Central Difference Scheme for Gas Dynamics Modeling using Fuzzy Grid Approach

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Central difference scheme for 2D meshless gas dynamics is presented. The corresponding meshless method, called FuzzyGrid has been presented earlier [1].

The method is a natural generalization of meshless methods, based on Free-points method and SPH methods ideas.

The main idea of the method is based on the approximation of the surface and volume integrals of the unknown functions in a particle as sums of these functions values in the points (particles), which are in the nearest vicinity to the given one.

\[
\int_V f dV_i \approx \sum_{j \in \Omega_i} A_{i,j} \cdot f_j \\
\oint_{\partial V} f dS_i \approx \sum_{j \in \Omega_i} B_{i,j} \cdot f_{i,j}
\] (1)

Here \( \Omega_i \) is a set of numbers of neighbor particles for the particle number \( i \), \( f_{i,j} \) - approximation of function \( f \) at the "fuzzy face" between \( i \)-th and \( j \)-th particles.

The coefficients in 1 should satisfy some relations. So, for each particle we have something like a cloud of particles around it, which is used for the approximation construction. The name "particle" is used as a close to the reality one, but really we have a volume, which doesn’t have strict bounds, but about which we know values, which are necessary for modeling of a specific applied problem.

The described idea makes it easy to implement any finite volume difference scheme in its frame. Our scheme is based on the well-known KT scheme for 1D hydrodynamics [2]. This scheme can be easily formulated in finite volume terms, thus making natural its 2D and 3D formulation for FuzzyGrid.

The results are illustrated by 1D and 2D numerical experiments.

References
