ERG搭載プラズマ波動観測器PWEにおける受信器特性の機上較正手法の実装

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Development of the Onboard Calibration System for ERG/PWE

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The Plasma Wave Experiment (PWE) is one of the science instruments on board the ERG (Exploration of energization and Radiation in Geospace) satellite to measure electric field and magnetic field in the inner magnetosphere. The sensor part of the PWE consists of a pair of dipole wire-probe antenna (WPT) and tri-axis magnetic search coils (MSC). The receiver part of the PWE consists of three sub-components, EFD (Electric Field Detector), OFA/WFC (Onboard Frequency Analyzer and Wave Form Capture), and HFA (High Frequency Analyzer). Especially, OFA/WFC measures electric and magnetic field spectrum and waveform from a few Hz to 20 kHz. Observed signals are amplified and filtered inside the analogue circuits. Finally, the signals are digitized by the A/D converters.

It is well known that the characteristics of the sensors in space change depending on the plasma parameters (e.g. plasma density, temperature, etc). In order to measure the nature of natural plasma waves, 'calibration procedure' is necessary. In this study, we developed the onboard calibration system for the middle frequency range receiver (OFA/WFC) and implemented as a part of the onboard software of the PWE. The calibration signal generator is contained in the analogue circuit of the PWE. An arbitrary frequency square wave is fed into the receiver or preamplifier by commands. The onboard calibration system controls calibration signal frequency and ON/OFF of the output. The system performs a fast Fourier transform (FFT) on the signal output from the A/D converters, and collects frequency responses of the fundamental and that of odd-numbered harmonics below 32.768 kHz. The transfer function can be derived on the ground by dividing observed responses into the reference square signal in the frequency domain. We successfully derived gain and phase specification of the onboard sensors and receivers (analogue circuit of the PWE) by using arbitrary frequency square waves generated in the receiver. Our software based calibration technic will be useful for future missions.