8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

BENCHMARK OF ADER SCHEMES IN MULTI-DIMENSINAL PHENOMENA

***Yoko TAKAKURA[1]**

[1] Tokyo Noko University
Nakacho 2-24-16 Nakacho, Koganei, Tokyo 184-8588, JAPAN
takakura@cc.tuat.ac.jp   http://www.tuat.ac.jp/~shok_lab/takakura/takakura.html

Key Words: *ADER Schemes, Benchmark, Multi-Dimensional Phenomena* .

ABSTRACT

The ADER approach is the extended Godunov-type schemes[1] which construct non-oscillatory explicit one-step schemes with very high order of accuracy in space and time by solving the DRPs (derivative Riemann problems). The ADER approach has been developed from the schemes for the linear scalar hyperbolic equations[2] to those for nonlinear multi-dimensional systems[3,4,5,6,7], and further to those for the equations with convex and non-convex fluxes[8]. In the process of developments the WENO[9,10] technique has been adopted to the reconstruction of cell-averaged data with the finite-volume framework[11], and the implementation onto the adaptive triangular meshes has been shown[12].

The ADER Schemes are now in the phase of application to practical problems. In this research, benchmarks of ADER schemes are shown mainly in multi-dimensional phenomena such as interaction between shock waves and vortices.

REFERENCES

[1] S.K.Godunov, “Finite Difference Methods for the Computation of Discontinuous Solutions of the Equations of Fluid Dynamics,” *Mat.Sb.*, Vol.47, pp.271-306, 1959.

[2] E.F.Toro, R.C.Millington, and L.A.M.Nejad, “Towards Very High Order Godunov Schemes,” *Godunov Methods: Theory and Applications*, E.F.Toro, Ed., Kluwer/Plenum Academic Publishers, p.907-940, 2001.

[3] E.F.Toro and V.A.Titarev, “Solution of the Generalised Riemann Problem for Advection-Reaction Equations,” *Proc.Roy.Soc.London*, Vol.458, No.2018, pp.271-281, 2002.

[4] Y.Takakura and E.F.Toro, “Arbitrarily Accurate Non-Oscillatory Schemes for a Nonlinear Scalar Conservation Law,” *CFD Journal*, Vol.11 No.1, p.6-17, 2002.

[5] E.F.Toro and V.A.Titarev, “ADER Schemes for Scalar Non-linear Hyperbolic Conservation Laws with Source Terms in Three-Space Dimensions,” *J. Comput. Phys.*, Vol.202, pp.196-215, 2005.

[6] V.A.Titarev and E.F.Toro, "ADER Schemes for Three-dimensional Non-linear Hyperbolic Systems," J. Comput. Phys., Vol.204, pp.715-736, 2005.

[7] E.F.Toro and V.A.Titarev, "Derivative Riemann Solvers for Systems of Conservation Laws and ADER methods," *J. Comput. Phys.*, Vol.212, pp.150-165, 2006.

[8] Y.Takakura, "Direct-Expansion Forms of ADER Schemes for Conservation Laws and Their verification," *J. Comput. Phys.*, Vol.219, pp.855-878, 2006.

[9] C.W.Shu, "Essentially Non-Oscillatory and Weighted Essentially Non-Oscillatory Schemes for Hyperbolic Conservation Laws," Technical Report, NASA/CR-97-206253, ICASE Report No.97-65, 1997.

[10] C.W.Shu, "Total-Variation-Diminishing time discretizations," *SIAM J. Scientific and Statistical Computing*, Vol.9, pp.1073-1084, 1988.

[11] V.A.Titarev and E.F.Toro, "FiniteVolume WENO Schemes for Three-Dimensional Conservation Laws," *J. Comput. Phys.*, Vol.201, pp.238-260, 2004.

[12] M.Kaeser, A.Iske, "ADER Schemes on Adaptive Triangular Meshes for Scalar Conservation Laws," *J. Comput. Phys.*, Vol.205, pp.486-508, 2005.