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Collocated approximations on unstructured grids: a comparison between General Finite Differences (GFD), Moving Least Squares (MLS), and Smoothed Particle Hydrodynamics (SPH)[1] YAROSLAV VASYLIV, ALEXANDER ALEXEEV, Georgia Institute of Technology — In the meshfree family of methods, partial differential equations are solved on unstructured grids where a search radius establishes an implicit nodal connectivity used to determine whether to include or exclude neighboring nodes in the constructed approximation. Smoothed Particle Hydrodynamics (SPH) is widely attributed to be the eldest of the meshfree methods dating back to an astrophysics paper published in 1977 by Gingold and Monaghan. However, beating them by five years was Jensen when he published Finite Differences for Arbitrary Grids (FIDAG) in 1972. Ultimately this work and others were generalized by Liszka and Orkisz in 1979 as a weighted least squares formulation solving for the Taylor coefficients and is now commonly known as General Finite Differences (GFD). Shortly after in 1981, Lancaster and Salkauskas introduced the Moving Least Squares (MLS) approximation for surface reconstruction using a weighted least squares formulation where the unknown coefficients are treated as functions varying from node to node in the support domain. Here we examine important differences, similarities and limitations of each method by solving the 2D Poisson equation on unstructured grids.

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