

New digital beacon receiver for the study of ionosphere with satellites TBEx, FORMOSAT-7/COSMIC, and PROPCUBE

**Mamoru Yamamoto*¹, Keiichi Iwata¹, Mayumi Matsunaga²,
Tung-Yuan Hsiao³, Roland Tsunoda⁴, Richard Doe⁴, and Paul A. Bernhardt⁵**

¹ Research Institute for Sustainable Humanosphere, Kyoto University, Uji, JAPAN
(E-mail: yamamoto@rish.kyoto-u.ac.jp)

² Graduate School of Science and Engineering, Ehime University, Matsuyama, JAPAN

³ Hsing Wu University, New Taipei, TAIWAN

⁴ Sri International, Menlo Park, USA

⁵ Plasma Physics Division, Naval Research Laboratory, Washington DC, USA

ABSTRACT

We have successfully conducted observations of total-electron content (TEC) of the ionosphere using a satellite-to-ground beacon experiment. A unique dual-band (150/400MHz) digital receiver GRBR (GNU Radio Beacon Receiver) was developed for this purpose, which is based on the recent digital-signal processing technologies. The block diagram is shown in Figure 1 [1]. The GRBR network was deployed into the southeast Asian and Pacific regions. By using beacon signals from the low-inclination satellite C/NOFS, we studied longitudinal “large-scale wave structures (LSWS)” in detail as a possible source of equatorial Spread-F (ESF) events. Now there are several new plans with dual- or tri-band beacon transmitters. One is TBEx (Tandem Beacon Explorer), a project by SRI International, to fly a constellation of two 3U cubesats with tri-band (150 MHz/400 MHz/1067 MHz) beacon transmitters. One more is a constellation of FORMOSAT-7/COSMIC-2 satellites, also with tri-band (400 MHz/965 MHz/2200 MHz) beacon transmitters. TBEx and FORMOSAT-7/COSMIC-2 will be launched at the same time in late 2016. Naval Research Laboratory has another project of three units of 1U cubesat named PROPCUBE which has different dual-band (380 MHz/2380 MHz) beacon transmitters. It is noted that 2 units of PROPCUBE are already in orbit, and the last one will be launched will be launched in 2016. These new satellites will provide great opportunities to enhance studies of the ionosphere. Kyoto University, Ehime University and Hsing Wu University are now developing the new GRBR system that is expected to be used for these satellites. Our developments are a unique multi-band panel antenna for TBEx and FORMOSAT-7/COSMIC-2 observations, and multi-channel GNU Radio based receiver. Several software-defined radio boards shown in Figure 2 are now tested. We will soon try test observations of the PROPCUBE beacon. In the presentation we show design of the new GRBR and its current status.

Key words: Satellite-ground beacon, Ionospheric TEC, COSMIC-2, cubesat, GRBR

Reference:

[1] Yamamoto, M. (2008) Digital beacon receiver for ionospheric TEC measurement developed with GNU Radio, *Earth Planets Space*, **60**, e21-e24, doi:10.1186/BF03353137.

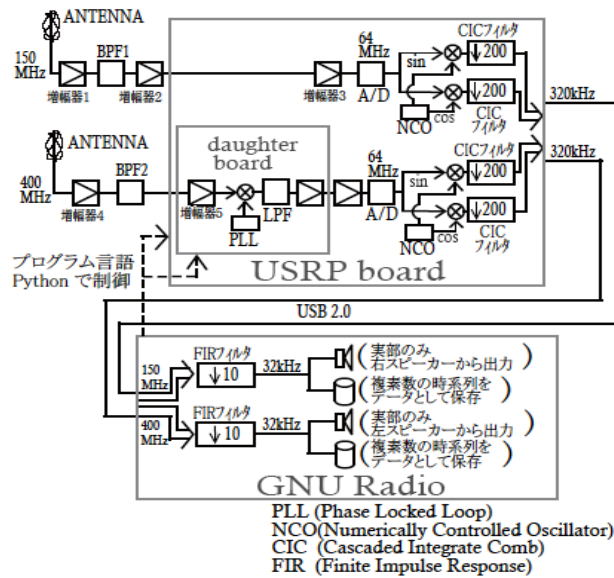


Figure 1: Block diagram of the GNU Radio Beacon Receiver (GRBR) [1].



Figure 2: Software-defined radio device which we now test for new beacon receiver.