Hierarchical Enrichment and hp-Adptivity in the Particle-Partition of Unity Method

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In particular, we present the Particle-Partition of Unity Method (PPUM) which is a meshfree generalization of the classical finite element method. The PPUM can be employed in an h-version, a p-version and an hp-version. Furthermore, the PPUM supports the use of problem-dependent approximation spaces (i.e. there is a PPUM q-version) and it can be interpreted as a variational multiscale method. We focus on hp-adaptive refinement of a PPUM discretization, the automatic hierarchical enrichment, and the efficient multilevel solution of the arising linear system. We present numerical results of our multilevel PPUM for the treatment of linear elastic fracture mechanics problems which demonstrate the approximation properties as well as the computational efficiency of the proposed scheme.