ON APPLICATION OF SAR-METHOD FOR THE GEOLOGICAL NATURE OF MARS EXPLORATION; O.N.Rzhiga[1], and A.S.Selivanov[2], [1]Institute of Radioengineering and Electronics, Academy of Sciences of the USSR, prosp. K.Marxa 18, 103907, Moscow, USSR, [2]Glavcosmos of the USSR, Krasnoproletarskaya str.9, 103030, Moscow, USSR

The Mars surface was studied in the optical diapason in detail. The purpose of this brief article is to show, that synthetic aperture radar (SAR)-method is able to give quite new information in addition to the well-known one by this time. This confidence is based on the qualitative different character of the radio wave reflection in comparison with visible light.

1. Specular back scattering. The principal peculiarity of the dependence of $\sigma(\varphi)$, which describes the reflected signals power per unit surface at an angle of incidence φ, is the sharp change of $\sigma(\varphi)$ in the coordanate origin (fig.1,1). This is evidence of the specular character of the scattering. The great slope of the curve creats the conditions for high contrast among elements, which have a different inclination to the incident ray. It is just the choice of Venera 15 and 16 SAR look angle in the vicinity of 10° ensure the receipt of the contrast images and the underlining of the geological structure shape (1).

As is known, in optics diffuse scattering prevails. Curve 2 (fig.1) presents $\sigma(\varphi)$ of the perfectly white surface, the scattering of which obeys the Lambert Law. In the coordinate origin curve 2 is gently sloping. The optical image contrast in comparison with radar one is determined first of all by albedo properties of the surface. The optical image contrast is reached at the expense of shadows. In case of a gentle relief this requires a low location of the Sun above the horizon.

2. Diffuse back scattering. Under large incident angle region the specular scattering is replaced by diffuse one, conditioned by the surface elements, the dimensions of which are smaller than the wave-length (fig.1.3). The scattering character is changed at $\varphi = 30^{o}$.

For the side looking radars, studying the earth surface from aircrafts with a higher resolution, than it was by the Venus survey (1 to 2 km), the look angle is chosen in the diffuse scattering region. This diminishes the probability of the ambiquity, which arises, if the steepness of the mountain formations slopes exeeds the incidence angle.

3. Wave depolarization. Diffuse scattering on the elements of the surface, the dimensions of which are smaller than the wave-length, is accompanied by depolarization. The depolarizated component $\sigma(\varphi)$ is shown on fig.1 (curve 4). Its level characterizes the surface roughness in the scale smaller, than the wave length. This can be used to choose the landing site of the descending apparatus.

4. Penetrating radio waves ability. The wave-length difference in comparison with the optical diapason determines the high penetrating ability of the radio waves. In dry soil it can reach 30 wave-lengths. On the Mars surface under the sandy or snow (in polar regions) layer it would be possible to see the bed-rock structure.

The wet soil is a good radio wave reflector, that is why the wet soil areas must be visible on the radar images. On the Mars the precence of wet soils saturated with brine in the regions of the polar cap thaw are more probable.

For Mars surface exploration the wave-length is to be choosen at about 30 cm. The penetrating depth up to 10 m reachable in this case coincides with the possible depth of the Mars soil drilling and by taking samples when searching for organic life. Based on the problem of the Mars geological nature exploration a multifunctional radar system was proposed which has:

- two look angles: 10° and 30°;
- two surface resolutions: 1 km and 100 m ;
- two ortogonal polarizations of the received waves.

To lessen the weight of the scientific equipment we use some onboard instruments of the Mars orbiter radio link.

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Figure 1. The radar cross section per unit surface at an angle of in cidence (and reflection) $\varphi(a)$. 1 - Mars surface, specular scattering; 2 - perfectly white surface; 3 - Mars surface, diffuse scattering; 4 - Mars surface, depolarized component.