Almost Everywhere Partition of Unity to deal with Essential Boundary Conditions in Meshless Methods

Hae-Soo Oh and Jae Woo Jeong

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Abstract

Due to overlapping nature of supports of partition of unity functions and the lack of the Kronecker delta property of meshless shape functions, it is difficult to deal with essential boundary conditions in meshless methods. In this paper, in order to alleviate this difficulty, we introduce almost everywhere partition of unity that is a partition of unity except a few points along boundary in two dimensional case. Actually, the gradient of partition of unity functions become infinitely large at these exceptional points. However, we prove that the presence of these bad points does not change the convergence rates of computed solutions. Comparing with the computed solutions obtained by the Lagrange multiplier method, the penalty method, and the Nitche's method, we demonstrate the proposed method is more effective in dealing with essential boundary conditions in meshless methods.

Key words and phrases: reproducing polynomial particle (RPP) shape functions, patch-wise arbitrary spaced particles, partition of unity function with flat-top, patch-wise RPPM, almost everywhere partition of unity.

Department of Mathematics and Statistics, UNC-Charlotte, Charlotte, NC 28223-0001