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SELECTION OF INITIAL APPROXIMATION FOR RECONSTRUCTION OF IMAGES IN IMPEDANCE TOMOGRAPHY

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A new method was suggested for the selection of initial approximation to two fields of potentials at the reconstruction of images in impedance tomography.

The impedance tomography is finding increasing use in various fields of science and technology for visualization of inner structure of objects [1–3]. The mathematical formulation of the two-dimensional problem of visualization (by analogy, we shall consider the distribution of electric resistance) consists in the determination of a smooth or piecewise smooth nonnegative function $\rho(x, y)$, which, is some prescribed domain (Fig. 1*a*, where *1* is a resistive film and *2* are equipotential contacts) satisfies the following system of internal inverse boundary problems [4]:

$$\nabla\left[\frac{1}{\rho\,(x,\,y)}\nabla U\,(x,\,y)\right]=0, \tag{1}$$

$$\begin{cases} U_{|G_{k,i}} = E_i\,, \;\; i=1,2,\ldots,n \\ U_{|G_{k,i}} = 0, \;\; j=1,2,\ldots,i-1,i+1,\ldots,n, \end{cases} \tag{2}$$

$$\frac{\partial U\,|}{\partial\, n\;|_G}=0, \tag{3}$$

$$\frac{1}{E_i}\int\limits_{l_{k,i}}\frac{1}{\rho\,(x,\,y)}\frac{\partial U}{\partial\, n}_{G_{k,i}}\,d\,l=\frac{I_{i,j}}{E_i}=\frac{1}{R_{i,j}}, \tag{4}$$

where $\rho(x, y)$ is the required distribution of electric resistance; n is the number of contacts over the perimeter of the domain under investigation; $G_{k,i}$ and $l_{k,i}$ are a segment of the boundary occupied by the ith contact, and its length; G is the domain boundary free from the contacts; $E_i = E_{i,j}$ ($j = 1, 2,..., i - 1, i + 1, n$) is the potential difference between the contacts i and j; $R_{i,j}$ is the resistance between the contacts i and j calculated from the known potential difference $E_{i,j}$ and the current $I_{i,j}$ measured by a galvanometer G.

System (1)–(4) can be resolved by any numerical method through variation of the parameters $\rho_{k,l}$ ($k = 1, 2,..., M$; $l = 1, 2,..., N$) of electric resistance of $M \times N$ elements of the image ($M \times N \le m(m - 1)/2$) produced after partition of the domain under investigation. The algorithm of such variation, gradually bringing the parameters of the medium to a required distribution, is set up based on algebraic algorithms of reconstruction [5].

Of primary importance for practical implementation of these algorithms is the choice of initial approximations to the potential fields of all $L = n - 1$ boundary problems with the averaged (over the domain) magnitude of resistivity $\rho_{avr}(x, y) =$

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