# User's guide

**Introduction.**

This fold is for the numerical experiments for the velocity-pressure-entropy-augmented Godunov scheme. The fold should be placed in the root directory of D disk and uses Compaq Visual Fortran 6 (under Windows XP) and Matlab (probably of any version). The fold contains the following folds:

1) Fold "algorithm" contains the program (project) for implementing the scheme.

2) Fold "Initial_values" contains the programs (projects) for preparing initial values, and it contains several folds:

2.1) Fold "blast_waves" is for Example 6.8, the blast waves problem.

2.2) Fold "pure_rarefaction" is for Example 6.2.

2.3) Fold "Riemann" is for several Riemann problems, including Example 6.3, Example 6.4, Example 6.5, Example 6.6, and Example 6.7.

2.4) Fold "Shu" is for Example 6.9, the Shu and Osher problem.

2.5) Fold "sine_waves" is for Example 6.1.

Each of the above folds contains a fold "theater" that contains the Matlab files for drawing pictures for the numerical simulations.

2.6) Fold "convergence_check" contains a little program (project) for computing the numerical errors and convergence rates for Example 6.1 and 6.2.

2.7) Fold "boundary_conditions" contains several Fortran files for treating boundary conditions.

3) Fold "Riemann_1d" contains a program (project) for 1D Riemann solver that provides exact solutions of Riemann problems for comparison.

4) Fold "input" is a fold for storing the initial values in DAT files for numerical simulations.

5) Fold "output" is a fold for storing the output values in DAT files for numerical simulations.

6) Fold "show" is a fold for storing output values for numerical simulations for drawing pictures with Matlab.

Finally, there is a BAT file "RESTORE" that deletes all the DAT files in fold "input" and copies all the DAT files in the fold "output" into the fold "input".

**Implementation.**

1) **Preparing initial values.**

1.1) Double-click the corresponding dsw file under the Compaq Visual Fortran to open the corresponding workspace (project) for preparing the initial values. For example, double-click the file

"initial_riemann.dsw" in "D:\Godunov_augmented\initial_values\Riemann" to open the workspace (project) for preparing the initial values for a Riemann problem.

1.2) After the "Build all" operation the user can "execute" the exe file to run the program to obtain the initial values. In running all the programs the value of "cells number" should be provided at user's will. In running the programs for Riemann problems the value of "case number" should be provided at user's will.

1.3) The produced initial values are DAT files and stored in the fold "output". To compute the numerical solution the user needs first to run the BAT file "RESTORE" by double-clicking it to copy the initial value files from the fold "output" into the fold "input".

2) **Computing numerical solution.**

2.1) Double-click "Godunove_augmented.dsw" in "D:\Godunov_augmented\algorithm" to open the workspace (project) for the algorithm of the scheme.

2.2) After the "Build all" operation the user can "execute" the exe file to run the program to compute the numerical solution with the initial values from the fold "input". In running the program the values of "final_time" and "final_steps" should be provided at user's will. The program will be terminated by either that the "current_time" reaches the "final_time" or that the "current_step" reaches the "final_step".

2.3) There are two parts of output results. The first part is stored in the fold "output", which is identical in form to the initial value files in the fold "input". Therefore, the user can copy these DAT files back to the fold "input" by running the file "RESTORE.BAT". After the copy the user can run the program from the previously terminated moment with a new (greater) "final_time" and new "final_step". The second part is stored in the fold "show" and is used for drawing pictures using Matlab.

**Visualizing numerical results.**

1) The user can use the Matlab files provided in the fold "theater" in each case to draw pictures with the numerical data from the fold "show".

2) For Riemann problems, the exact solutions can be obtained by running the program in the fold "Riemann_1d" to produce the corresponding exact solutions and store them in the fold "exact" in the fold "show". For the blast-waves problem and Shu problem the exact solutions are computed using a WENO scheme on very fine grids and are already stored in the folds "exact_solutions" in the corresponding folds "theater".