The Software Structure and Data Flow of Ecological Remote Sensing System

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Abstract – The paper reports on the software structure and data flow of ecological remote sensing system based on HJ-1 constellation, which was designed for environmental protection and disaster prevention in Oct. 2008. The software structure is devided into six layers, including hardware support layer, environment support layer, data support layer, processing layer, middle applied layer and user applied layer. The data flow runs from data manager system, after crossing client subsystem and server subsystem into data managerment system. The output products refer to NDVI, LAI, LST, TOA reflectance and so on. The products are birth from a product chain based on HPC parallel system and oracle 11g database.

Keywords: HJ-1 / software structure / data flow / remote sensing

1.   SATELLITE AND IMAGERY INTRODUCTION

1.1.   HJ-A Constellation

HJ-1, a satellite constellation for environment and disaster monitoring and forecasting, has been launched by China in September, 2008. HJ-1 consisted of 3 satellites, that is HJ-1A, HJ-1B and HJ-1C. HJ-1A and HJ-1B has been launched and runs on-orbitly 3 years, while HJ-1C was adjourn to 2012 for technical obstacle. HJ-1A and HJ-1B onboard two CCDs each other, and HIS and IRS are loaded by HJ-1A and HJ-1B respectively.

HJ-1 constellation designed parameters are presented by *Table 1*. Each CCD has a 4 bands imagery and 360km spatial width. The temporal resolution of CCD is 2 days at the combination of HJ-1A and HJ-1B, and 4 days for IRS. IRS swath width is 720km that one of five of China boundary.

Table1. HJ-1 constellation designed parameters

Satellite	Sensor	Bands(μm)	Spatial resolution(m)
HJ-1A/B	CCD	0.45~0.52,0.52~0.59,0.63~0.69,0.76~0.90	30
HJ-1A	HSI	0.45~0.95 totally 115 bands	100
HJ-1B	IRS	0.75~1.10,1.55~1.75,3.50~3.90,10.5~12.5	150(300TIR)

1.2.   Applicaton Demands

HJ-1 is the first satellite that aims to environmental and disaster application for China. Two satellite application centers were builder for the operational appliance of it. The main topics of them are imagery processing, production analysis and policy issue. The products make by HJ-1 include NDVI, land surface temperature, leaf area index, atmospheric aerosol depth, and so on. The applied department refers to national land, forester, water and sea resources. The products of aerosol depth, land surface temperature and others have been published to public every 4 days.

2.   SOFTWARE STRUCTURE

2.1.   System layers

HJ-1 ecological remote sensing system (HJES) is designed and developed aimed at the HJ-1 imagery for ecological thermatic and professional products. The applied structure of HJES is Client/Server mode that satisfys the need of multi-personnel cooperation. The systemic structure of HJES are devide into six layers by the user applied layer at the topmost, and then middle applied layer, processing layer, data support layer, environment support layer, with the hardware support layer at the bottom shown as the left part of *Figure1*. The user applied layer faces to the final operationer with computer screen, printer, and projector, and the middle applied layer managers the image processing, systemic configuration and operation help. Product retrievals such as LAI, NDVI, GPP and LST are hold in the processing layer. Auxiliary, metadata, imagery and log data are supported by the data support layer at the underpin of environment support layer. The hardware support layer consists of computer, net-ware and store-ware.
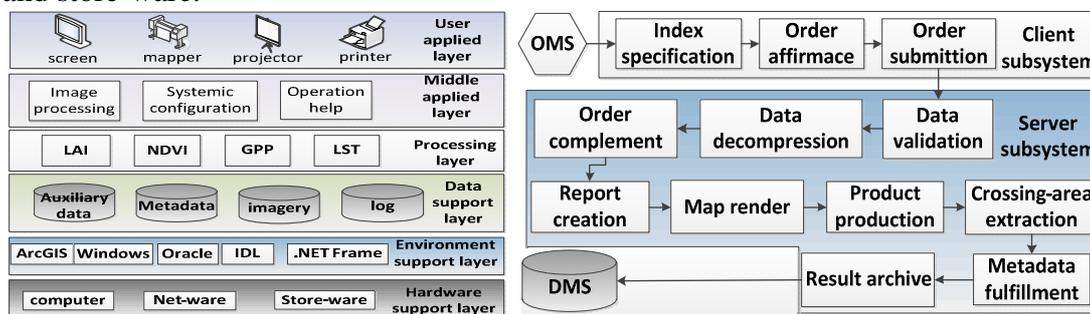

Figure.1 The systemic structure and data flow of HJES

Hardware support layer is the base support of the HJES, which has 4 computers as processing server, in which one is treated as center server (deployed as HPC header node) and the other 3 are pointed as servant servers (deployed as HPC leaves).

All data are prepared by the data support layer before the beginning of product process in one processing factory, including imagery folder, base data folder, map model folder and report model folder. All folder and files are orgernized by metadatas stored in the metadata data base.

Processing layer constructure a relation map that composing of all products, such as TOA reflectance, NDVI, LST, ET, and so on. TOA reflectance is the base input of NDVI, NDVI is the base input of LST, and LST is the base input of ET. The processing layer is concerated on the HJ-1 imagery, and each image is just processed for 1 times in the whole chains.

In the middle applied layer, users appointment are transfer into the machine dictate, and user's operation demand are configured by this layer.

User applied layer support the output of visualization by screen, mapper projector and printer. All the whole chain can be suspected in the self-mode or auto mode.

2.2.   System run environments

HJES was developed with C# language with user grapheric interface, C/S communication, and database managerment, while the algorithms of products were developed by IDL (Interactive Data Language) language for matrix operation. ArcGIS was used for the spatial analysis and cross-area extract during data preparation. Finally, Microsoft word was used to express the pictures, tables and texts for the product at different discribe angles.

Generally, the base environments of HJES are ArcGIS, Windows HPC, Oracle 11g, IDL 7.1 and et al. The hardware environments of HJES are 4 servers for HPC, 2 servers for DMS and OMS respectively, and 1 computer for client operation.

3. DATA FLOW

3.1. Full chain flow

The exterior data flow of HJES involves operational manage system(OMS) and database manage system(DMS). HJES receives order mission form the OMS and extract processing data from DMS. The interior data flow of HJES entails client-subsystem(CSS) and server-subsystem(SSS). The CSS side main works are the product index specification, order affirmance and order submittion. The SSS side excutives from order complement, data decompression and validation, crossing-area extraction, product production, map render, report creation, metadata fulfillment to result archive show as the right of *Figure 1*. Three level processing parallels, signed as task parallel, subdata parallel and algorithm parallel are taken into account for the processing acceleration in the product production subflow.

3.2 Key point

The assignment of operational manage system is the trigger of the whole chain. HJES only receives order from OMS and deconstructured the order into corresponding segments that send to center server. OMS gives the production name, selected data, executive time demands, and interesting area. After gives the conditions above, OMS send the order to HJES, and then HJES search the data according the received order. The processing status of HJES are feed back to OMS in time by TLQ mid-softwart, including current processing progress, waited product, system thread counts and so on.

The data manager system is the destination of the production. All products are archive into database by the description of metadata, which includes product format, satellite, sensor, order ID, up coordinate, left coordinate, right coordinate, down coordinate, and scanning date. The DMS store imagery in file format and keep the metedata in data talbe, while other data as rainfall, railway density and economical GDP are store by data entity.

Three level processing parallels are considered in the calculation to accerate the speed limitlation. The first level is task parallel, and subdata parallel is applied under it. At last algorithm parallel is constructure for atomic process.

4. APPLIANCE

HJES has been successfully applied to the environmental and disaster application. The production type contains two types of 42 kinds. The thermatic map type is to process the information directly from imagery noted as 3~5 level products. The industrial appliance type is to deep analysis the information from thermatic map for spetial purpose, such as thermal island, forest fire trend, disaster estimation and optimal path determination. The HJES outputs are 300Gb totally every day. The HJES also cooperated with other system that face to water environmental remote sensing (WERS) and atmospheric environmental remote sensing (AERS).

HJES is the first application system that aims to the HJ-1 constellation service to China public. The system service level is determined by the share ability of the HJ-1 imagery base infrastructure and public policy. HJ-1 imagery and its products are all free all over the word for scientific research and public use.

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