THE RADIO-HOLOGRAPHY APPROACH IN GNSS OCCULTATION DATA ANALYSIS: REVIEW AND APPLICATION TO RESOLVING FINE STRUCTURES IN THE ATMOSPHERE AND IONOSPHERE

A. G. Pavelyev*(1), Y. A. Liou (2), K. Igarashi (3), J. Wickert (4), K. Hocke (3), and C. Y. Huang (2)

(1) IRE RAS, Moscow, Russia
(2) CSRSR, Chung-Li 320, Taiwan
(3) CRL, Tokyo 184-8795, Japan
(4) GFZ Potsdam, Germany

GNSS radio navigational signals are highly- coherent and highly- precise, and thus sufficient for use in radio holographic remote sensing of the atmosphere, ionosphere, and the Earth' s surface from space. Review of different radio holographic methods demonstrates necessity to obtain generalized three dimensional form for radio holographic equations. In principle, 3-D radio holographic remote sensing is possible using radio holographic vector equations to retrieve the radio field within the atmosphere from a radio field known at some interface outside the atmosphere. As follows from these equations a reference signal is needed to obtain the field distribution from radio hologram. Reference signal is coincided with the Green function of back-propagated field and can be found by solution of wave equation for inhomogeneous medium. The 3-D form of the radio holographic method accounts for the polarization of electromagnetic waves and can be used to elaborate a new direction of investigation: polarization radio holography for recovering polarization-sensitive objects in the atmosphere, ionosphere, and on the Earth' s surface. A simplified 2-D form of the radio holographic method developed under an assumption of local spherical symmetry can be used to obtain vertical profiles of temperature, pressure, refractivity and humidity in the atmosphere, and ionosphere as well as 2-D radio images of the atmosphere and terrestrial surface with vertical resolution about 50 - 70 m. To achieve this, radio holograms recorded by a GPS receiver onboard a low Earth-orbit (LEO) satellite at two GPS frequencies can be used and focused synthetic aperture principle applied. Results regarding the detailed retrieval of the vertical gradient of refractivity in the atmosphere and electron density in the ionosphere from GPS/MET radio occultation (RO) data are presented. These results demonstrate applicability of GNSS radio holography to detailed global study of natural processes in the atmosphere and ionosphere.