

# On some classes of Volterra integral equations

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## Abstract

Many physical, chemical and biological problems are modelled as nonlinear singular Volterra integral equations (VIEs). One can find in the literature numerous papers which deal with the analytical properties and/or numerical approximations of specific applied problems, namely: superfluidity and travelling wave analysis in nonlinear reaction-convection-diffusion problems, nonlinear waves, heat flow problems with radiation cooling at the boundary, absorption of gas through a liquid surface, industrial problems related with the ageing of stainless steel; we also refer to the problem of a competitive chemical reaction between an antigen and a labeled antigen for antibody sites on a cell wall, with applications to some medical devices. In this talk we will give a review of some of these works.

Due to the singularities in the kernels of the integral equations, their exact solutions will in general not be differentiable at an end point of the integration interval; this causes a loss of the optimal (global) convergence orders of the classical product integration and collocation methods based on piecewise polynomial approximations. If one wants a high order method, the nonsmooth behaviour of the solutions has to be taken into account. We illustrate some techniques that allow us to recover the optimal orders.

For comprehensive studies and many references we refer to [1], [2].

## References

- [1] H. Brunner, *Collocation Methods for Volterra Integral and Related Functional Equations*, Cambridge University Press, Cambridge, 2004.
- [2] H. Brunner, *Volterra Integral Equations. An Introduction to Theory and Applications*, Cambridge University Press, Cambridge, 2017.