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Development of compact GNSS scintillation system based-on SDR technology and packaged S4 index visualization tool

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Characteristics of radio propagation related to the ionosphere are used in fields such as positioning and communications. Disturbances in the ionospheric environment cause changes in the amplitude and strength of signals passing through the ionosphere, which have various adverse effects on our society. Continuous monitoring of the ionospheric environment is important to predict these effects. The objective of this study is to develop a scintillation sensor using GNSS signals as an ionospheric monitoring system. The proposed system requires to be based-on the software defined radio technology device as a signal processing unit (it will be combined with the existing FMCW radar in near future) and to reduce the cost of equipment and transportation for multipoint observations.

In this study, the proposed system consists of a GNSS scintillation unit based-on the software defined radio technology, and a scintillation index calculation unit based-on a Raspberry Pi and Python . The GNSS scintillation unit obtains the GNSS signal strength values from the navigation data (ephemeris) received in the process of coordinate positioning and flows them to the following S4 index (signal strength scintillation index) calculation processor. The scintillation index calculation unit provides S4 index and produce several summary statistical variables and quick look figures for visualizing the GNSS scintillation variation.

We will present that continuous operation test resulted in the successful S4 index observation with our proposed system. The observation time resolution of the present system is 30 seconds. We will also report a new improved system with a higher time-resolution (20 Hz) than the current measurement model and a proposed visualization tool (application) for the GNSS signal intensity and S4 index.