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Perspectives of the bistatic radar and occultation studying of the Venus atmosphere and surface

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Studying the physical properties of Venus surface and subsurface structures is an important direction in the space research. The first aim of this contribution is to present some results of reanalysis of the bistatic radar and occultation experiments provided using Venera-9, 10 and 15, 16 satellites. Comparison is made with Magellan and Venus Express bistatic radar missions. Bistatic radio images of the Venus surface is compared with monostatic radio images obtained by the Soviet and USA orbiters. The second aim consists in introducing new methods for investigation of the layered structure of the Venus atmosphere and measuring parameters of Venus surface and subsurface structures using the bistatic radar technology.

The first bistatic radar measurements with spatial resolution $\sim$ 10-20 km have been carried out during autumn of 1975 year in the five Venus equatorial regions using the Venera-9 and 10 satellites. Small roughness and, in general, plain character of relief in the investigated regions have been revealed. In 1983, the satellites Venera 15 and 16 have carried out new bistatic radar experiments with spatial resolution in the interval 5 - 10 km. New information on the large-scale topography and roughness of small-scale relief has been obtained in Northern polar areas of the planet. Some features have been detected. 1. The significant variations of the reflectivity $\sim$ 2-4 times were found in the first region. The second area of reflectivity magnitude was far below (by three - four times) the previously measured values in the equatorial regions of Venus. These significant reflectivity variations may be related to changes in the conductivity of the ground. 2. Extremely small values roughness with rms of slopes $\sim$ 0.20 were recorded in the northern area. 3. Both the bending angle and the reflection coefficient were determined in the experiment from the measured frequency difference between the direct and the reflected signals as a function of time, using the orbital data.

New methods developed by analysis of the experimental data obtained using high-stability radio fields of the Earth's navigational satellites are introduced. For investigations of the layered structures of the Venus atmosphere a new eikonal acceleration/intensity technique is proposed. This technique allows: (1) one frequency high-precision measuring the total absorption of radio waves in the atmosphere; (2) estimating vertical gradients of the refractivity, and determining the height, slope, and horizontal displacement of the atmospheric and ionospheric layers; (3) a criterion is introduced for identification of the internal waves in the Venus atmosphere.

To obtain the information on the planetary subsurface structure up to depth 1 km it is necessary to use radio waves in the Low Frequency (LF), Medium Frequency (MF), or High Frequency (HF) bands with wavelength from 1 m up 300 m. The depth of radio sounding is proportional to the wavelength, the intensity of the radio-emission source, and depends on the conductivity of the ground. The bistatic subsurface remote sensing of the planet can be achieved using powerful Earth based transmitters, and/or sporadic radio emission of the Sun and other space radio sources.

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