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Potential field data inversion for 3D objects of arbitrary shape

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Developed are theoretical foundations, numerical algorithms and packages of computer programs to find geometry of 3D restricted body of arbitrary shape, one or several 3D contact surfaces using square gravity, magnetic or electromagnetic data. It should be emphasized, that we have managed to get rid of any modeling: new integral equations have been derived to find a function, determining geometry of the object sought, which integrands are algebraic relative the function sought and don't contain its derivatives. The method of local corrections has been suggested, which makes it possible to curtail the time required to solve an inverse problem approximately by an order of magnitude.

Our technique has been successfully used in mining, prospecting and space geophysics. Inversion of the difference of temporal micro gravity measurements provides the means of permanent control over mining process. The opportunity to find density contrast surface (barren rock-ore or air-ore boundary) at any moment has permitted to improve mining technology. 3D relief of the upper boundary of pre-Jurassic rocks was found using square gravity measurements mainly. Subsequent comparison of the relief obtained with the position of the boundary according to the seismic profile, unknown for the author beforehand, has revealed their quite satisfactory coincidence. The volume model of Kendykty granitoid massif has been constructed by means of magnetic data inversion. 3D geometry of the diorite core in the granite block has been recovered, which lower boundary was expected to be a metallotect. Gravitational and magnetic models of core-mantle boundary have been suggested. Their correlation led us to some hypothesis on the core material flow. The method of local corrections allowed to derive the algorithm to find 3D relief of conductivity contrast surface using square electromagnetic data (in direct current approximation or in quasistatic approximation).