The Closed Form Reproducing Kernel Particle Shape Functions: Part 2. Non-Uniformly Distributed Particles

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Abstract

In part 1 of this paper ([22]), for uniformly distributed particles, we construct highly regular piecewise polynomial RKP shape functions that have the polynomial reproducing property of order k for any given integer $k \geq 0$ and satisfy the Kronecker Delta Property. This discovery of closed form shape functions not only ensures high accuracy of RKPM, but also alleviates difficulties arising in implementing RKPM such as imposing Dirichlet boundary conditions and numerical integrations. However, uniformly distributed particles can be impractical, especially when the problems contain singularities or the solution domains are irregular. Thus, in this report, we generalize the construction of piecewise polynomial RKP shape functions described in part 1 to the case when the particles are non-uniformly distributed in $\mathbb{R}$ and to the case when the particles are non-uniformly distributed in a bounded closed interval. Furthermore, we present a more direct proof of an error estimate of the interpolation associated with these closed form RKP shape functions.

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