KITSAT-3 Image Product Generation System

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Abstract

In this paper, we describe the configuration of the KITSAT-3 image data receiving, archiving, processing and distribution system in operation. Following the low-cost and software-based design concept, the whole system is composed of three PCs : two for data receiving , archiving and processing which provide a full dual-redundant configuration and one for image catalog browsing which can be accessed by public users. Except that receiving and archiving PCs have serial data ingest boards plugged in, they are configured by general peripherals. This basic and simple hardware configuration made it possible to show that a very low cost system can support a full ground operation for the utilization of high-resolution satellite image data.

1. Introduction

KITSAT-3 was launched successfully on 26 May 1999. Among several payloads on-board KITSAT-3, MEIS (Multi-spectral Earth Imaging System) is the primary payload. MEIS has linear CCD arrays of 3456 cells and it will provide three spectral channel images (green, red and near-IR) with a nominal ground resolution of 13.5m. The image will cover approximately 50km swath.

In order to receive, archive, process and distribute the KITSAT-3 MEIS image data, a chain of modules have been developed. Although some of the development strategies have been changed, the original concept has never been even doubted : modular and low-cost.

Today, many commercial companies provide the whole chain of satellite image ground station system which are huge, as automated as possible, multi-satellite image handling and therefore expensive. The small and modular ground system developed for the KITSAT-3 image reception and processing, however, can be added to the existing antenna and signal receiving system at very small expense.

This paper describes the configuration and characteristics of the KITSAT-3 image ground system as well as the procedure of image product generation.

2. System Hardware Configuration

Figure 1 shows the configuration of KITSAT-3 image data receiving and processing system. The system receives demodulated serial data stream as well as bit-synchronized clock stream from the antenna system. The system consists of only three PCs.

The two PCs (Pentium II, 250MHz, 64MB RAM) are dedicated to receiving, archiving and processing of image data. They are equipped with PCRx cards (PC Receiving Card) and CD-ROM writers. During the data receiving process, the input serial data are ingested to the PCRx

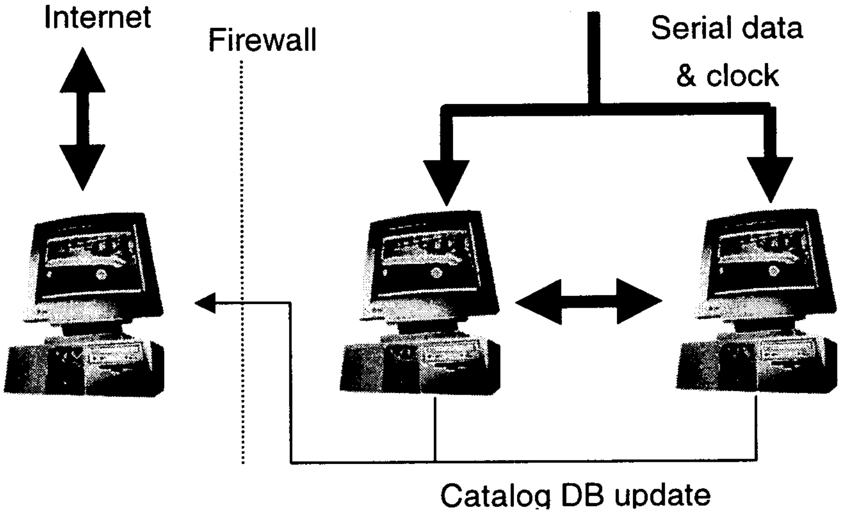

Figure 1. MEIS image data receiving and processing system configuration

card. The PCRx card which is plugged in the 16-bit ISA slot in the two PCs receives the serial image data and clock data, descrambles them, converts them to parallel data and store them into two ping-pong FIFO buffers (Kim, 1996). The data are transferred to PC memory by the high-speed DMA technique. The data receiving PC then manipulate the input data. It synchronizes the data frame, stores them to hard disk, sub-samples them and displays the image by moving window display software. The fully dual-redundant configuration can double the reliability of the system during the data receiving process.

After the data receiving process, the received image data are divided into scenes, reformatted and permanently archived to CD-ROMs. This process is called transcription. During the transcription process, some missing image data frames are recovered (Shin *et al.*, 1999a). The image catalog and browse image data are generated in this process too. Information on each generated scene such as image acquisition time, location, amount of cloud and so on is generated and stored in database. This database is copied to the third PC on a regular basis. The third PC is dedicated as a web server which can be accessed by external users. The users can, therefore, browse the MEIS image catalog and order scenes of interest. Since the data receiving and processing system is secured by using firewall, external users are not allowed to access the system directly.

When a user orders a scene, one of the two processing PCs reads the corresponding transcription data from a CD-ROM and then generates an image product of the user-specified level. The product can then be written to a another CD-ROM and then sent to the user or directly through the on-line network.

3. System Software

The system has basically three stand-alone software components

- MWD : real-time data processing and moving window display software
- KIMS3 : image catalog and product generation software
- KIDS3 : image catalog browsing software

MWD is run at the time of real-time data reception. It detects the frame synchronization words of received data (Shin *et al.*, 1999a), extracts image data, sub-samples them and display the image in waterfall manner in real-time. It also has a playback capability by reading the received and stored data and simulating the data reception operation.

KIMS3 reads the received/stored pass data and then generates catalog and browse image database as well as scene-divided transcription file. The catalog and browse image data which are generated by KIMS3 are transferred to the web server PC and can be accessed by public users by using KIDS3.

KIMS3 can also process the transcription data to multi-level image products.

- radiometrically corrected
- systematically geocoded
- precision geocoded
- ortho-rectified

The radiometric correction algorithm corrects even-odd pixel brightness difference and vignetting effects (Shin *et al.*, 1999b).

An image can be geocoded by using many different datum, Earth ellipsoidal models and map projection schemes. A robust, accurate and fully-physical camera model as well as a efficient inverse-transform resampling algorithm was developed in KIMS3 for the systematic geocoding (Shin and Lee, 1997).

The precision correction algorithm in KIMS3 projects an image to an absolute ground location by using GCPs (Ground Control Points). A fully-physical orbit-sensor-Earth model as well as Kalman filter based adjustment algorithm were adopted so that the image can be corrected accurately by using a few GCPs (Shin *et al.* 1998a). KIMS3 has several functions to obtain GCPs including digital map handling, GCP DB chip handling and external GPS measurement ingestion, so that operator's efforts for GCP extraction can be minimized (Shin *et al.*, 1998b)

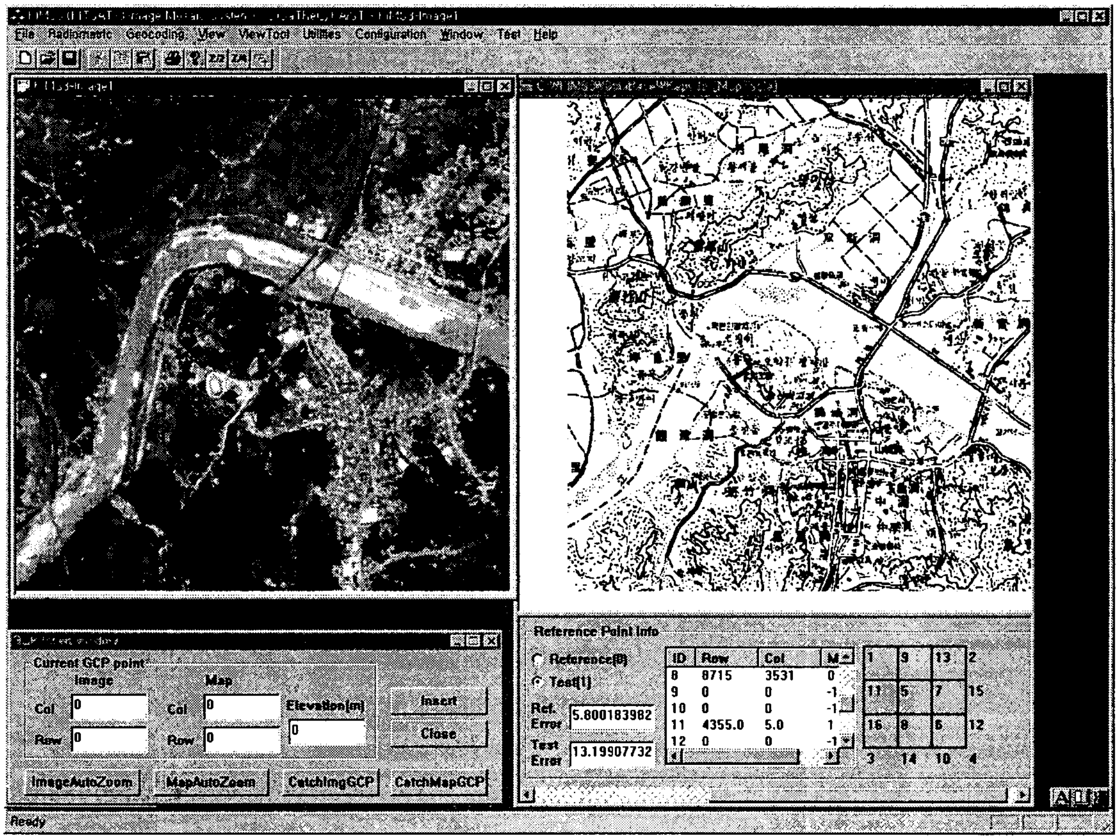

Figure 2. KIMS3 software graphic user interface

KIMS3 can also generate ortho-rectified images by using GCPs and DEM (Digital Elevation Model). Although 3 arc-sec (~70m resolution) DEM data of Korean Peninsular are used currently in operation, other DEM data with different resolution can be ingested to different DEM layers (Kwak *et al.*, 1999). The ortho-correction algorithm eliminates disparities in an image which were caused by the perspective imaging scheme of a sensor and the height of a target.

Figure 2 shows the graphic user interface of KIMS3 software. It is completely menu-driven software which provides user-friendly graphic user interface on the Windows95™ operating system. The figure shows GCP extraction procedure using a digital raster map.

The catalog and browse image data which are generated by KIMS3 are copied to the web server PC and can be accessed by public users via KIDS3 (Lee *et al.* 1998). It was developed on the basis of HTML, CGI and Java applets so that users can easily search and browse the image catalog by using general web browsers. Since MS-ACCESS™ was adopted for the database manager, virtually no additional cost for off-the-shelf software components was charged. Figure 3 shows the catalog search interface and detailed result view of KIDS3.

4. Conclusions

The developed system is fully operational at the current stage. In addition, the developed software and hardware configuration can play a very good role for prototyping a state-of-the-art satellite image ground system for supporting higher resolution, higher data rate and multi satellite image data.

References

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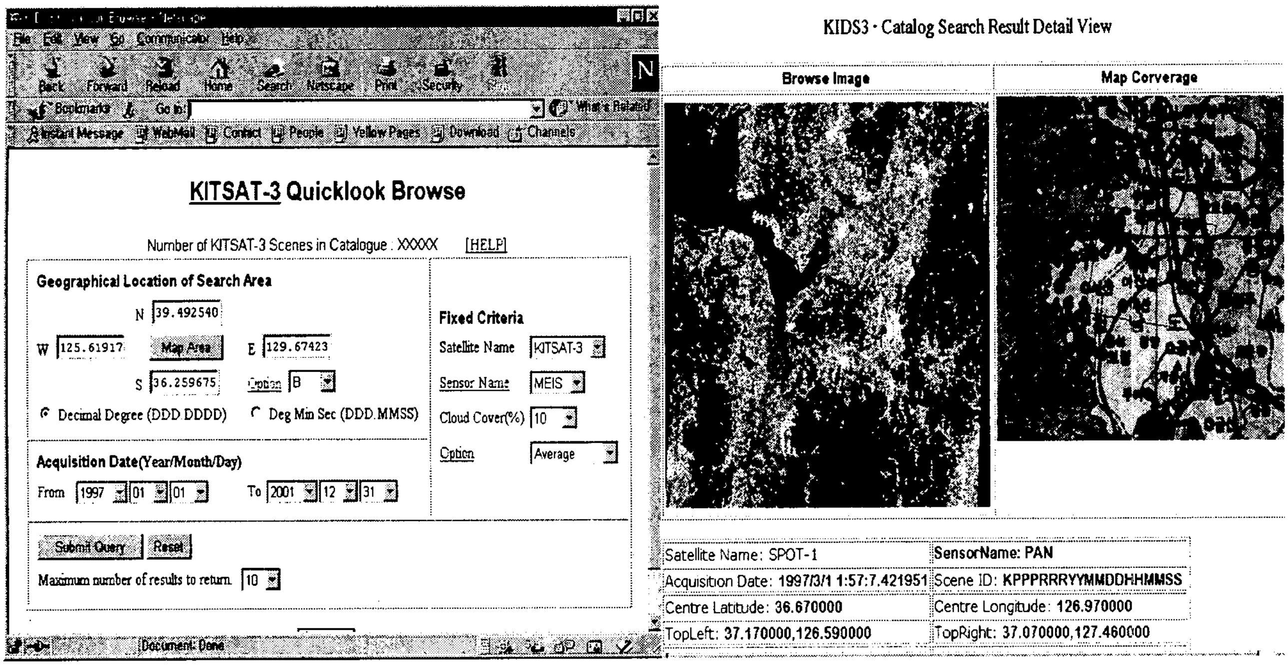

Figure 3. KIDS3 catalog search interface and detailed result view.

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