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Ghiocel Groza, Mohsen Razzaghi

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Approximation of solutions of polynomial partial differential equations in two independent variables

Ghiocel Groza[a,*], Mohsen Razzaghi[b]

[a] *Technical University of Civil Eng. of Bucharest, Department of Mathematics and Computer Science, 020396, Romania*
[b] *Mississippi State University, Department of Mathematics and Statistics, Mississippi State, MS 397622, USA*

Abstract

A numerical method for solving polynomial partial differential equations in two independent variables, defined in the paper, is presented. The technique is based on polynomial approximation. Properties and the operational matrices for partial derivatives for a polynomial in two variables are presented first. These properties are then used to reduce the solution of partial differential equations in two independent variables to a system of algebraic equations. Five illustrative examples are presented to prove the effectiveness of the present method. Results show that the numerical scheme is very convenient for solving polynomial partial differential equations.

Mathematics Subject Classification (2010): 35G20, 41A10, 41A58

Keywords: polynomial partial differential equation, polynomial approximation, analytic functions, distance in a metric space

1. Introduction

Many important models in physical, biological or other sciences are based on partial differential equations (PDE). The nonlinear PDE are in a central position because they govern a large area of complex phenomena of motion, reaction, diffusion, equilibrium, conservation, and more (see [1] and [2]). By using Stone-Weierstrass Theorem many of these PDE's can be reduced to polynomial partial differential equations (see Eqs. (5), (6) and Example 5).

The problem of finding exact solutions to partial differential equations has been deeply studied in the literature. However, there is not a general method to be followed when handling a specific equation [3]. The authors in [3] present a procedure for solving first-order autonomous algebraic

*Corresponding author
Email addresses: grozag@utcb.ro (Ghiocel Groza), razzaghi@math.msstate.edu (Mohsen Razzaghi)