Spectral Methods For Integral Equations And Functional Differential Equations

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The main purpose of this work is to provide a novel numerical approach for the Volterra integral equations based on a spectral approach. In particular, an efficient spectral posteprocessing technique will be presented, which uses a Gauss-Seidal type iterative procedure to produce numerical solutions (for initial value problems and Volterra type integral equations) with spectral accuracy.

We provide a rigorous error analysis for the spectral method for the Volterra integral equations, which indicate that the numerical errors decay exponentially provided that the the kernel function and the source function are sufficiently smooth. The result in this work seems to be the first successful spectral approach (with theoretical justification) for the Volterra type equations.

The idea will be extended to handle delay equations for which the conventional collocation type methods suffer from lower accuracy and computational complexity.