

Consistency and convergence of SPH approximations

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Smoothed particle hydrodynamics, or SPH, is a widely used numerical technique for solving differential equations. There is, as yet, no complete analysis in the literature which shows under which conditions the method is consistent and converges. We aim to contribute towards such an analysis by considering two aspects of SPH: (1) the integral formulations used to approximate functions and their derivatives, and (2) the discretisation technique used to approximate these integrals numerically. With regard to (1) we explain the conditions placed on kernels in the literature, and also show how simpler, linear kernels can be used. We also present an as yet unpublished but essential condition on the continuity at the boundary of the problem domain. Our work in (2) is not yet complete but from our tests we show a sensitivity to the distribution of discretisation points. We are looking at several quadrature techniques and performing various analyses to try to both explain and mitigate these issues.