

## **GNSS REFLECTOMETRY IN ENGINEERING AND ENVIRONMENTAL APPLICATIONS**

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GNSS-R (Global Navigation Satellite System Reflectometry) or GNSS-IR is a technique based on reflections from the Earth's navigation signals, which allows us to monitor various environmental factors. It has been effectively utilized for monitoring snow surface conditions, measuring water levels, assessing terrestrial water storage, gauging soil moisture content, and others. This technology has the potential to significantly enhance our ability to understand and manage our natural resources.

Based on the SNR (Signal-to-Noise-Ratio) is a parameter measured by a geodetic receiver. SNR is a ratio between signal strength and its noise. A simple geometric transformation allows us to determine the antenna's height and based on that ice depth or water level could be measured. Also based on SNR quality, soil moisture might be determined. SNR data could be expressed as in Equation 1 for a single satellite and a receiver.

$$SNR = A \sin\left(\frac{4\pi H_r}{\lambda} \sin(e) + \phi\right) \quad (1)$$

A is the amplitude;  $H_r$  is the vertical distance between the GNSS antenna phase center and the horizontal reflecting surface;  $\lambda$  is the GNSS wavelength;  $e$  is the satellite elevation angle;  $\phi$  is the phase constant. This presentation shows the results of selected applications of reflectometry using observations from permanent GNSS stations.

This research based on 1 s and 30 s RINEX observation files from the EPN (European Permanent Network) or IGS (International GNSS Service) network of permanent stations will be presented as results.

The results showed the diverse applications of GNSS reflectometry in engineering and environmental research applications. The spectrum of the applications is very wide and contains, e.g. soil moisture, water level, or snow cover applications.