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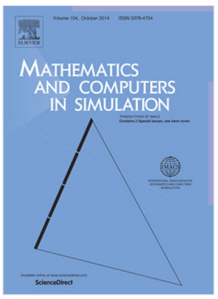

A mixed Lagrange-Bernoulli tensor product expansion on the rectangle with applications

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A mixed Lagrange-Bernoulli tensor product expansion on the rectangle with applications

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Abstract

A mixed Lagrange-Bernoulli tensor product polynomial operator for bivariate functions of class (m, n) with only boundary data on the rectangle is presented. Properties of interpolation and error bounds are studied. Application to functions approximation, solution of Poisson equations with Dirichelet's conditions and numerical cubature are proposed. Numerical results are also given.

Keywords: Bivariate function approximation, Lagrange polynomial expansion, Bernoulli polynomial expansion, Poisson boundary value problems, Numerical cubature
2010 MSC: 41A05, 65D05, 65L05, 65D32

1. Introduction

Polynomial expansion of a function f on a bounded closed domain, with only boundary data, have found in the past decades several applications in sciences. For example, in the one dimensional case, one of the most important application consists in the approximation of the displacement of a body which is in rectilinear motion, knowing its initial and final positions, velocities and accelerations. There is a considerable amount of literature about this topic both in the univariate such as in the bivariate case. For instance, in the univariate case, we have classical univariate boundary value formulas and some recent one: two-point Hermite formula [1], two-point Taylor formula [2], Lidstone expansion [3, 4], Complementary Lidstone formula [1, 4], Bernoulli formula [5, 6], Euler formula [5, 7, 8], Two-point Abel-Gontscharoff formula [9, 8, 10], Modified Abel expansion [11]. As stated by Cheney and Light [12] a powerful method, to extend univariate formulas to bivariate ones on a rectangle, is the tensor-product interpolation since it preserves the property of exactness in polynomial reproduction up to a certain order. The simplest tensor-product polynomial interpolation is obtained by considering the Lagrange interpolation formula on two adjacent

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