ON APPLICATION OF SAR-METHOD FOR THE GEOLOGICAL NATURE OF MARS EXPLO-
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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 dif-
ferent character of the radio wave reflection in comparison with visible light.
1. Specular back scattering. The principal peculiarity of the dependen-
ce of $\sigma(\varphi)$, which describes the reflected signals power per unit surface
at an angle of incidence $\varphi$, is the sharp change of $\sigma(\varphi)$ in the coordina-
te origin (fig.1,1). This is evidence of the specular character of the scat-
tering. The great slope of the curve creates 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 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) presen-
ts $\sigma(\varphi)$ of the perfectly white surface, the scattering of which
obeys $\sigma(\varphi) = \pi$. Large angle scattering curve 2 is gently sloping.
The optical image contrast in comparison with radar one is determined first
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 spec-
cular scattering is replaced by diffuse one, conditioned by the surface ele-
ments, the dimensions of which are smaller than the wave-length (fig.1,3).
The scattering character is changed at $\varphi = 30^\circ$.

For the side looking radars, studying the earth surface from aircrafts
with a higher resolution, then 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 ambiguity, which arises, if the steepness of the mountain
formations slopes excedes the incidence angle.

3. Wave depolarization. Diffuse scattering on the surface, the dimen-
sions of which are smaller than the wave-length, is accompa-
nied by depolarization. The depolarized 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 com-
parison 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 pos-
sible 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 presence 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: $10^\circ$ and $30^\circ$;
- 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 incidence (and reflection) $\varphi(q)$. 1 - Mars surface, specular scattering; 2 - perfectly white surface; 3 - Mars surface, diffuse scattering; 4 - Mars surface, depolarized component.