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Regularized Legendre-Galerkin method for Fredholm integral equations of the first kind

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In this study, a numerical approach based on the Legendre-Galerkin method is proposed to approximate the solution of Fredholm integral equations of the first kind. We established some error estimates are also given under suitable assumptions on the exact solution. Finally, some numerical examples will be stated to show the accuracy of this method. Many problems in applied mathematics and engineering can be formulated as Fredholm integral equations of the first kind:

$$Kf(x) = \int_a^b k(x,y)f(y)dy = g(x)$$

Where the kernel k (;) and the right-hand side g are smooth real-valued functions. The determination of the solution f of this equation is an ill-posed problem in the sense of Hadamard; in the sense that the solution (if it exists) does not depend continuously on the data. In this work, we suggest a numerical procedure based on the Legendre-Galerkin projection method, where the solution is projected onto a subspace generated by Legendre polynomials.

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