Special Program in Applied Mathematics and Applied Mechanics

Recent advances and applications of the generalized finite difference method

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In this talk, recent advances and applications of the generalized finite difference method (GFDM) will be presented and discussed. The GFDM is a promising newly- developed meshless method, since the GFDM can truly get rid of time-consuming mesh generation and numerical quadrature. The GFDM is evolved from the classical finite difference method, so the GFDM remains the simplicity and accuracy of the finite difference method. While a boundary value problem governed by partial differential equation is considered, only a set of scattered nodes are needed by the GFDM instead of structured and unstructured meshes. In the GFDM, the moving-least squares approach is adopted to derive the expressions of the spatial derivatives, which are expressed as linear combination of nearby function values. To enforce the satisfactions of governing equations at every interior node and boundary conditions at every boundary nodes via a collocation approach, a linear (non-linear) sparse system of algebraic equations can be yielded. Then, the numerical solutions can be acquired by solving the resultant system of algebraic equations. Hence, it is noticed that the GFDM keeps the advantages from both of meshless and mesh-based numerical methods. In this presentation, some research results of the GFDM by our group will be provided, which includes the error analysis, inverse problems, sloshing problem, wave propagation in a numerical wave tank, the shallow water equations, the groundwater problems, the heat conduction problems, etc. Furthermore, some future research directions of the GFDM will also be discussed.

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