

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

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To examine the dynamics of the ionosphere, the observation of both steady and disturbed states of the ionosphere is important. Various observation systems have been utilized to observe the behaviors of the ionosphere itself and the ionospheric disturbances. One of the useful observation systems is HF Doppler sounding. When the reflection point of the radio wave moves vertically, the frequency of the radio wave shifts due to the Doppler effect. From this Doppler frequency, we are able to estimate the vertical motions of the ionospheric plasma. To develop and maintain the transmitter and the receiver of Doppler sounding system, the knowledge of the analog circuit has been inevitable. Recently, on the other hand, Software-Defined Radio (SDR) device, which equips digital electronics for signal processing, is developed and make it possible to develop the equipments for HF Doppler sounding system easily by utilizing the software processing. This means that the receivers for HF Doppler sounding system are developed without the knowledge of the analog circuits. Therefore, we have developed the new HF receiver using SDR device instead of the traditional receiver. In this study, we adopted USRP N210 as a new SDR device. In HFD sounding system, the transmitter for 5.006 MHz and 8.006 MHz is located at Chofu Campus of the University of Electro-Communications and that for 6.055 MHz and 9.595 MHz (now off the air) is Radio NIKKEI transmitter located at Nagara. The previous receiver can observe radio waves at four different frequencies with 100 Hz sampling. New SDR receiver is also enable to observe the four different radio waves with 160 Hz sampling. Test observation of the new SDR receiver were performed in Awaji with the previous receiver. We compared the observational results of Doppler frequencies between both receivers.

The Doppler frequencies of the sky wave observed by SDR receiver and the previous analog receiver are coincided each other. Therefore, it is found that the new receiver can be utilized for the actual observation. New SDR receivers will be installed at Onna, Sarobetsu, and existing stations.

Keywords: HF Doppler sounding, Receiver Development, Software Defined Radio, USRP