Variational algorithm for construction of dynamical adaptive grids with applications for spatial nonsteady gas dynamics problems

D.V.Rudenko*, S.V.Utyuzhnikov*, **

**Dept. of Computational Mathematics, Moscow Institute of Physics & Technology, 141700 Dolgoprudny, Moscow*
***Dept. of Mechanical, Aerospace & Manufacturing Engineering, UMIST, PO Box 88, Manchester, M60 1 QD, UK*
e-mail: drudenko@3ka.mipt.ru , s.utyuzhnikov@umist.ac.uk, m. (095)408–89-88

An algorithm for generation of dynamically adapted to the solution spatial computational meshes is represented. The algorithm is based on the algorithm by Brackbill and Saltzman for the generation of stationary 2D grids [1]. Functionals characterising required mesh properties, such as smoothness, orthogonality and adaptation to the solution, are introduced. The system of equations of the grid generator, obtained according to this algorithm, and the weight function, which the computational mesh should be adapted to, are described. Grid generator system of equation is effectively solved using a preconditioning approach.

The solution of the grid generator equations determines transformation $\xi = \xi(\mathbf{x},t)$, mapping the original moving computational region onto the stationary computational region $\{\xi,\tau\}$ where the computational mesh is uniform and rectangular. The system of gas dynamic equations is solved in the $\{\xi,\tau\}$ coordinate system. The transformation $\xi = \xi(\mathbf{x},t)$ should satisfy the "geometric conservation law" [2]. The system of gas dynamic equations is solved by Rodionov's UNO-scheme [3]. Restrictions on the computational grid adaptation are introduced to satisfy the stability condition of the numerical solution of the gas dynamical equations. The estimation of the maximal time step value is given for the case, when adaptive meshes are applied. It is shown that the application of the dynamically adaptive computational meshes allows us to weaken restriction on the maximum value of the time step.

The effectiveness of the algorithm suggested is illustrated by the solutions of some test problems.

1. *Brackbill J.U., Saltzman J.S.* Adaptive zoning for singular problems in two dimensions// J. Comput. Physics. 1982. V.46. p.342-368.

2. *Thomas P.D. and Lombard C.K.* Geometric conservation law and its application to flow computations on moving grids// AIAA. J. 1979. V.17, No10, p.1030-1037.

3. *Rodionov A.V.* A second order monotone scheme to calculate nonequilibrium flows by shock-capturing technique (in Russian), Journal of Comp. Math. & Mathem. Physics, v.27 1987, pp.585-593