Abstract

In this thesis, we consider numerical approximation to the solutions of nonlinear Fredholm integral equations using polynomially-based discrete projection methods. We develop discretized versions of Galerkin and collocation methods for Hammerstein and mixed type Hammerstein integral equations with smooth kernels using Legendre polynomial basis functions. Using sufficiently accurate numerical quadrature rule, we establish superconvergence results for the iterated approximate solutions of discrete Legendre Galerkin and collocation methods in both infinity and L^2-norm. We extend these results to the Urysohn integral equation with a smooth kernel and obtain superconvergence results in both infinity and L^2-norm. Next we propose Legendre polynomial based discrete multi-projection methods for solving nonlinear Fredholm integral equations of Urysohn type using discrete orthogonal and interpolatory projection operators. Taking use of a numerical quadrature rule with certain degree of precision, we are able to establish improved superconvergence results for the approximate and iterated approximate solutions in discrete Legendre M-Galerkin and discrete Legendre M-collocation methods in both infinity and L^2-norm.

Keywords: Fredholm integral equations, Urysohn integral equations, Hammerstein integral equations, Mixed type Hammerstein integral equations, Legendre polynomials, Numerical quadrature, Superconvergence rates.