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Convergence Analysis of Meshfree Approximation Schemes

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This work is concerned with the formulation of a general framework for the analysis of meshfree approximation schemes and with the convergence analysis of the Local Maximum-Entropy (LME) scheme as a particular example. We provide conditions for the convergence in Sobolev spaces of schemes that are n-consistent, in the sense of exactly reproducing polynomials of degree less or equal to n, and whose basis functions are of rapid decay. The convergence of the LME in a locally Sobolev space follows as a direct application of the general theory. The analysis shows that the convergence order is linear in h, a measure of the density of the point set. The analysis also shows how to parameterize the LME scheme for optimal convergence. Because of the convex approximation property of LME, its behavior near the boundary is singular and requires additional analysis. For the particular case of polyhedral domains we show that, away from a small singular part of the boundary, any Sobolev function can be approximated by means of the LME scheme. With the aid of a capacity argument, we further obtain approximation results with truncated LME basis functions in H1 and for spatial dimension d > 2.

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