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A Review of Continuous and Discontinuous Galerkin Finite Element Methodfor Differential Equations

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Abstract:

This study is a review of both the continuous Galerkin finite element method (CGFEM)and the discontinuous Galerkin finite element method (DGFEM).A group of the most important research over the last 13 years has been compared to both methods and their historical development, as well as comparing the advantages and disadvantages of both methods.This review is aimed at determining the best and most efficient method to solve complex problems in the future.

Keywords: continuous Galerkin finite element method, discontinuous Galerkin finite element method, differential equations.

1. Introduction

The finite element method (FEM) is a computational tool for solving physics and engineering differential equations. The approach was initially introduced in an article by Turner, Clough, and Martin [48] in the aerospace sector in the early 1950s. Clough [15] (1960) used the phrase CGFEM in a work about planar elasticity applications. Argyris [9] (1960) proposed a straightforward technique based on the virtual work idea. He created this work to use computational tools to address extremely difficult situations. Researchers in the early 1960s quickly shifted their focus to the solution of nonlinear issues. The CGFEMapproachwas originally used for conduction heat transport and fluid dynamics by Zienkiewicz and Cheung (1965)[56], and Wilson and Nickell (1966)[50]. Other researchers, Szabo and Lee (1969)[47], and Zienkiewicz (1971)[55], demonstrated that the element equations for structural mechanics, heat transfer, and fluid mechanics may be found using a weighted residual strategy such as Galerkin's method or the least-squares approach. This understanding is crucial to the theory since it enables the application of the FEM to any differential problem. The FEM has advanced from a structural