[EE] Evening Poster | P (Space and Planetary Sciences) | P-CG Complex & General

[P-CG21]Future missions and instrumentation for space and planetary science

convener:Shingo Kameda(School of Science, Rikkyo University), Satoshi Kasahara(The university of Tokyo), Mitsunori Ozaki(金沢大学理工研究域電子情報学系, 共同), Kazuo Yoshioka(Graduate School of frontier Science, The University of Tokyo)

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Not only national space agencies but some universities and even companies in the world are now leading a number of space science and exploration missions and also energetically initiating new research activities for satellite and rocket developments and international collaborations in these days because the Earth observations from the space and the space explorations could be achieved much easier than a few decades ago. The deployment to the space, which itself is not purely a scientific purpose but one of methods for better sciences, is vigorously motivating the technical innovation and the educational development. For successful space missions, it is also crucial to research and develop aim-oriented on-board instruments, and the fundamental research and development of observational instrumentation with future perspectives could totally lead space missions in some case. Detailed investigation and evaluation on various on-board instruments are needed during their proposals, selections, and fabrications in order to promote the missions, and inevitably we have to make multi-sided arrangements and evolution at every process and aspect of any type of space missions, independently of their mission sizes. In this session, we focus on these comprehensive research activities in the space missions, including the mission integrations and the individual instrumental developments, and we also call many presentations showing the uniqueness and renovation regarding the mission strategy and methodology, and the status and latest results in the related state-of-the-art researches and developments, which would provide all of researchers and developers with invaluable opportunities for active discussion, information sharing, and collaboration toward the realization of more missions for more fruitful space sciences and explorations in nearer future.

[PCG21-P04]Small Plasma Waveform Capture Receiver on the analog-digital mixed chip

*Shunsuke Kamata[1], Hirotsugu Kojima[2], Takahiro Zushi[1], Yoshiya Kasahara[3], Tsubasa Takahashi[4], Takuya Hamano[4], Satoshi Yagitani[5], Mitsunori Ozaki[6], Yuya Tokunaga[4], Hiroshi Yamakawa[2] (1.Graduate School of Engineering, Kyoto University, 2.Research Institute for Sustainable Humanosphere, Kyoto University, 3.Information Media Center, Kanazawa University, 4.Graduate school, Kanazawa University, 5.Institute of Science and Engineering, Kanazawa University, 6.Faculty of Electrical and Computer Engineering, Institute of Science and Engineering, Kanazawa University)

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Space is filled with subtle plasma, so-called space plasma. Since space plasma is basically collisionless, plasma particles exchange their own kinetic energies and moments through plasma waves. Observing plasma waves allows us to understand physical processes occurring in the space plasma. However, the size of a plasma wave receiver on board satellites tends to be large to meet science requirements.
In order to reduce the required resource for plasma wave receivers, our research group has been attempting to miniaturize plasma wave receivers using ASIC (Application Specific Integrated Circuit) technology.
In the present paper, we focus on the development of a small waveform capture receiver based on an analog-digital mixed chip. The waveform capture receiver is a receiver to acquire waveform data of plasma waves sampled directly. The amount of original waveform data is large, so it is difficult to send them to a ground

station without data compression. The onboard data compression is realized by a digital part of a plasma wave receiver. On the part of the digital processing, we succeeded in implementing the data compression logic on the FPGA in Kanazawa University. By using the logic in the FPGA, our research introduces the data compression logic onto an analog-digital hybrid chip. The target of our research is to achieve the ultimate miniaturization by putting both analog part and digital part which are in the waveform capture type receiver into one chip. In this presentation, the digital filters used in the waveform compression are implemented on the ASIC chip and its operation verification was carried out.
On the other hand, we added the additional function to the analog part of the waveform receiver chip. In addition to the dipole measurement taking the differential of the dipole antenna, there is an interferometry mode in which the two antennas of the dipole antenna are monopole antennas. By using the interferometry mode, we can identify the phase velocity of the plasma wave, which is a necessary observation item in next scientific satellite missions. However, since the differential is not taken in the interferometry mode, it is weak against external noise. Also, crosstalk between different channels should be examined. The chip which was made this time has two circuits, a circuit which performs dipole measurement and monopole measurement at the same time, and a circuit which switches between dipole measurement and monopole measurement. We show the performance in each circuit on the chip and results of immunities against external noises. We also check the linearity of the switch that alternatives the circuits for the dipole mode and monopole mode.
In this presentation, we present the details of the design of the circuit mounted on the chip made this time and its operation verification result. Moreover, we explain the results of its operation verification, and guidelines for further development as a more advanced waveform capture receiver in the future.