QUICK-LOOK TEST OF KOMPSAT-2 FOR IMAGE CHAIN VERIFICATION

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ABSTRACT:

KOMPSAT-2 equipped with an optical telescope(MSC) will be launched in this year. It can take images of the earth with push-broom scanning at altitude 685Km. Its resolution is 1m in panchromatic channel with a swath width of 15 km. After the MSC is tested and the performance is measured at instrument level, it is installed on satellite. The image passes through the electro-optical system, compression and storage unit and finally downlink sub-systems. This integration procedure necessitates the functional test of all subsystems participating in the image chain. The objective of functional test at satellite level(Quick Look test) is to check the functionality of image chain by real target image. Collimated moving image is input to the EOS in order to simulate the operational environments as if KOMPSAT-2 is being operated in orbit. The image chain from EOS to data downlink subsystem will be verified through Quick Look test. This paper explains the Quick Look test of KOMPSAT-2 and compares the taken images with collimated input ones.

KEY WORDS: Multi-Spectral Camera(MSC), KOMPSAT-2, Image chain test, push-broom scanning

1. INTRODUCTION

After the MSC is tested and the performance is measured at instrument level it is installed on satellite. So, it is necessary to test and verify the image chain from EOS to data downlink subsystems. The test is to be carried out in the high bay of KARI SITC building, as well as in the launch site. This paper generally describes the overall concepts, method and configuration of the test including accompanying considerations.

The purpose of this test is to check the functionality of MSC image chain under simulated/limited operational environment using light source, collimator and moving target as if the satellite is being operating in orbit. The image chain consists of all the subsystems participating in image generation from optics to data downlink system. However optical test equipments for Quick look are small and simple, which makes it far from optical performance test of the MSC in accordance with test objective and environments.

This test would be performed when it is necessary to check out MSC imaging function including data transfer to make sure that all electrical boxes are alive, the interfaces are correctly mated and there are no visible defects in the optical module. This test shall not be categorized as an optical performance test. This will demonstrate overall aliveness of MSC optics and electronics.

2. TEST CONFIGURATIONS

Figure 1 shows the overall configuration of MSC Quick-Look Test. This test would be performed under ambient condition and the functionality of MSC should be verified by the output image that could be observed in DLS EGSE. In some case, by the request, the X-band antenna output would be connected to the roof-top antenna of SITC via cable interface to establish the direct RF contact to KOMPSAT-2 Image Receiving & Processing Element (IRPE). With this test configuration, overall capability for imaging, transmitting, receiving and processing of MSC data would be demonstrated. The X-band antenna would be remained in stowed position during the test, and it may be required to inhibit the command sending for MSC HRM fire.

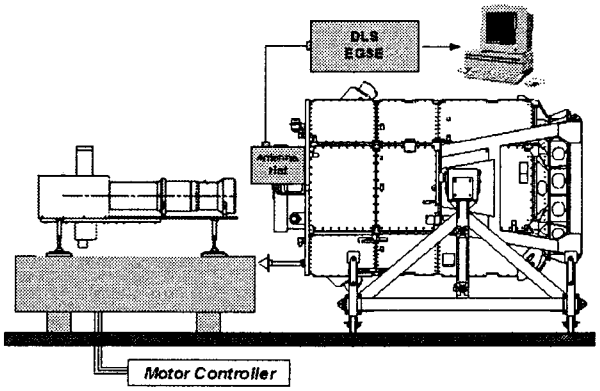

Figure 1. Overall configuration of the Quick-Look

Real test image will be injected to EOS using collimated moving target in order to simulate the operational environment as if MSC is being operated in orbit. The image data will be processed through all step of the MSC image chain from EOS to antenna or ASU after optical target signal converted to electrical signal

and finally collected by DLS EGSE or KGS. One of the mission configurations will be selected for this test. Overall operation and functional status of MSC image chain will be checked and analysed by real image data and MSC SOH.

A collimator would be used to change the diverging light from a point source to a parallel beam, which will be placed on the optical bench near KOMPSAT-2. The collimator includes a set of collimating lens and mirrors, a light source and a translator that moves target image to simulate satellite movement. It can be aligned off-axis to the satellite optics when the diameter of collimator is smaller than that of the satellite telescope since the secondary mirror blocks the central parts of the telescope. When off axis alignment is used, possible image degradation would be notified prior to testing through an analysis.

The two input targets are prepared. The target images contain bar targets, colorized texts, simple images and remote sensing images. It was agreed that these images were quite suitable to demonstrate the correct functionality of MSC.

KOMPSAT-2 satellite will be located on the MGSE rotation dolly, and then rotated in 90° from the normal position. The accuracy of angular rotation will be around 90°±5°, so collimator mounting table would have the capability for rotational misalignment compensation. To protect any visible radiation from side, a light cover would be used between the collimator and MSC optics.

MSC will take a picture and store those data in MSC DCSU. Upon finishing the imaging, downlink to DLS EGSE will be started. This test would be performed for PAN only and PAN+MS with compression

3. EXPECTED OUTPUT IMAGE

Table 1 shows the specification of collimator used for this test. Because it is necessary to have wider field of view than that of MSC to cover the full field, refractive type collimator is selected to have as large as 9° field of view. Because the collimator can be easily moved from KARI to launch campaign site and budget is limited, the aperture of collimator is 150mm, only a quarter of MSC.

Table 1. Specification of the collimator

Item	Specification
Collimator type	Refractive
Wavelength region	0.5μm to 0.8μm
Effective focal length	760 mm
Clear aperture	150 mm
Field of view	Square 9° x 9°

The expected performance is analysed as in figure 2. Optical parameters of the MSC and the collimator are given in Code V in order to extract combined MTF curve. The result is shown in figure 3. This analysis does not take into account the effects of vibration and alignment errors between the MSC and the collimator. Because this test is done not on the optical table nor seismic ground, the vibration effects, even though it is not estimated by analysis, is thought to degrade the output image more or less severely.

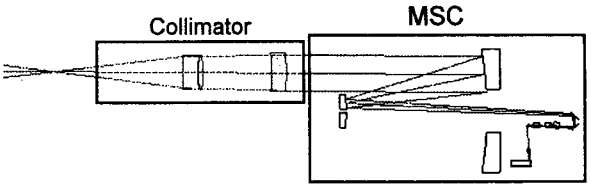

Figure 2. Combined system for expected output image evaluation

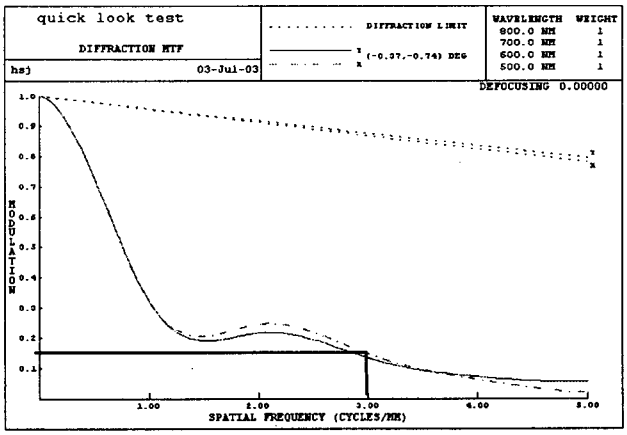

Figure 3. MTF curve of combined system of the MSC and the collimator

4. RESULTS

The Quick-Look test was done on the clean room at KARI. The satellite resides on the dolly in horizontal pointing to receive the collimated beam from the collimator as in figure 4. The test was performed sequentially from static target to full length target changing line rate of the CCD and compression modes. At first static image where bar target is fixed is taken in order to remove moving effect of the collimator. Since the MSC has capability to vary the line rate of the CCD, the line rate is set as low as possible to compensate the small aperture of the collimator.

Figure 5(a) shows the PAN channel image of black and white target and Figure 5(b) shows composite image of 4 MS channels of color target with the line rate of 680. The characters in output image are clearly visible in PAN and MS channels whereas some bar pattern in PAN is indistinguishable. Since bar pattern consists of many variable thick bars from 13m in ground, some of the thinnest bars seem to lose their details in output images, which is expected in the analysis.

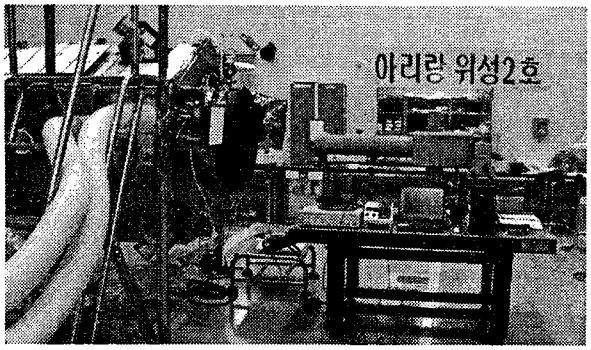

Figure 4. Photograph of test setup

(a) (b)

Figure 5 Output image. (a) PAN image of black and white input target (b) MS image of color input target.

5. SUMMARY

Quick-Look test was done successfully to validate the functionality of image chain of KOMPSAT-2 from MSC to KGS. The output image seems very close to what we expect. The vibration from the test room seems to be less critical. The alignment between the collimator and the MSC was done more or less easily to commit the original concept of quick verification of image chain.

References

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Acknowledgements

This study has been supported by Ministry of Science & Technology in Korea.