UNIFIED THEORY OF DIFFERENTIAL OPERATORS ACTING ON DISCONTINUOUS FUNCTIONS AND OF MATRICES ACTING ON DISCONTINUOUS VECTORS

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Abstract

For the application of discontinuous functions in the area of numerical methods for partial differential equations (NMPDE), there are mainly two approaches: Trefftz methods and discontinuous Galerkin (dG) methods. The Theory of Differential Equations in Discontinuous Piecewise-Defined-Functions, introduced and developed by Herrera [3], constitutes a unified framework for these procedures. On the other hand, nowadays the application of high performance computing to the solution of PDEs is progressing at a very swift pace. Among the new computational resources parallel computing is outstanding. In turn, the most effective means for applying parallel computing are domain decomposition methods (DDM). Since the 1980s parallel computing has received considerable attention by the NMPDE community and at present it is recognized that non-overlapping DDMs are the most effective. Most of the work done up to recently for this latter kind of methods had been restricted mainly to symmetric and positive definite problems. However, recently Herrera [1-7] has introduced a new formulation in which symmetric and nonsymmetrical problems are handled in a unified manner, thereby producing a systematic non-overlapping and preconditioned DDM for non-symmetric matrices. These procedures are carried out in vector-spaces whose elements are discontinuous, using a unified theory of differential operators acting on discontinuous functions and of matrices acting on discontinuous vectors, to which this plenary lecture is devoted.

Keywords: Trefftz method, discontinuous Galerkin; domain decomposition methods; Steklov-Poincaré operator; multipliers-free DDM; Lagrange multipliers.

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