Discrete Petrov-Galerkin scheme for boundary value differential and integral problems: Theory and Applications

M. Ganesh[*], R.D. Grigorieff[†] and K. Moustapha[‡]

Abstract

In this work we analyse the error of a discrete Petrov-Galerkin scheme for nonlinear m-th order ordinary differential and integro-differential equations on a finite interval subject to nonlinear side conditions. As a trial space we chose high-order C^m-splines. We prove optimal order convergence and superconvergence in the knots for lower order derivatives, where the range of derivatives for these enhanced convergences to hold is determined by the behaviour of the nonlocal part of the integro-differential equation. Our results extend and simplify earlier results by M. Ganesh and I. Sloan (1999).

The numerical experiments in this work, for several *singularly perturbed* ordinary differential equations demonstrate the power of our scheme that does not require any mesh restriction.

[*]School of Mathematics, University of New South Wales, Sydney 2052, Australia. email: ganesh@maths.unsw.edu.au

[†]Technische Universität Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany. email: grigo@math.tu-berlin.de

[‡]School of Mathematics, University of New South Wales, Sydney 2052, Australia. email: ganesh@maths.unsw.edu.au