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Overview of meshless radial basis functions of solve multi-dimensional problems

A radial distance, rab is the shortest path between a pair of points in a curved space, $\Re^n$; a radial basis function (RBF), $\varphi(r_{ab})$, is a univariate function of r_{ab}. The C∞ (infinite differentiability) RBFs are non-orthonormal wavelets that converge exponentially, and faster as the spatial dimensions increases making them the best tools for plasma simulations and multi-dimensional quantum mechanics. Since no mesh is involved, strictly hyperbolic PDEs can be very accurately modelled by allowing each interior point, xi in the interior, $\Omega\backslash\partial\Omega$ to move at a velocity, v_i, such that a complicated nonlinear PDE becomes an exact differential in a moving frame, v_i. Strict conservation of specie, mass, momentum components, and total energy are enforced by integrating the RBFs over space. The solution space can be enriched by including discontinuous RBFs; these are products of a Heaviside function in the normal propagation direction, and a RBF in $\Re^{(n-1)}$ in the tangential directions. RBFs are either very broad-banded or global; domain decomposition , pre-conditioners, regularization, global optimization are used to control ill-conditioning. Recent computer science developments in extended arithmetic precision permit the control of ill-conditioning to produce extremely accurate numerical results. In both accuracy and the minimization of execution time, the total number of discretization points can be minimized compared to finite element methods.

Biography

Edward J Kansa is the president of Convergent Solutions, LLC and principal investigator in computational sciences, LLC. He received his Ph D from Vanderbilt University; He has an experience of road background in solving multi-disciplinary problems in physics, and engineering with emphasis on analysis and computational modeling.

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