

R005-16

Zoom meeting C : 11/1 PM1 (13:45-15:30)  
14:45-15:00

## Development of new receivers for HF Doppler sounding utilized by Software-Defined Radio device

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HF Doppler sounding system has been utilized to examine the behaviors of the ionosphere. To maintain and develop the system of this sounding system, the knowledge of the analog circuit's hardware is necessary. Recently, on the other hand, the Software-Defined Radio (SDR) techniques, which can implement various wireless communication methods using software instead of traditional hardware, has been developed. We can easily establish the equipment for HF Doppler sounding system by utilizing the SDR devices without the knowledge of the analog circuits. In this study, therefore, new receivers of the HFD sounding system were developed using SDR devices (USRP N210). The operation of USRP can be performed by the free software, GNU Radio. The former receivers can observe radio waves at four different frequencies (5006 kHz, 6055 kHz, 8006 kHz, and 9595 kHz) with 100 Hz sampling. The new receivers were constructed with comparable specifications. Since the transmission of 9595 kHz has stopped, the new receivers receive 3.925 MHz instead. In the new system, the signal flows into four filters from the source (the signal from the antenna), and each signal decimated to a 100 sampling/sec rate. By simultaneous observations of the previous analog receiver and the new digital receiver, the performance of the new digital receiver was confirmed. It was found that the SN ratio of new digital receivers is much better (about 20dB) than the former analog receivers. I/Q detection and sharp edge filter brought SDR receivers improved characteristics on interference. We also checked the frequency accuracy of the observations by examining the Doppler frequency offsets of the SDR radio reception. In most SDR, the offsets of the Doppler frequency are within about 0.01 Hz. By using the rather low-spec PC for data acquisition, on the other hand, the offset becomes worse (about 0.09 Hz). Therefore, the spec of PC for data acquisition must be high enough to receive the four radio waves.

As the future of the HFD observation system, we are now planning to replace the analog receivers to the new digital receivers, and install the receivers at Sarobetsu and Kyushu area. In addition to the improvement of the transmission system, we also plan the ranging of the reflection heights by the new system.