1 About this package

This matlab package implements the Lagrangian flux calculation (LFC) method described in the manuscript Q. Zhang & L. Ding "Lagrangian Flux Calculation Through A Fixed Planar Curve For Scalar Conservation Laws" which may appear in the SIAM Journal on Scientific Computing (SISC). This document lists the relevant files for reproducing the tables and figures in that manuscript.

2 File

2.1 ../LFC

This folder contains the main files of our LFC method.

1. `fluxDR2D.m` is the main subroutine of this package, which computes the flux of a scalar function through a static simple curve by our LFC method.
2. `testfluxDR2D.m` is a demo of our LFC method.
3. `donatingRegion.m` is the subroutine which constructs the spline approximation of donating region.
4. `splinegauss.m` is modified from the package maintained by Sommariva and M. Vianello [2] `http://www.math.unipd.it/~marcov/software.html`.

2.2 ../FluxDoRe2D2019723

This package is downloaded from `https://github.com/dkarrasch/FluxDoRe2D`. The latest commit was on 2019 Jul 23. This package is maintained by Daniel Karrasch. For more information, please read `../FluxDoRe2D2019723/readme.md`.

1. `../FluxDoRe2D2019723/examples/generateTable4_4.m`

   This file is modified from `FluxDoRe2D2019723/examples/demoValidation.m`, which computes relative error by the method described in the paper [1] and reports the CPU time. It will reproduce the left column of Table 4.4 in the manuscript. Notice that this package has adopted parallel computation while our subroutine `fluxDR2D.m` hasn't. Hence, we disabled the parallel computation when we reproduced the left column of Table 4.4 in the manuscript. In this file, we use the command " parpool('local',1)" to disable the parallel computation.

2.3 ../paper

This folder contains the files which reproduce the tables and figures in the manuscript.

1. `generateTable4_123.m` computes the errors and convergence rates of each tests, which reproduces Table 4.1, 4.2, 4.3 in the manuscript.

2. `generateFiguresForPaper.m` reproduces the figures in the manuscript.

3. `StreamLineRomKedar.m` reproduces the streamline animation of the oscillating vortex pair (OVP) flow.

4. `dynamicRomKedar.m` reproduces Fig 4.3 in the manuscript.

5. `generateTable4_4.m` computes the relative errors of flux by LFC method and reports the CPU time, which reproduces the right column of Table 4.4 in the manuscript. One can compare these results with those results reproduced by `../FluxDoRe2D2019723/examples/generateTable4_4.m`

6. `generateTable4_6.m` reproduces Table 4.6 in the manuscript.

2.4 ../advectEquation/fv

This folder contains the subroutines that implement the fourth-order accurate finite volume (FV) algorithm [3] and perform some relevant numerical tests.

1. `generateTable4_5.m` computes relative errors and compares the CPU time of the FV method and LFC method, which reproduces Table 4.5.

2.5 ../other

This folder includes the tools for generating figures.

2.6 ../useCase

This folder includes the scalar functions and velocity fields which may be used in reproducing the tables or figures in our manuscript.

References

[1] F. Hofherr and D. Karrasch. Lagrangian transport through surfaces in compressible flows. *Siam Journal on Applied Dynamical Systems*, 2017.

[2] A. Sommariva and M. Vianello. Gauss-Green cubature and moment computation over arbitrary geometry. *J. Comput. Appl. Math.*, 231:886–896, 2009. doi:10.1016/j.cam.2009.05.014.

[3] Q. Zhang, H. Johansen, and P. Colella. A fourth-order accurate finite-volume method with structured adaptive mesh refinement for solving the advection-diffusion equation. *Siam Journal on Scientific Computing*, 34(2):B179–B201, 2013.