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Quasi-invariants method in CABARET schemes for hyperbolic systems of conservation laws that don't have the form of invariants

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The standard algorithm of the CABARET scheme [1], which approximates a hyperbolic system of conservation laws, assumes that this system can be written in the form of invariants. However, if the hyperbolic system of differential equations does not allow writing in the form of invariants, then to construct the CABARET scheme it is necessary to use quasi-invariants, which in the general case are determined ambiguously [2].

In this work, we present a general formulation of the quasi-invariants method for constructing a CABARET scheme that approximates a hyperbolic system of conservation laws that can't be written in the form of invariants [3]. Elements of the monotonic Cabaret scheme are used to improve the dissipation properties [4]. It is carried out a comparative accuracy analysis of proposed CABARET scheme modifications in the calculation of the classical Riemann problems [5] and Blast Wave problem [6] for the equations of polytropic gas dynamics. Based on this analysis, the optimal form of quasi-invariants has been identified, which allows the CABARET scheme to localize with high accuracy strong and weak discontinuities of the exact solution.

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References

[1] S.A. Karabasov and V.M. Goloviznin Compact accurately boundary-adjusting high-resolution technique for fluid dynamics. *J. Comput. Phys.*, 2009. V. 228. P. 7426-7451

[2] V. M. Goloviznin, M. A. Zaitsev, S. A. Karabasov, and I. A. Korotkin, *New CFD Algorithms for Multiprocessor Computer Systems.* Mosk. Gos. Univ., Moscow, 2013. [in Russian]

[3] V.V. Ostapenko and V.A. Kolotilov Application of the CABARET scheme for the calculation of discontinuous solutions of the hyperbolic system of conservation laws *Doklady Mathematics*

[4] O.A. Kovyrkina and V.V. Ostapenko Monotonicity of the CABARET Scheme Approximating a Hyperbolic System of Conservation Laws. *Comput. Math. and Math. Phys.*, 2018. V. 58. P. 1435-1450

[5] E.F. Toro *The equations of fluid dynamics. In: Riemann Solvers and Numerical Methods for Fluid Dynamics.* Springer, Berlin, Heidelberg (2009).

[6] P. Woodward and P. Colella The numerical simulation of two-dimensional fluid flow with strong shocks *J. Comput. Phys.*, 1984, V. 54, I. 1, P. 115-173, ISSN 0021-9991,

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