Sun-Jung Ham[1,3], Ji-Yeon Yoon[4], Hoseop Yoon[1,4], Jin-Seok Hong[5], Ho-Soon Yang[2], Byong hyok Chon[2], Hae-Sook Hwang[8], Hanshin Lee[3,6], Sug-Whan Kim[1], and Mike Lockwood[3,7]

[1]Dept. of Astronomy, Yonsei University, Seoul 120-749, Korea, [2]Korean Research Institute of Standards and Science, Daejeon 305-340, Korea, [3]Rutherford Appleton Laboratory, UK, [4]Korea Astronomy and Space Science Institute, Daejeon 305-348, Korea, [5]I&A Technology, Sungnam 463-500, Korea, [6]Astronomy sub-dept. University of Oxford, UK, [7]Space Environment Physics Group, School of Physics and Astronomy, University of Southampton, UK, [8]Dept. of Applied Chemistry, Daejon University, Daejon 305-380, Korea

The Albedo MONitor and RAdiometer (AMON-RA) instrument system is designed to measure Earth global albedo anomaly over the wavelength range of 0.3um to 4um. The instrument consists of two interconnecting optical subsystems i.e. a visible channel and an energy channel. The energy channel instrument consists of a modified Winston cone, a couple of relay mirrors and a pyro-electric detector. First, we report the integration and alignment process, leading to the prototype bolometer instrument. We then discuss the radiometric performance characterization including laboratory measurement results and the future plan for further incorporation of the bolometer instrument into the prototype AMON-RA instrument.

■ Session VI-2 : Satellites 2

Thursday, 23 October [11:25-12:25]

[VI-2-1] Development of Hardware-in-the-loop Simulator for Spacecraft Attitude Control using thrusters

Dong-Wook Koh, Sang-Young Park, and Kyu-Hong Choi

Astrodynamics & Control Lab, Department of Astronomy, yonsei University, Seoul 120-749, Korea

The ground-based spacecraft simulator is a useful tool to realize various space missions and satellite formation flying in the future. Also, the spacecraft simulator can be used to develop and verify new control laws required by modern spacecraft applications. In this research, therefore, Hardware-in-the-loop (HIL) simulator which can be demonstrated the experimental validation of the theoretical