EF-ROM REPORT

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1 EF-ROM-DF

The following are burgers equation,

$$\begin{cases} u_t - \nu u_{xx} + \overline{u} u_x = f & x \in \Omega, \\ u(x,0) = u_0(x) & x \in \Omega, \\ u(x,t) = g(x,t) & x \in \partial\Omega \end{cases} \tag{1.1}$$

where ν is the diffusion parameter, f the forcing term, $\Omega \subset R$ the computational domain, $t \in [0,T]$.

$$u_0(x) = \begin{cases} 1 & x \in (0, \frac{1}{2}], \\ 0 & x \in (\frac{1}{2}, 1). \end{cases} \tag{1.2}$$

where $\nu = 10^{-3}$, domain $x \in [0,1]$, time interval $t \in [0,1]$. The boundary conditions are homogeneous Dirichlet $u(0,t) = u(1,t) = 0$ for all t, the forcing term $f = 0$. The following parameters were used in the computation $\Delta x = 1/1024$; time-step $\Delta t = 10^{-3}$ with Backward Euler in DNS, $\Delta t = 10^{-4}$ with Forward Euler in EF-ROM and L-ROM; number of snapshots m=101 (i.e. saved at every 10 step in DNS). the above figure

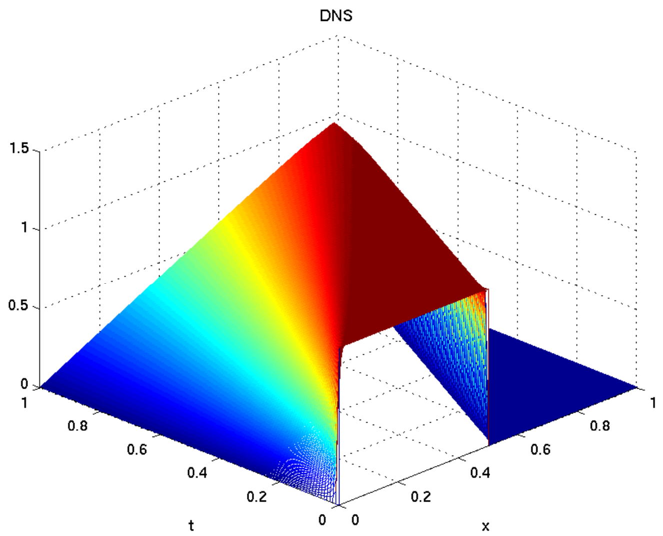

Figure 1.1: this is the DNS solution

indicates optimal $\delta = 0.0003$, and $\delta = 0.0006$. Then, we check the time evolution: From the above the optimal $\delta = 0.0003$.

2 POD-Leray-DF

I used $r = 6, 10, 20$. The optimal for each one is pretty close. See the following picture 2.1.
So, according to optimal L^2 error, the optimal around $\delta = 0.135$. I plot the time-evolution, for $\delta = 0.135$ and $\delta = 0.5$.see fig.2.2

From the above, we know that, $\Delta t = 1/10000$, as δ increase, the solution becomes bad. BUT, when we try $\Delta t = 1/30000$.

3 EF-ROM-Projection

For EF-ROM-projection, I did 2 test, one is for $r = 6$ while $R = 2, 4, 5$, another is for $r = 20$, $R = 5, 10, 15$. I also calculated the kinetic energy at each time level. My results show that IF r and R are small, the results are bad. BUT if r and R are large, EF-ROM-projection can still be good. see the plots 3.1, 3.2.

4 POD-Leray-Projection

For Leray-Projection, those results are good if we choose R is pretty close to r. It doesn't matter how large r it is. see plots 4.1, 4.2.