# User's guide

## Introduction

The folder “workf90\_1\” is for the numerical experiments of three interfacial instability problems using the conservative front-tracking method equipped with numerical dissipations simulating the real physical dissipations missing in the Euler system of fluid dynamics. The three simulated problems are Peng, Zabusky and Zhangs’ Richtmyer-Meshkov interface problem and Haas and Sturtevants’ two shock-bubble interaction problems. The folder should be placed in the root directory of the “D\” disk and uses Compaq Visual Fortran6 (under Windows XP) and Matlab (probably of any versions). The folder has the following structure:

1. The folder “main\_itf\main\_euler\" contains the program (project) for the front-tracking method.
2. The folder “ini\_data\" contains the programs (projects) for preparing the initial values of the three problems and the corresponding boundary conditions for their simulations. The folder “init\_HS\_airHe\” is for the air-helium shock–bubble problem, the folder “init\_HS\_airR22\” is for the air-R22 shock-bubble problem, and the folder “init\_RM\_peng\” is for the Peng et al’s Richtmyer-Meshkov problem. Each of the above folders contains also the Matlab visualization facilities for the simulation in the corresponding folders “theater\” and/or “theater\_1d\”.
3. The folder “Riemann\" contains programs (projects) for one-dimensional Riemann solvers that provides exact solutions of the Riemann problems for possible comparisons.
4. The folder “input\" is for storing the initial values in DAT files for the numerical simulations.
5. The folder “output\" is for storing the output values in DAT files for the numerical simulations.
6. The folder “show\" is for storing output values of numerical simulations for visualization using Matlab.
7. The fortran90 files of the programs are scattered everywhere in all the folders, especially in the folder “BS\_struct\”, which contains most files for basic data structures, and in the folder “BS\_oprt\”, which contains most files for different operations.

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

## Implementation

1. Preparing initial values.
   1. Double-click the corresponding dsw files to open the workspaces (projects) for preparing the initial values. For example, double-click the file “initial\_HS\_airHe.dsw" in the folder “init\_HS\_airHe\" to open the workspace (project) for preparing the initial values of the Haas Sturtevants’ shock-helium-bubble problem. Similar operations open the initial value preparing workspaces for the other two problems.
   2. After the “Build all" operation the user can “execute" the exe files to run the programs to obtain the initial values. In all the programs the values of “cells number" should be provided at user's wish, the values of “cases" should be 1, and the values of “Radius” in the two shock-bubble problems should be 0.25.
   3. The produced initial values are DAT files and stored in the folder “output\". To compute the numerical solution the user needs to run the BAT file “RESTORE.bat" by double-clicking it to copy the initial value files from the folder “output\" into the folder “input\".
2. Computing numerical solutions.

2.1) Choose values of the dissipation coefficients, mass\_diffusion, viscosity and heat\_conduction, in the fortran file “eulernew.f90” in the folder “main\_itf\main\_euler\euler\” as parameters.

2.2) Double-click “main\_euler.dsw" in the folder “main\_itf\main\_euler\" to open the workspace (project) for the algorithm of the front-tracking method.

2.3) After the “Build all" operation the user can “execute" the file “main\_euler.exe” to run the program to compute the numerical solution with the initial values from the folder “input\". In the program the values of “final\_time" and “maximum\_step" should be provided at user's wish. The program will be terminated at the moment either when the “current\_ time" reaches the “final time" or when the “current\_ step" reaches the “maximum\_step".

2.4) There are two parts of output results. The first part is stored in the folder “output\", which is identical in form to the initial value files in the folder “input\". Therefore, the user can copy these DAT files back to the folder “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 “maximum step". The second part is stored in the folder “show\" and is used for drawing pictures using Matlab.

## Visualizing numerical results

The user can use the Matlab files in the folder "theater\" in the folder for initial value preparing in each case to draw pictures with the numerical data from the folder “show\". In each “theater\” folder there is “show\_dp.m” for showing the tracked interface. Add or delete some part of the Matlab code can make the grid on or off in the picture. There are “show\_rhoc.m”, “show\_uc.m”, “show\_vc.m” and “show\_pc.m” for showing respectively the density, x-velocity, y-velocity and pressure in a contour style. There are also “show\_rhocc.m”, “show\_ucc.m”, “show\_vcc.m” and “show\_pcc.m” for showing respectively the density, x-velocity, y-velocity and pressure in a different contour style.