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Numerical analysis of potential distribution for a point current source in horizontally stratified multilayer earth

Slavko Vujević

Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, Ruđera Boškovića b.b., HR-21000 Split, CROATIA

SUMMARY

This paper describes a numerical procedure for approximating the potential distribution for a point source of direct current which is buried in horizontally stratified multilayer earth. The procedure is very efficient and general. The total number of layers and the source position in relation to the earth model layers are completely arbitrary. The efficiency of the computation procedure is based on the successful application of numerical approximations of two kernel functions of the integral expression for the potential distribution within an arbitrarily chosen layer of the earth model. Each kernel function of the observed layer is approximated using a linear combination of 15 exponential functions. Using these approximations of the kernel functions and the analytical integration based on Lipschitz integral, a simple expression for numerical approximation of potential distribution within boundaries of the observed layer is given. The algorithm for computing unknown coefficients of the numerical approximation of potential distribution is maximally simplified to the multiplication of a known constant pseudoinverse matrix by 25 sample values of the respective kernel function of the observed layer.

The numerical model developed for the point source is the basis of the wider numerical model for computation of the stationary current field of earthing grids buried in horizontally stratified earth. Because of the universality of the numerical methods, the numerical procedure presented can also be successfully applied to solving similar problems in other technical areas.