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Numerical-analytical methods for the analysis of forward and inverse scattering by dielectric bodies in waveguides

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Abstract: We develop analytical and numerical techniques for the solution to inverse problems of reconstructing permittivity of homogeneous and inhomogeneous bodies in waveguides from the values of the transmission coefficient known at different frequencies. The methods employ nonlinear volume singular integral equations, operator method, and contraction mappings. For a particular family of inclusions in the form of layered dielectric parallel---plane diaphragms the solution to the inverse problem is obtained in a closed form. The contents of the presentation: Statement of forward problems of wave scattering and propagation in 2D and 3D waveguides with dielectric inclusions. Green's tensor function and volume singular integral equations. Statement of inverse problems of reconstructing permittivity of homogeneous and Inhomogeneous bodies. Existence, uniqueness, and solution methods employing iterations and contraction. Statement and solution of inverse problem for layered dielectric inclusions in the form of parallel---plane multi---sectional diaphragms in a waveguide of rectangular cross--section. Results of numerical simulation.

Yury Shestopalov is now professor of mathematics at the University of Gävle, Sweden. He accomplished complete university career from teaching assistant to professor and department head at Moscow State University (MSU), Karlstad University and University of Gävle (since 2013). Y. Shestopalov has been continuously teaching (since 1977) all university courses in mathematics. In 1992-1993 he created and then was head of the department of computer science at the MSU Kolmogorov Advanced Education and Science Centre (AESC)—The Kolmogorov School. Y. Shestopalov organized the teaching of computer science, programming, and foundations of applied mathematics, worked out programs and basic courses, textbooks, compendiums, and course materials. As a member of Board of Advisors and then of the Board of Directors Y. Shestopalov initiated the Faculty of Higher Pedagogical Education at MSU. His main scientific results and contributions are within the following areas: spectral theory of operators and its application in mathematical methods for electromagnetics; methods of solution to inverse problems and problems with uncertain data; wave propagation in nonlinear media and nonlinear operator equations; integral equations, partial differential equations; numerical methods, optimization, applied computer codes, software and program packages. Among his recent achievements are complete description of the spectrum of waves in a broad class of inhomogeneously filled waveguides and mathematical theory of inverse waveguide problems. Y. Shestopalov has authored and co-authored five books, also published in USA and UK, more than 60 articles in peer-reviewed journals and in total more than 200 scientific works. He supervised several PhD works; among his disciples there are active professors in mathematics, applied mathematics and electrical engineering.

Y. Shestopalov performs international cooperation as visiting professor and co-heads international research projects with several institutions in Sweden, USA, Japan, Germany, Finland, Russia, and Ukraine. Since 1977 Y. Shestopalov organized more than 20 and participated in more than 60 international conferences and symposia; he is Vice-Chairman of Progress in Electromagnetics Research Symposium and Programme Committee member of several URSI conferences.