Development of a miniaturized 3-axis search coil magnetometer and a wave receiver powered by a noise reduction technique for micro-satellite experiments

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Multipoint plasma wave observations (several Hz to 100 kHz) are important to identify the spatio-temporal dynamics of plasma waves. However, the spatial resolution of the multiple-satellite observations is not enough for probing the plasma waves. It is required to reduce the resources for launching a lot of satellites with low costs. We propose a miniaturized 3-axis search coil magnetometer and a wave receiver powered by a noise reduction technique for micro-satellite experiments.
The length of 1-axis search coil is 6 cm to be installed inside a 1U cube-satellite (10 cubic centimeters). The sensor has the magnetic sensitivity of 45 fT/sqrt(Hz) at 4.2 kHz and the power consumption is approximately 30 mW. The radiation tolerance is 400 krad and the operation temperature range is -20 to 60 degrees Celsius. The sensor can operate in the harsh space environment.
We concerned the effect of noise generated from a satellite body. In the case of conventional plasma wave measurements, a search coil is installed at a tip of a mast to prevent the noise from a satellite body. In this study, the sensor is installed inside a satellite body to remove the mast. We developed a digital module of FPGA for the noise reduction technique. The technique is based on the Spectral Subtraction (SS) method in the audio signal processing. The SS method estimates noise spectra from observation data and reduces the estimated noise from the data. We evaluated the noise reduction performance using the test data. From the evaluation results, the stationary noises (less than 2 kHz) decreased by approximately 20 dB. The noise reduction technique is effective for satellite experiments without the mast.
In this presentation, we will present the miniaturized 3-axis search coil magnetometer and the wave receiver powered by the noise reduction technique for micro-satellite experiments in detail.

Keywords: Search coil magnetometer, Micro-satellite experiment, Noise reduction technique

