An analysis of the polarization diagrams obtained is up to the present the main method used for studies of the reflected signal polarization. Evidently using a simple dipole a partially polarized signal is not distinguishable from one that is elliptically polarized, nor is a non-polarized signal distinguished from circularly polarized. However, the data recently obtained are of great importance, particularly from studies of glacier crystal structure made in deep core drilling.

Possible reasons for the polarization changes of the signal have been analysed. Results of the analyses of the polarization diagrams obtained both at individual points and along extended traverses are discussed. It has been found that the signal reflected from a considerable ice thickness is polarized in such a way that the parallel orientation of the receiving and transmitting dipoles can be disregarded. *En route* recordings of the signal fluctuations obtained by parallel and orthogonally polarized dipoles are shown. The results of polarization studies are important for practical purposes. For example, bedrock relief sounding carried out with crossed dipoles makes it possible to get rid of interference signals occurring due to scattering from inhomogeneous structures of the upper part of the glacier.

PROGRESS IN RADIO-ECHO SOUNDING THEORY

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Abstract. The inverse problem of radio-echo sounding consists in the reconstruction of subglacial relief from the known radio-echo profile, and the path, and speed of the aircraft. The present work shows that in the geometrical optical approach the solution of the inverse problem for a homogeneous, two-dimensional object (valley glacier) exists, and there is a unique solution. An algorithm for interpretation of the experimental data is suggested. It may be considered as the generalization of Harrison's transformations for any surfaces, paths, and speed.

The direct problem of radio-echo sounding consists in the reconstruction of radio-echo profile from the known surface and subsurface relief, path, and aircraft speed. The analysis of traces in the standard radio-echo sounding mode of operation reveals the possibility of introducing a three-index trace classification $\{K, \text{sign } S'(0), K_+\}$ where K is the number of real roots characteristic of the equations, K_+ the number of positive roots, and $S'(0)$ the position derivative, the argument being equal to zero. The form $\{0, -0\}$ is optimal for the precision of the calculation of the reflected surface coordinates, as well as for the simplicity of the interpreted picture. By a special choice of the altitude of flight, any form of any surface can be brought to $\{0, -0\}$. The decrease in beam width is equivalent to the diminution of roots of the characteristic equations. For a pencil beam the trace degenerates into a point.

The attenuation of the reflected signal depends on the glacier geometry, the dielectric parameters of the medium, the altitude and the course of the aircraft, as well as statistical characteristics of the mutual orientation of the interfaces and aerials. For the description of the energetics of radio-echo sounding, equivalent reflecting surfaces are suggested. These surfaces correspond to the Harrison's equivalent reflecting surface. Exact formulae for the power of coherent and incoherent components of the reflected signal are obtained. Components of the full attenuation such as absorption, depolarization, and spherical divergence, are investigated with respect to refraction and focusing effects.