The computational solution of Volterra integral equations with highly oscillatory kernels

Hermann Brunner

Department of Mathematics and Statistics
Memorial University of Newfoundland
Elizabeth Avenue
St John's, NL A1C 5S7
CANADA

`hermann@math.mun.ca; hbrunner@math.hkbu.edu.hk`

Abstract

The equations resulting from the application of a collocation or a discontinuous Galerkin method to a Volterra integral equation are in general not yet amenable to numerical computation: an additional discretisation process that is able efficiently and accurately to approximate the integrals involving the highly oscillatory kernel and the basis functions is needed. Classical quadrature processes like Gauss quadrature are not feasible since they can only cope with high frequencies when unacceptably small time steps are used.

In this talk I shall describe recent and ongoing work on this problem, focusing on so-called Filon-type quadrature and some alternative approaches (to which the talk will provide a brief introduction). This will be preceded by a discussion of relevant results on the nature of solutions to highly oscillatory Volterra integral equations of the first and second kind, and by an application that motivated part of this work. Remarks on related current research (e.g. on highly oscillatory Volterra equations with delay arguments) and on open problems will conclude the presentation.

The talk is based on joint work with Arieh Iserles (Cambridge/UK) and Syvert Norsett (Trondheim/Norway).