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# Methods of solution of singular integral equations

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## Abstract

**Purpose:** This paper investigates a different method to evaluate different real improper integrals and also to obtain the solutions of various types of Cauchy-type singular integral equations of the first kind.

**Methods:** Methods using the analysis of functions of real variables only are reviewed and utilized for the above purpose. These methods clearly demonstrate that details of complex function theory which are normally employed in handling such integral equations for their solutions can be avoided altogether. Also, some approximate methods of solution of such integral equations are developed.

**Results:** The solutions of real singular integral equations over different intervals such as  $(-1, 1)$ ;  $(a, b)$ ;  $(0, a) \cup (b, c)$ ;  $(-1, k) \cup (k, 1)$ ;  $(-\infty, b)$ ;  $(a, +\infty)$ ;  $(-\infty, +\infty)$ ; infinite intervals with a gap are obtained by using the proposed methods.

**Conclusion:** The proposed methods are new and each has its own structure.

**Keywords:** Real singular integral equations, Cauchy-type kernels, Real variable method

**MSC:** 45E05

## Background

Real singular integral equations involving Cauchy-type singularities arise (see [1-10]) in a natural way in handling a large class of mixed boundary value problems of mathematical physics, especially when two-dimensional problems are encountered. The integrals occurring in these integral equations are in fact improper and their evaluations in most cases can be rendered by using the theory of functions of complex variables involving the application of Cauchy's residue theorem. It is desirable, as is always felt, to avoid the use of complex function theory to evaluate real integrals because the details can be more involved analytically speaking than what is actually necessary for being able to use the final results in practical problems. It is with this idea in mind, in the present paper, that we have first reviewed the problems of evaluation of several real improper integrals (see [11]) by the help of the theory of functions of real variables only whilst the application of complex function theory is also demonstrated for these problems for comparison as well as for realizing the major differences of the analysis involved.

Thus, by developing the feeling that complex function theory can be avoided for problems involving improper real integrals, we have next taken up some known real singular

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Kanwal,2000 This work focuses on the distributional solutions of singular integral equations progressing from basic concepts of the classical theory to the more difficult two dimensional problems

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Payne,1986     *Problems and Methods in Mathematical Physics* Johannes Elschner,Israel Gohberg,Bernd Silbermann,2012-12-06 This volume presents the proceedings of the 11th Conference on Problems and Methods in Mathematical Physics 11th TMP held in Chemnitz March 25 28 1999 The conference was dedicated to the memory of Siegfried Pr ssdorf who made important contributions to the theory and numerical analysis of operator equations and their applications in mathematical physics and mechanics The main part of the book comprises original research papers The topics are ranging from integral and pseudodifferential equations boundary value problems operator theory boundary element and wavelet methods approximation theory and inverse problems to various concrete problems and applications in physics and engineering and reflect Pr ssdorf s broad spectrum of research activities The volume also contains articles describing the life and mathematical achievements of Siegfried Pr ssdorf and includes a list of his publications The book is addressed to a wide audience in the mathematical and engineering sciences     **Numerical Solution of Integral Equations** Michael A.

Golberg,2013-11-11 In 1979 I edited Volume 18 in this series Solution Methods for Integral Equations Theory and Applications Since that time there has been an explosive growth in all aspects of the numerical solution of integral equations By my estimate over 2000 papers on this subject have been published in the last decade and more than 60 books on theory and applications have appeared In particular as can be seen in many of the chapters in this book integral equation techniques are playing an increas ingly important role in the solution of many scientific and engineering problems For instance the boundary element method discussed by Atkinson in Chapter 1 is becoming an equal partner with finite element and finite difference techniques for solving many types of partial differential equations Obviously in one volume it would be impossible to present a complete picture of what has taken place in this area during the past ten years Consequently we have chosen a number of subjects in which significant advances have been made that we feel have not been covered in depth in other books

For instance ten years ago the theory of the numerical solution of Cauchy singular equations was in its infancy Today as shown by Golberg and Elliott in Chapters 5 and 6 the theory of polynomial approximations is essentially complete although many details of practical implementation remain to be worked out

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