Publications

List of Papers Published

1. Deka, D. and Sen, S. A new transformation free generalized (5,5)HOC discretization of transient Navier-Stokes/Boussinesq equations on nonuniform grids. *International Journal of Heat and Mass Transfer*, 171: 120821, 2021.

2. Deka, D. and Sen, S. Compact higher order discretization of 3D generalized convection diffusion equation with variable coefficients in nonuniform grids. *Applied Mathematics and Computation*, 413: 126652, 2022.

List of Papers under Preparation

1. Deka, D. and Sen, S. A new transient higher order compact scheme for computation of flow and heat transfer on nonuniform polar grids.

List of Conference Presentations

1. "Transformation-free compact high order Navier-Stokes equation solver on nonuniform grid" in *International Conference on Advances in Mathematics, Science and Technology (ICAMST)-2020*, Department of Mathematics, Rajiv Gandhi University, September 1-4, 2020.

2. "Numerical simulations of interior and exterior flow problems for *Re* value beyond Hopf bifurcation" in *International Conference on Present Scenario of Mathematical Sciences (ICPSMS)-2020*, Department of Mathematics, Karnatak University's Karnatak Arts College, Dharwad, September 12-13, 2022.

3. “Numerical study of heat transfer in annulus using higher order compact schemes” in *National Seminar on Recent Development in Science and Technology (NSRDST-2024)*, Department of Chemistry, Karimganj College, Karimganj, February 17-18, 2024.

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Page count:	161
Word count:	45,227
Character count:	202,690
Submission date:	24-Jul-2024 12:12PM (UTC+0530)
Submission ID:	2421696298

Abstract

A class of compact finite difference schemes has been developed on nonuniform girds to tackle the convection-diffusion equation (CDE). A nonuniform grid has the leverage of clustering grids in higher-gradient regions and spreading out grid lines at other places, thereby making the computation less expensive. Contrary to the schemes available in the literature, the present schemes are abstained from using any kind of coordinate transformation to resolve nonuniform grids. The content of the present work can be divided into three parts. In the first part, a compact discretization of generalized 3D CDE on nonuniform grids is presented. This work on nonuniform grids consider presence of cross-derivative terms and the discretization uses only nineteen-point stencil. Extension of this newly proposed discretization to semi-linear and convection-diffusion-reaction problems is seen to be straightforward and this inherent advantage is thoroughly exploited. The scheme is found to be efficient in capturing boundary layers and preserve the nonoscillatory property of the solution. The proposed method is tested using several benchmark linear and nonlinear problems from the literature. Additionally, problems with sharp gradients are solved. These diverse numerical examples demonstrate the accuracy and efficiency of the scheme proposed. Further, the numerical rate of convergence is seen to approach four confirming theoretical estimation.

The second part of the work pertains to the implicit compact discretization of the Navier-Stokes (N-S) equations on nonuniform grids. Subsequently, the discretization is used to approximate the Boussinesq equation as well. This newly developed scheme is based on a comparatively smaller five-point stencil and leads to an algebraic system of equations with constant coefficients. The scheme carries the flow variable and its gradients as unknowns and is seen to report back

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