

Development of SDR-based scintillation detector system and observation with magnetometer and radar

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The upper part of Earth's atmosphere is ionized by solar ultraviolet and X-ray radiation. This region is called the ionosphere. It is located from about 60km to 1000km altitude and separated to some regions according to their characteristics. The ionosphere plays an important role for radio wave propagations. These propagations are dependent on the condition of the ionosphere because the ionosphere changes these conditions temporally and spatially by background fluctuations. Some disturbances are regular and repeated, such as daily, seasonal, and solar activity. In addition, some disturbances are irregular, such as sporadic E layer, and plasma bubbles. These disturbances cause the ionospheric scintillation, rapid intensity and phase changes of radio waves which pass through the ionosphere. Therefore, the observation of ionospheric scintillation is equivalent to observing the state of the ionosphere.

We developed the SDR (Software-Defined Radio) -based scintillation detector system for understanding the dynamics of ionosphere. We use the USRP N210 with WBX daughter board from Ettus research as the front end, and signal processing software based on some open source products. This system uses two GPS antennas, one is large antenna with multipath-mitigation and 30db gain, and the other is small antenna for GPS Disciplined Oscillator. For performance evaluation, we installed this system on the roof of the building. The data observed by our system have good correlation with others from a nearby GPS reference points. For the initial observation, we will install it at Sasaguri, Fukuoka, Japan (33.64N, 130.51E, in Geographic Coordinate). We operate magnetometers and a FM-CW radar at the station. Thus, our new device can observe GPS scintillation simultaneously with magnetic field variation recorded by magnetometer and ionosphere plasma density profile detected by FM-CW radar, which helps our understanding about magnetosphere and ionosphere coupling. In this paper, we will present the initial results of these observation.