

GNU RADIO BEACON RECEIVER SYSTEM AND APPLICATION

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Abstract.

A digital receiver named "GNU Radio Beacon Receiver" (GRBR) was developed for the satellite-ground beacon experiment to measure the ionospheric total electron content (TEC). The open-source software toolkit for the software defined radio, GNU Radio, is utilized to realize the basic function of the receiver, and perform fast signal processing. The software is written in Python for a LINUX PC. The open-source hardware called Universal Software Radio Peripheral (USRP), which best matches the GNU Radio, is used as a frontend to acquire the satellite beacon signals of 150 and 400 MHz. Advantages of the GRBR system are as follows.

1. Flexibility: The system is tunable at ± 400 ppm range. Simultaneous multi-channel observation is realized. Modification of the system is easy.
2. Accuracy: TEC with GRBR shows very good agreement to that from co-located analog beacon receivers.
3. Open system: Detailed design information and software codes are open to public at the URL <http://www.rish.kyoto-u.ac.jp/digitalbeacon/>.

GRBR is now successfully utilized for studies of the ionosphere. From tomography analysis based on three-station network in Japan, we found detailed behaviors of Mid-latitude Summer Nighttime Anomaly (MSNA), which is the nighttime enhancement of plasma density in the selected areas of the midlatitude. We now pursue studies of day-to-day variability of the equatorial Spread-F from the low-latitude network of GRBR and other instruments (we have a related presentation in this symposium). In this topic, observations of Large-Scale Wave Structure (LSWS) and hemispheric symmetry of the plasma density are the main contribution from the GRBR network. As an extension of the system, we recently added scintillation- measurement capability. We are now developing "Non-schedule" observation mode, too. In presentation, we show system description and applications of GRBR, a new and useful tool for the beacon experiment.