

Software Development of EWO-WFC/OFA aboard BepiColombo MMO spacecraft

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Abstract

On the mission of BepiColombo Mercury Magnetospheric Orbiter (MMO), we aim to investigate the properties of electromagnetic field and plasma wave phenomena at Mercury's magnetosphere and the interplanetary region around Mercury. For the subject we are developing software of EWO-OFA/WFC that is a component of PWI. The developing environment is placed at a laboratory of Kanazawa University, and the software is under developing. In our presentation, we will report the detail of the software and the status of development.

1. Introduction

On the mission of BepiColombo Mercury Magnetospheric Orbiter (MMO), we aim to investigate the properties of electromagnetic field and plasma wave phenomena at Mercury's magnetosphere and the interplanetary region around Mercury. For the subject we are developing Plasma Wave Instrument (PWI) aboard MMO^[1]. EWO is one of components of PWI. It includes Electric Field Detector (EFD), Waveform Capture (WFC) and Onboard Frequency Analyzer (OFA). PWI has two dimensional electric field sensors and three dimensional magnetic field sensors. The measured fields detected by the sensors are converted to digital data by each receiver instrument and processed by Mission Data Processor (MDP). The transmission rate from the receivers to MDP is up to a few Mbps, however, the bandwidth of telemetry communication from MMO to the earth is up to several ten kbps. To achieve an efficient observation, highly optimized data processing is required, and it largely due to the performance of MDP software.

In this paper, we describe about overview of MDP software for EWO-WFC/OFA and show the current status of the development.

2. The data to be processed on MDP

MMO has two pairs of electric field sensor and tri-axis magnetic sensors for electromagnetic field measurement (Fig. 1). The electric sensors are called Wire-Probe Antenna (WPT) and Mercury Electric Field In-Situ Tool (MEFISTO). They are placed perpendicularly at the spin plane of MMO. The magnetic sensors are constructed with Low Frequency Search Coil (LF-SC) and Double Band Search Coil (DB-SC). LF-SC has two coils placed perpendicularly at the spin plain and DB-SC is placed in vertical direction of the spin plane. These five sensors are connected to EWO receiver instruments and the other component of PWI. EWO instrument convert the signals from the sensors to digital data, and send it to MDP via Space Wire (SpW). The transmitted data is stored into the memory buffer of MDP and inspected by the software running on MDP to produce the data written onto the telemetry stream sent to the earth (Fig. 2).

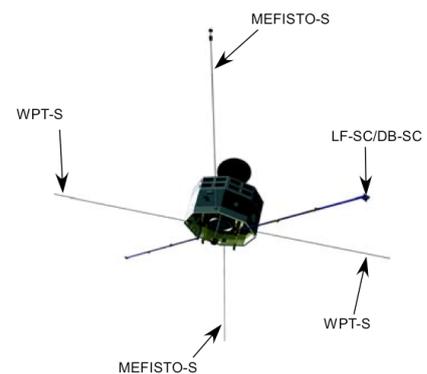


Fig. 1 The sensors aboard MMO for electromagnetic field measurement

2. The data to be produced by MDP

The EWO-WFC/OFA data produced by MDP is basically classified to under three types, L-mode, M-mode and H-mode.

- L-mode data:
It is continuously generated, and all data is transmitted to the earth. It is used to investigate the rough profile of observation result.
- M-mode data:
It is continuously generated and stored into the data recorder of MMO. It is selectively transmitted to the earth according to the request from researchers. It has more detail resolution than L-mode data, however, it is not possible to send all data to the earth because of their large size.
- H-mode data:
It is eventually generated and stored into the data recorder of MMO and selectively transmitted. It is most detail data, but its size is largest.

The primary content of the L-mode and M-mode data is spectrum. It is generated from the waveform data measured by the sensors using FFT on MDP. The time and frequency resolution can be selectively changed. And a small amount of other data useful for researchers is also included. The H-mode data is waveform. It is most useful to detail investigation, however, the observation period is quite short.

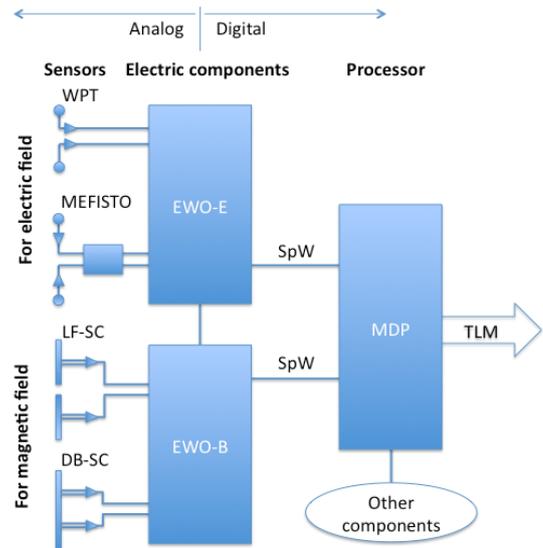


Fig. 2 Over view of EWO block diagram

3. Software development

The main component of MDP is Data Processing Unit which is a microprocessor based on MIPS architecture with TRON operating system. The environment of EWO-WFC/OFA software is show in Fig. 3. The hardware of MDP is controlled from PC by using ICE. DMC emulator holds the operation of command sending and data receiving. The software is developed on PC that is connected to ICE and DMC emulator. The data produced by MDP is stored on the storage on PC.

The MDP software has five layers. The APP01 layer that is given the highest priority processes the commands sent to MDP. The second layer (APP02) produces House Keeping data (HK) that informs us the status of MDP and its components. The third layer (APP03) makes L-mode and M-mode data of nominal observation data, and the forth layer (APP4) also makes data of eventual observation that includes H-mode. The last layer (APP05) is for background processes that take very long time.

The software under developing and the related documents are managed by a repository system. The developing environment is placed at a laboratory of Kanazawa University, and it can be operated from out side of campus.

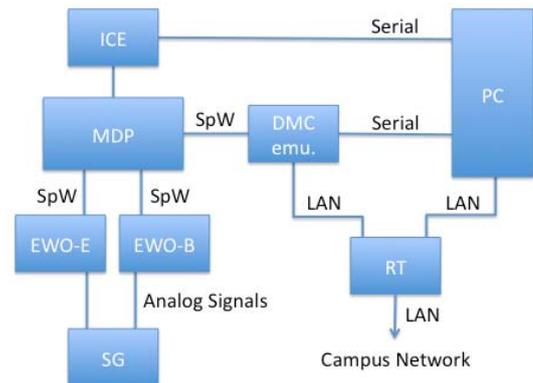


Fig. 3 The environment of EWO-WFC/OFA software development.

4. Conclusion

The software of EWO-WFC/OFA is under developing. We will report the detail of the software and the status of development in our presentation.

5. References

1. Y. Kasaba, et. Al., "The Plasma Wave Investigation (PWI) onboard the BepiColombo / MMO: First measurement of electric fields, electromagnetic waves, and radio waves around Mercury", *Planet. Space Sci.*, 58, 238-278, 2010.