Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM36-02 Room:312 Time:April 28 09:15-09:30

R&D of passive radar -Water vapor estimation with digital terrestrial broadcasting wave-

KAWAMURA, Seiji[1*] ; OHTA, Hiroki[1] ; HANADO, Hiroshi[1]

[1]National Institute of Information and Communications Technology

In general, radars retrieve some information by transmitting radio waves and by receiving their scatted echoes. On the other hand, passive radars never transmit radio waves. They retrieve some information by receiving radio waves which are transmitted by others for other purposes. Passive radars do not need new radio wave frequencies, and just consist of rather simple and low cost receivers because they do not transmit radio waves. We, National Institute of Information and Communications Technology (NICT), are developing passive radar measurement systems whose targets are environmental monitoring.

In this study, we are developing a water vapor measurement system using digital terrestrial broadcasting wave as one of passive radars. Localized heavy rain in the urban area is a social issue in these days. Water vapor is an essential parameter for weather forecast because it is a state before rain drop. And it is one of the most difficult physical quantity to measure with remote sensing technique. If we can monitor water vapor around the ground surface with precise time and spacial resolutions, the weather forecast might be able to predict the localized heavy rain.

Radio waves are delayed due to water vapor through propagation. If we can measure this time delay, water vapor can be retrieved from it. Since delay doe to water vapor is quite small, very precise (sub-nano second order) measurements are needed. Radio waves used for digital terrestrial broadcasting are modulated with OFDM, and known signals are embedded. Complex delay profiles are calculated using these known signals. Using the phase of delay profile, we can measure propagation delay with precise accuracy (pico-second order).

When we consider the accuracy with order of sub-nano seconds, phase fluctuations of local oscillators at radio tower and receivers are essential error factors. We have developed a real-time delay (phase of delay profiles) measurement system with software-defined radio technique. Using this system, we can also measure phase fluctuations of local oscillator at each TV station by just receiving radio waves. With these systems at two receiving points on the same line including the radio tower, and with synchronization between their local oscillators, we can measure water vapor between two receiving points. After proving test of estimation of water vapor, we will distribute many small receivers and develop water vapor monitoring system in collaboration with many observations and data assimilations.

Keywords: passive radar, digital terrestrial broadcasting wave, water vapor, propagation delay