

GOES-9 GVAR Imager Processing System Development by KARI

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Abstract: Recently, KARI developed in-house meteorological sensor processing system named MESIS for GOES GVAR 5-CH Imager for better KOMPSAT EOC mission operation. MESIS consists of antenna system, receiver, serial telemetry card, processing and mapping software, and 2 NT PC systems. This paper shows system requirement, system design, characteristic and test results of processing system. System operation concept and sample image are also provided. Implemented system was proven to be fully operational through lots of operations covering from RF signal reception to web publishing.

Key words: GOES, GVAR, IMAGER, PROCESSING

1. Introduction

More accurate weather information is required for electro-optical payload operation in LEO missions. KARI had used GMS-5 S-VISSR data obtained by KMA as one of weather information sources in KOMPSAT EOC mission planning. JMA and NOAA agreed to place GOES-9 onto 155 deg, east to replace S-VISSR service by GVAR service until MTSAT-1R operation. This agreement imposed impacts on meteorological data reception and processing architecture in Korea because GOES GVAR data format and sensor characteristic are different with that of GMS S-VISSR. Especially processing software should be modified to handle GVAR data.

In 2002, KARI decided to implement cost-effective GOES GVAR receiving and processing system by ourselves instead of total system procurement through major provider like Seaspace inc, USA. Main objectives of implementations includes:

- Weather information restoration from GVAR for KOMPSAT EOC mission planning
- GVAR raw data and/or image file provision to KMA, if required
- In-depth engineering experiences

To minimize development risk, we decided to use field-proven COTS hardware as much as possible. In later section, detail descriptions for how GOES GVAR data receiving and processing system has been implemented at KARI is provided.

2. System Features

KARI derived several key system requirements in

functional and performance during initial design phase as followings:

- L-Band Antenna with G/T, >12dB/K
- LNB & BPSK/NRZ receiver
- Frame Sync card
- 1 PC for Archive/FTP service/Processing
- 1 PC for web server
- Unmanned operation
- System log & Alarm
- GVAR 5-CH processing S/W
- Image Mapping S/W

GOES technical documents available through NOAA and NASA website [1][2] were reviewed and especially GVAR transmission data format [3] was thoroughly reviewed for reliable processing algorithm developments.

1) Receiving End

Through simple link margin analysis considering installation and operation environments, optimum RF/IF/BB equipments were selected among commercially available sources. Mesh-type 3.6M parabola antenna was selected for less wind-load. To increase G/T, LNB was interfaced with L-Band linear polarization feed directly. LNB provides 50dB of conversion gain and 1.09dB of noise figure.

Antenna system was installed on office roof. Two 70m RF cables were used between antenna and CD-ROM sized GVAR receiver mounted in PC. Receiver supplies DC power for LNB. Receiver outputs are data and clock in NRZ-L PCM. PCI card type frame synchronizer is configured to perform optimum frame sync per dedicated GVAR block format from the data and clock in RS422 level. Bit-slip was not considered in frame synchronizer because GVAR format length is not fixed. 0.5Tbyte RAID was used to store the frame synced data.

2) GVAR processing S/W

GVAR processing software has been developed under VC++6.0 environments. S/W was designed to be invoked and ingest GVAR data automatically per operation schedule file. Features of S/W are followings:

- Ingest of GVAR formatted data
- Extraction of each channel's data
- 10bit-to-8bit conversion wrt calibration LUT recommended by NOAA
- Image navigation & sampling (pixel/line no. to

- lat/lon per recommendation of NOAA)
- Production of 10 imagery (5 for earth full disk, 5 for east Asia) each scheduled operation for further processing
- Compressing & Archiving GVAR formatted data for later use
- GVAR raw data conversion and transfer to KMA

Fig.1 shows processing software flow diagram. Processing S/W also monitors and controls all operation of receiver and frame synchronizer. Recorded GVAR data is processed to get oblate full disk first considering line and pixel information contained in header section.

Re-sampling process is used to get true earth full disk image while conversion process from pixel/line to lat/lon is used to get east Asia image.

3) MAPPER S/W

After generating 5-ch images for both full disk and east Asia, mapping software is invoked via system call by processing software, MESIS for accurate image registrations. MAPPER S/W has been developed using IDL5.6 runtime module.

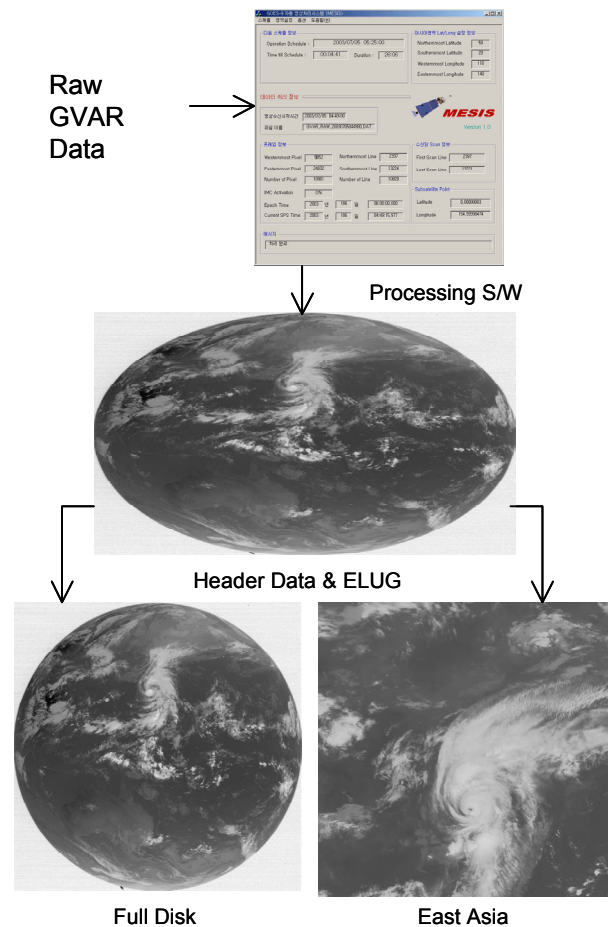


Fig. 1. MESIS S/W flow diagram

Functions of MAPPER S/W are followings:

- Image to map registration for 5-CH
- Image fusion (CH-1:R, CH-4:G, CH-5:B)
- Generation of image file for web service

To make accurate image registration, latest sub-satellite lat/lon data from GVAR block header and satellite altitude information are used.

After successful mapping activity, MESIS S/W uploads image products to web server via FTP. When TCP/IP connection is not available due to any reason, products are moved to temporary directory for later automatic upload after TCP/IP connectivity recovery.

4) Web Server

Web service S/W deals with creation, revision, deletion & maintenance of DB for GOES-9 imagery transferred from processing S/W. JSP(Java Server Page) scheme with Apache web-server and MySQL DB had been used for web service implementation. Final image file products are transferred to web server via FTP and associated attribute information are recorded in DB for dynamic service.

Web server provides enhanced animation loop function for each product with image preloading techniques and image search and view function for all historical image file by selecting date, channel number, and interested area like earth or Asia.

5) Add-On Utilities

NTP has been used to keep accurate system time for proper scheduled operation. RF signal strength is monitored during data acquisition for later trouble shooting and validation of antenna pointing via dedicated software and system daemon software has been used to check if core processing S/W works right. When processing S/W does not provide "OK", daemon invokes processing software to secure proper operations.

3. Test & Operations

Antenna system G/T was tested 5 times with sun noise source on 11 Feb. 2003 and proven to have more than 13.4dB/K, providing additional 3dB margin to what expected value for 1×10^{-6} BER in data quality.

Overall system was integrated in April 2003. During 2 weeks after normal GOES-9 GVAR service, KARI performed overall system tests in functional and performance from initial RF signal reception and final web service. After both correcting several detected bugs and adding algorithm to cope with missing scan line data from GOES-9, systems had worked nicely in unmanned operational environments during test periods.

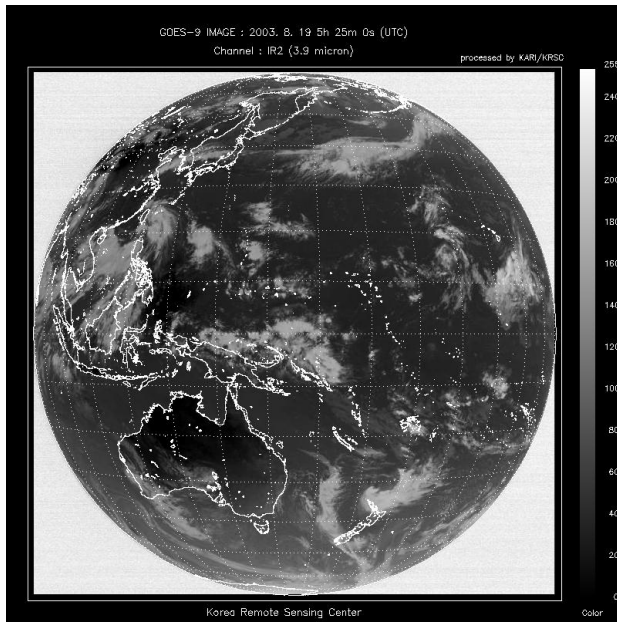


Fig. 2. 3.9micron IR image for full disk

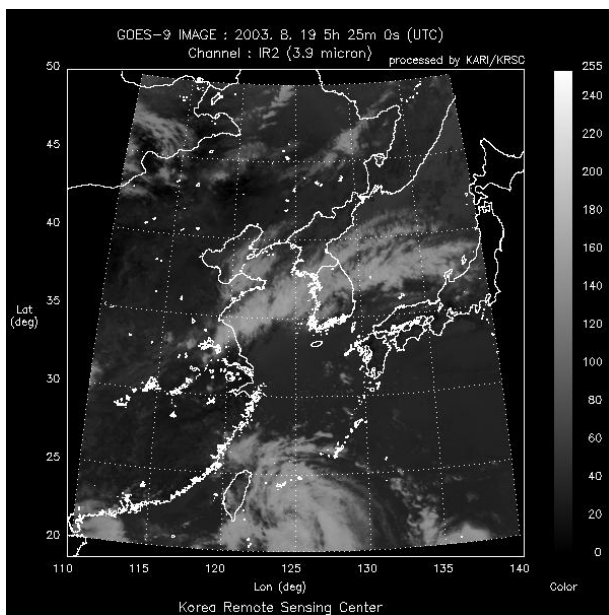


Fig. 3. 3.9micron IR image for East Asia

Our products for earth and east Asia had been compared with NASA products [4] and were revealed as defect-free.

Fig 2 and 3 shows 3.9micron IR channel data for earth full disk and east Asia, respectively. 3.9micron IR data is known as very effective for clouds detection during night time.

In addition, KARI-reformatted raw data compatibility with SeaSpace TeraScan system operated by KMA was verified by processing KARI-reformatted raw data and achieving required end-products at KMA successfully.

Automatic FTP upload system to KMA is now under operation.

After test periods, KARI decided to process at least 28 times for full disk observation a day. Compression tool was added to reduce raw data file size occupied in RAID. 0.5Tbyte of storage is used to keep minimum latest 2-month raw data in FIFO concept.

4. Conclusion

The overall description of GOES-9 GVAR receiving and processing system developed by KARI was covered in this paper. KARI implemented GVAR processing system successfully during only 8 months from decision to go to final working system covering documents review, H/W selection, procurements, installation, S/W design, coding, system integration, and final system tests.

Through fruitful developments, KARI can acquire frequently cloud information required for EOC mission operations locally and provide faultless GVAR raw data for KMA when required as national usage.

KARI believes one of most important products obtained from this project is engineering experience and experiences shall be real asset in future related project like COMS processing system as well as MTSAT-1R HiRiD/LRIT/HRIT processing system developments.

Anyone interested in GVAR image can access our web server, <http://mesis.kari.re.kr>, and enjoy.

References

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