Software for 2D Multilevel Schemes for Conservation Laws

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* Research supported by TMR project :
Wavelets in Numerical Simulation

General Setting

2D Compressible Euler Equations

High order shock capturing schemes

High computational cost

Multilevel schemes (Harten)

Implemented Algorithm

Initialization of parameters

Time evolution : Runge-Kutta Order 2,3

- Multiresolution transform
  - Harten Point Values Order 4
- Thresholding procedure
  - $(x_i, y_j) \quad b_{ij} = 0, 1$
- Multilevel computation of fluxes
- Real time visualisation
  - DISLIN
- Reference solution
  - Errors, efficiency,..

Multilevel evaluation of the numerical divergence

$$\vec{U}^{n+1}_{ij,0} = \vec{U}^{n}_{ij,0} - dt\ \vec{D}_{ij,0}(U^n)$$

$$\vec{D}_{ij,0}(\vec{U}) = \frac{\vec{F}_{i+1/2,j} - \vec{F}_{i-1/2,j}}{dx} + \frac{\vec{G}_{i,j+1/2} - \vec{G}_{i,j-1/2}}{dy}$$

Finest grid $\mathcal{G}_0$ $\{\mathcal{G}_L, \mathcal{G}_{L-1}, .., \mathcal{G}_1\}$

Algorithm

Coarsest grid $\mathcal{G}_L$:

Computation with solver of $\vec{D}_{ij,L}(\vec{U}^n)$ $(x_i, y_j) \in \mathcal{G}_L$

Finer grids $\mathcal{G}_{L-1}, .., \mathcal{G}_1$:

if $b_{i,j,l} = 1$ Solver computation of $\vec{D}_{ij,l}(\vec{U}^n)$

if $b_{i,j,l} = 0$ Interpolation of $\vec{D}_{ij,l}(\vec{U}^n)$ with $\vec{D}_{km,l+1}(\vec{U}^n)$

Solver : Roe + ENO2,ENO3

Marquina's flux splitting + PHM

New versions

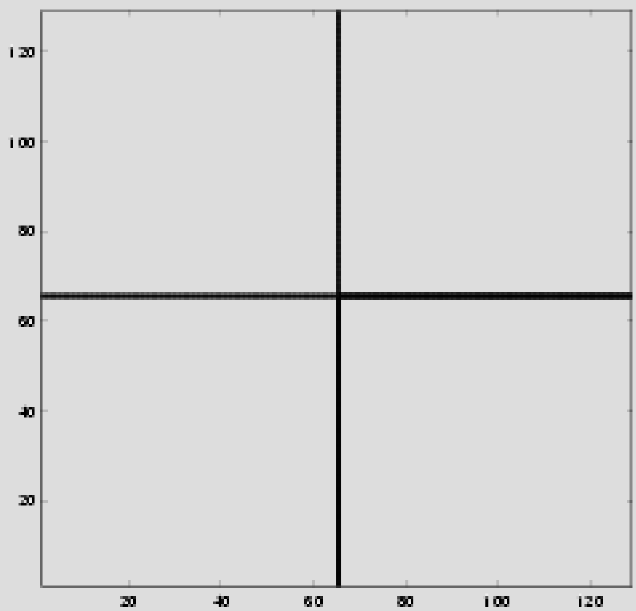
Optimized

data structures P. Mulet (Valencia)

Parallelized

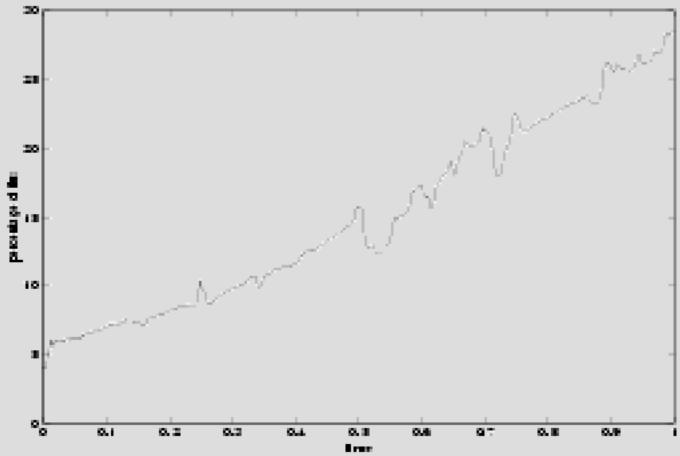
MPI P. Dussoulliez (Marseille), P. Mulet

Exemple

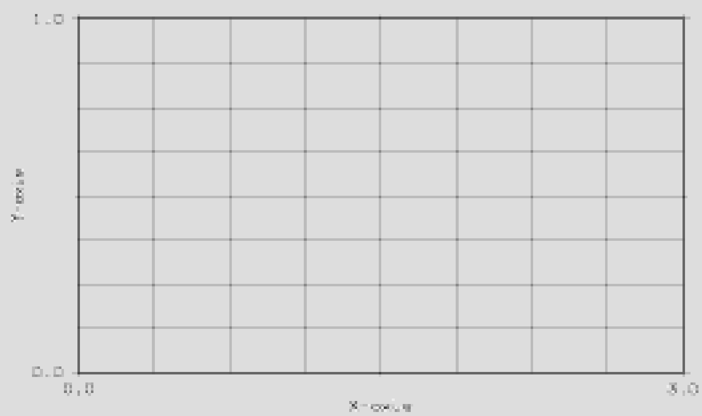


Efficiency

Percentage of expensive fluxes



Gain $\theta \sim 3.6$



1.0
0.0
0.0
8.0
X-axis
Y-axis