ACTIVITIES OF CALIBRATION AND VALIDATION FOR THE KOMPSAT-2 MSC DATA

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ABSTRACT:

KARI has prepared Calibration and Validation activities for the KOMPSAT-2 (KOrea Multi-Purpose SATellite-2) MSC data that will be launched at the end of this year. Firstly, we divided the Cal/Val activities of it to four parts, Spatial, Spectral, Radiometric and Geometric, and defined the detailed Cal/Val items from them. Secondly, Cal/Val targets have been defined and manufactured for the role of them. Thirdly, we have made the plan and the procedure for the Cal/Val items, developed the codes for them, studied more detailed method to do them, and trained the Cal/Val activities using the foreign satellite image data by ourselves. KARI has been now setting up the KOMPSAT-2 LEOP plan with the Cal/Val activities, and probably will finish the EOP Cal/Val activities for the KOMPSAT-2 MSC data by the next April or May.

KEY WORDS: KOMPSAT-2, Calibration, Validation, MSC, Image data

1. INTRODUCTION

The Calibration and the Validation for KOMPSAT-2 MSC data has been prepared by KARI one by one so far, and the Cal/Val activities for KOMPSAT-2 will be carrying up for 4-5 months from KOMSPAT-2 launch to first release of MSC image data to Users. Because KARI has designed and developed the KOMPSAT-2, KARI has a responsibility for the Cal/Val of KOMPSAT-2. If KARI will get the good result of the Cal/Val activities during LEOP (Launch and Early Operation phase), the basic requirements of KOMPSAT-2 will be accomplished and Users will get the good quality of the MSC image data. This paper will present the overall Cal/Val activities for the KOMPSAT-2 MSC data.

2. ITEMS OF THE KOMPSAT-2 CAL/VAL

Table 1. Items of the KOMPSAT-2 Cal/Val

종류	Parameter		방법	검보정 target	검보정 위치	수행시기		
						1	2	3
Spatial	Focusing		검보정 target	Edge, 부점표, 펄럭거울, Pulse	Portable	√		√
	GSD, FOV		검보정 target, 여러 지역 영상	펄럭거울	대전, 고흥	√		√
	MTF, NIIRS		검보정 target	Edge, 부점표, 펄럭거울, Pulse	Portable	√		√
	Optical Distortion		GCP DB		대전, 고흥		√	√
	TDI	Level (Gain)	검보정 target, 여러 지역 영상	Tarp	Portable	√		√
		Line rate	검보정 target, 여러 지역 영상	Tarp	대전, 고흥	√		√
		Yaw Steering	연구 필요, 검보정 target		대전, 고흥	√		√
Spectral	Spectral Characteristics							

종류	Parameter	방법	검보정 target	검보정 위치	수행시기		
					1	2	3
Radio-metric	Electric Gain/Offset	검보정 target, 여러 지역 영상	Tarp	Portable	√		√
	Relative (NUC table)	검보정 target, 여러 지역 영상	Tarp, Dark Cal., OBRC	Portable	√		√
	SNR	사막, 호수, 검보정 target	Tarp, Dark Cal., OBRC	Portable	√		√
	Linearity	검보정 target, 여러 지역 영상	Tarp, Dark Cal., OBRC	Portable		√	√
	Dynamic Range	검보정 target, 여러 지역 영상	Tarp, Dark Cal., OBRC	Portable		√	√
	Absolute	검보정 target, 여러 지역 영상	Tarp, Dark Cal., OBRC (눈, 얼, 사막, 호수)	Portable		√	√
Geo-metric	UTC & GPS Sync				√		√
	POS				√		√
	KPADS 초기화	GCP DB		고흥 Pass	√		√
	AOCS On-Orbit Cal.	GCP DB		고흥 Pass	√		√
	Pointing Accuracy	GCP DB 여러 지역 영상		대전, 고흥	√		√
	CCD Geometry	GCP DB		대전, 고흥		√	√
	Exterior Orientation	GCP DB		대전, 고흥		√	√

The KOMPSAT-2 Cal/Val is divided for 4 groups; Spatial, Spectral, Radiometric and Geometric, and each group has several items according to its property (Ryan 2003). 'Optical Distortion' of Spatial and 'CCD Geometry' of Geometric mean 'Interior Orientation'. In Table 1, the blue items are the parameters to initialize the KOMPSAT-2 with Telemetry Command, the green items are the parameters to upgrade the KOMPSAT-2 performance, the yellow items are the parameters to validate, and the white items are product parameters for the end-users.

3. CAL/VAL TARGETS

For the KOMPSAT-2 Cal/Val activities, we need the Cal/Val targets that can be imaged by KOMPSAT-2

MSC, and has made Siemens, convex mirror, tarp and GCP target.

Table 2. Cal/Val Targets

Target	Cal/Val Parameter	Location
Siemens	MTF, Aliasing, IFOV	KARI, Goheung
Convex mirror	MTF, GCP	Portable
Tarp	Edge(MTF), Linearity, Radiometric, Dynamic Range	Portable
GCP target	CCD Geometric, CCD Distortion, Pointing Accuracy, KPADS S/W 초기화, AOCS On-orbit sensor calibration	Daejeon, Goheung, (Incheon ariport) Portable

3.1 Siemens target

Siemens target located at Goheung has been designed to validate the MTF, Focusing, etc.

Table 3. Spec. of Siemens target

Angle (Deg.)	Radius (m)	Number	Arc length (m)	Total angel (Deg.)
4.2	68.1	27	5	113.4

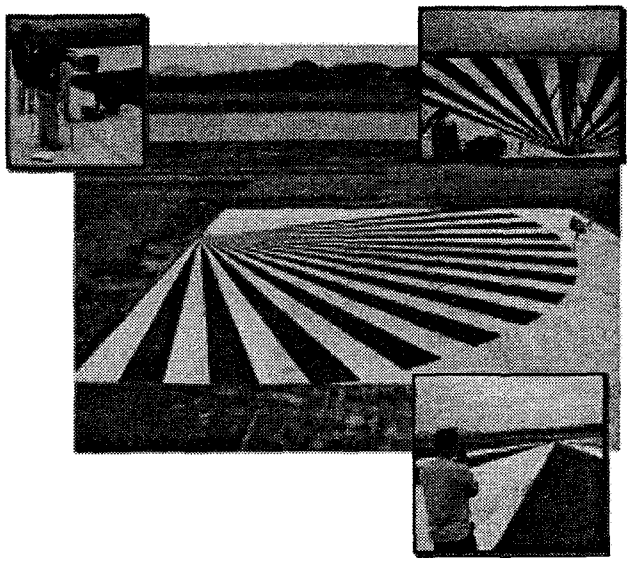


Figure 1. Siemens target at Goheung

3.2 Tarp target

Tarp target, portable, has been designed to validate the MTF, Focusing, Linearity, Absolute radiometric cal., etc.

Table 4. Spec. of Tarp target

Reflectance	3.5%	23%	35%	53%
Number	8	8	8	8
Size	5m x 20m			

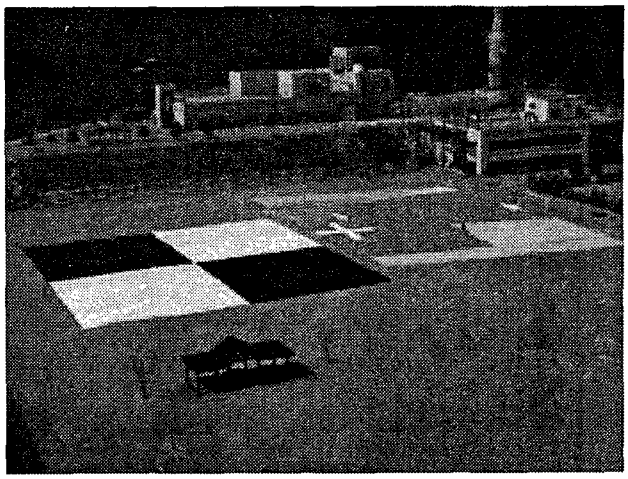


Figure 2. Deployed Tarp target

3.3 Convex mirror

Convex mirror, portable, has been designed to validate the MTF and GCP.

3.4 GCP DB

GCP DB for the KOMPSAT-2 Geometric Cal/Val has been establishing at Daejeon, Goheung, Incheon airport before LEOP to calibrate and validate the KPADS S/W, AOCS on-orbit Cal., interior orientation and pointing accuracy check. The basic requirement of KOMPSAT-2 GCP DB is the next;

- Accuracy: <0.5m (Horizon), < 0.5m (Height)
- Minimum number: >30 in 1 scene

Figure 3. GCP DB at Daejeon

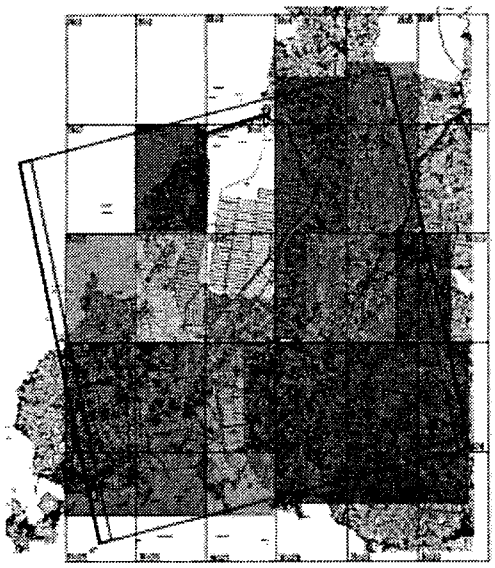


Figure 4. GCP DB design at Goheung

4. CAL/VAL PRACTICE

KARI Cal/Val team has 4 times Cal/Val field works to practice the Cal/Val activities with 1m foreign remote sensing satellite.

Table 5. Imaging location and date

Imaging location	Date
Goheung	2004. 11. 4
KARI	2005. 3. 7
Nonsan	2005. 4. 4
Goheung	2005 5. 27

4.1 Goheung (2005. 5. 27) field work

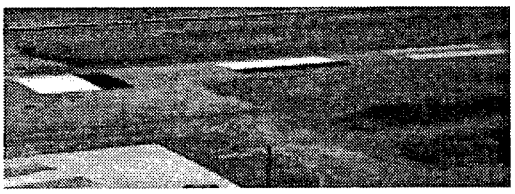


Figure 5. Deployed tarp target

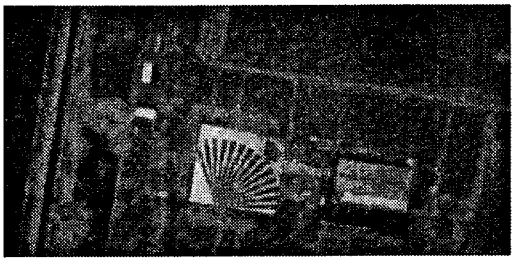
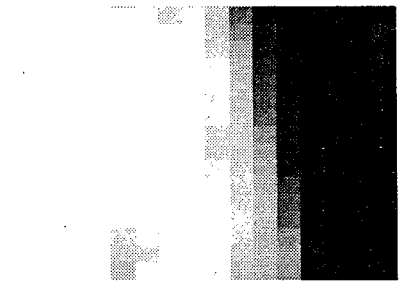


Figure 6. Satellite image

5. CAL/VAL PRACTICE RESULT

5.1 MTF



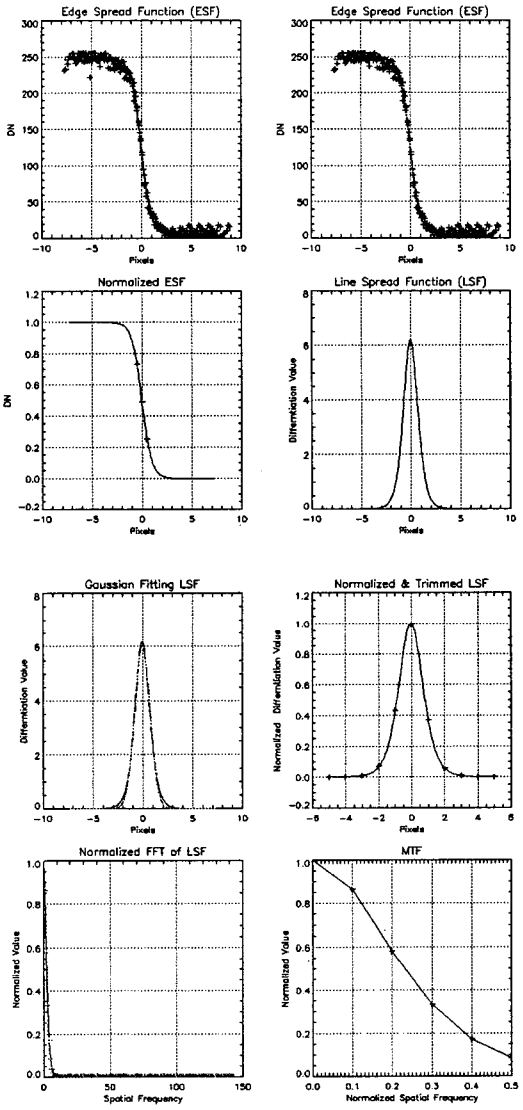


Figure 7. MTF calculation procedure

SNR = 36.4927
Edge Response = 0.475223
FWHM = 1.81330
Nyquist Frequency = 6.02500
MTF at Nyquist = 0.0824242

5.2 Absolute radiometric calibration

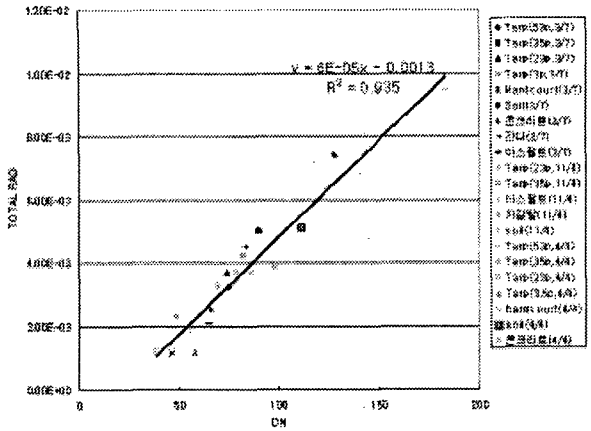


Figure 8. Absolute radiometric Cal. result

5.3 GSD

평균	1.0175
표준 오차	0.0018
중앙값	1.0234
최빈값	1.0056
표준 편차	0.0086
최소값	1.0056
최대값	1.0235
신뢰 수준 (95.0%)	0.0036

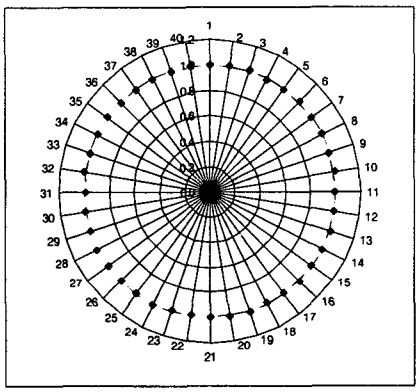


Figure 9. GSD result

6. FUTURE WORK

KARI Cal/Val team has finished the basic readiness for the KOMPSAT-2 Cal/Val activities, and has to complete the GCP DB, the detailed procedure, the detailed plan of LEOP Cal/Val and the algorithm of interior orientation, etc. If we get the good result from the KOMPSAT-2 Cal/Val activities, the result of it will be applied to the image restoration and the image enhancement in KOMPSAT-2 IRPE (Image Receiving & Processing Element), the end-users will get the good quality of the KOMPSAT-2 MSC image data.

7. REFERENCE

Ryan, R., 2003. Parameters Describing Earth Observing Remote Sensing Systems. In: *International workshop on Radiometric and Geometric Calibration*, USA