Joint Symposium by OSJ and OSK on Optical Design & Fabrication

Invited Ⅵ 7월 11일(금) 12:00~12:30 피닉스볼룸 I(A)

Current Status of the development of a Compact Imaging Spectrometer (COMIS) for a microsatellite STSAT3

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과학기술위성3호 부탑재체로 선정된 영상분광기(COMIS, Compact Hyperspectral Imager) 2010년 발사를 목적으로 개발 중에 있으며, 현재 광학 및 전자부의 공학 모델이 개발 중에 있다. COMIS는 발사 후 궤도 700km 상공에서 해상도 30m 및 30km 폭을 갖는 지표면 또는 대기를 관측할 수 있다. 관측 시 가시광 및 근적외선 영역에서 16~62대역(4~15nm 파장 분해능)의 초분광 관측을 수행할 수 있다. 현재 COMIS의 광학 소자(렌즈, 프리즘, 슬릿)등의 단품 가공 및 평가가 완료되었으며, 평가가 완료된 광학 소자를 이용한 결상 광학 및 분광 광학계의 조립 및 성능 시험이 현재 진행 중에 있다. 본 논문에서는 영상분광기의 COMIS의 단품 및 모듈 단위의 성능 및 일부 환경 시험 결과를 포함한 진행 현황을 보고한다.

• Biograph

Jun Ho Lee received his BSc degree from the Mechanical Engineering Department of the Korea Advanced Institute of Science and Technology (KAIST) in 1994, and his MSc degree with distinction in Satellite communication and spacecraft technologies from University College London (UCL) in 1995. He then received the PhD in adaptive optics from UCL in 1999. He had been a research professor at the Satellite Technology Research Center (SaTReC), KAIST and is now an associate professor of the Optical Engineering Department at Kongju National University. His current research interests include space optics and adaptive optics for astronomical and industrial uses.

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I. Introduction

The Ministry of Education & Science and Technology (MoEST) of South Korea initiated the STSAT series at 2000 designated in the Long-Term Plan for Korea's Space Development (figure 1). The STSAT series were incubated based on the successful technical development and demonstration of the Korea's first microsatellites KITSAT series. The STSAT series are to achieve both engineering objectives by demonstrating core-satellite technologies, and scientific objectives by providing in-space-measurements to the space/earth science communities.

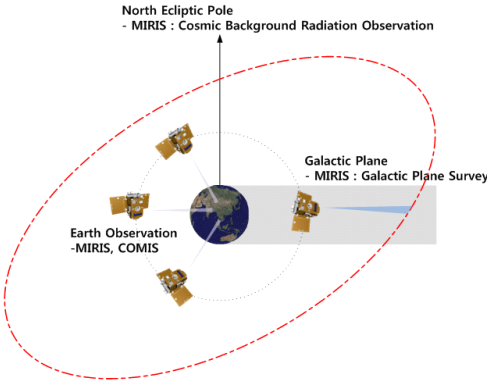

Fig 1. Operational concept of STSAT3

Item		Specification	Remark
Mass		< 115 kg + 30 kg (main PD) + 5 kg (sub PD)	TBD
Size		~ 710 x 865 x 1067 mm	TBD
Power Consumption		< 265 W (BUS) + 35 W (Payloads)	TBD
Solar Panel Capacity		> 300 W @ EOL(TJC : GaInP2/GaAs/Ge)	TBD
Battery		> 20 Ahr (Li-ion Cell)	TBD
Attitude Control		3-Axis Stabilized	
Mass Memory		4 Gbits (~100 Mbps)	TBD
RF Link	TT&C	S-Band Tx (38.4 kbps) and Rx (9.6 kbps)	TBD
	Payload Downlink	X-Band Tx (10 Mbps)	TBD

Table 1. Specifications of STSAT3

STSAT-3 is a microsatellite, the platform of which will be developed with the technical heritages of the previous missions; KTSAT-1, 2, 3 & ST-1 and 2. The engineering objective of STSAT-3 is to provide a test-bed for satellite core technology such as a multi-functional composite structure and a hall-thruster. The primary scientific objective is to provide IR imaging of the Galaxy (1-2m) while the secondary is to provide hyper-spectral imaging of the Earth surface mainly over the Korean Peninsula in visible and near IR band (0.4~1.05m).

The secondary payload is a hypers-spectral imager called Compact Imaging Spectrometer (COMIS). The COMIS was inspired by the success of a small hyper-spectral imager CHRIS developed for the ESA microsatellite PROBA and the COMIS was proposed to achieve equivalent or similar imaging capability to CHRIS but with a smaller diameter (~5cm) and mass (~5kg). The COMIS takes hyper-spectral images of 30m/60m ground sampling distance (GSD) over 30km swath width. The numbers of bands are selectable among 18 or 62. The COMIS takes hyper-spectral images in the two different modes; a) Pushbroomand b) multi-directional observation. The major scientific applications of the COMIS are for environmental monitoring such as in-land water quality monitoring of the Paldang Lake located next to Seoul, the capital of South Korea.

II. Instrumental Description

The COMIS is an imaging spectrometer or hyper-spectral imager. The COMIS is to image the Earth surface or atmosphere with GSDs of 30m/60m at 18/62 spectral bands (4.0~1.05m). The following figures show the optical layout, the mechanical layout, two imaging modes and the electrical layout of COMIS.

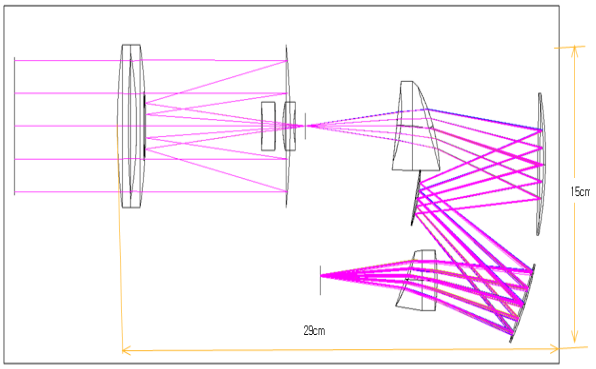

Fig 2. Optical layout of COMIS

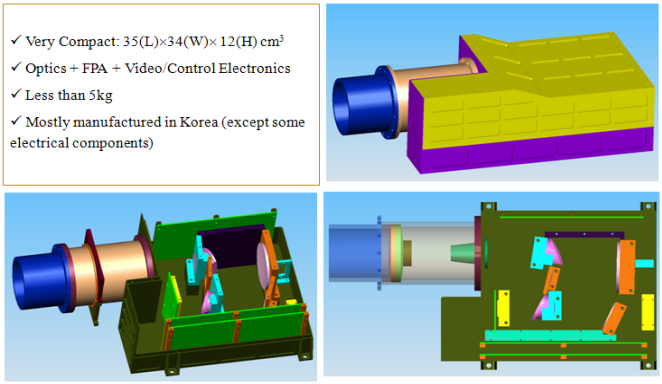

Fig 3. Mechanical layout of COMIS

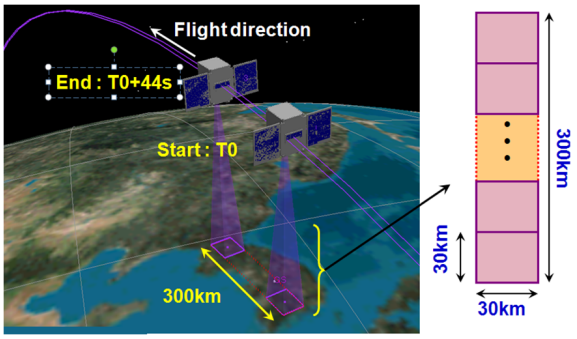

Fig 4. Strip imaging

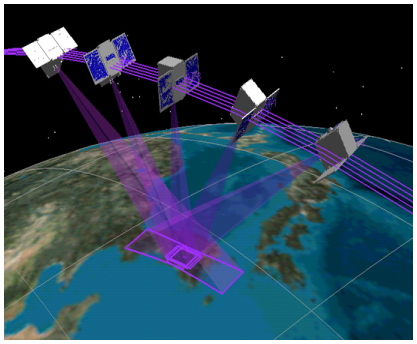

Fig 5. Stereo imaging

III. COMIS Scientific Applications

The COMIS operations are mainly focused on the environmental monitoring over the Korean Peninsula but the possible international cooperation or research using the COMIS is quite open to the international community. Currently the three major applications are accepted as the primary candidates 1) water quality control of the Paldang Lake, 2) Aerosol optical thickness study, and 3) the rice plant growth modeling over the Kim-Je rice field.

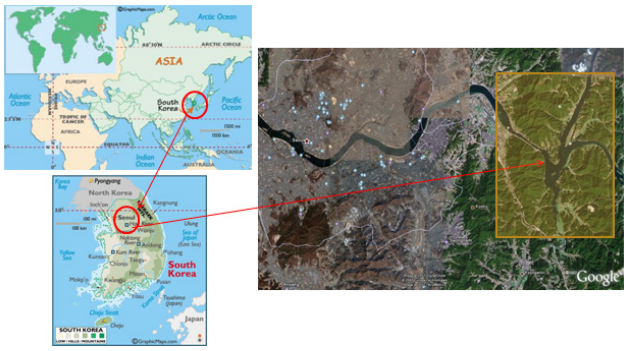

Fig 6. Site of the water quality research, Paldang Lake

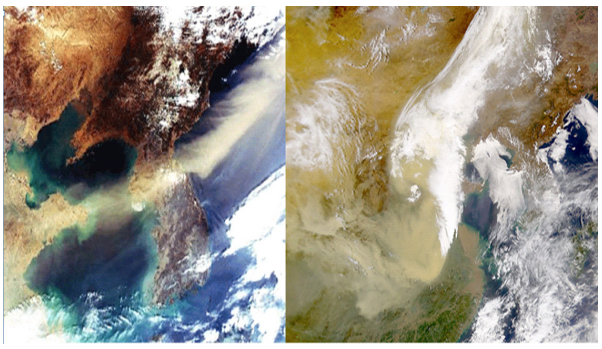

Figure 7. Satellite images of the Yellow Sand over the Korean peninsula