High Order Workshop Results for Case 3.3 Taylor-Green Vortex $Re = 1600$

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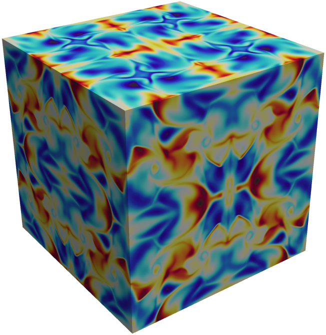
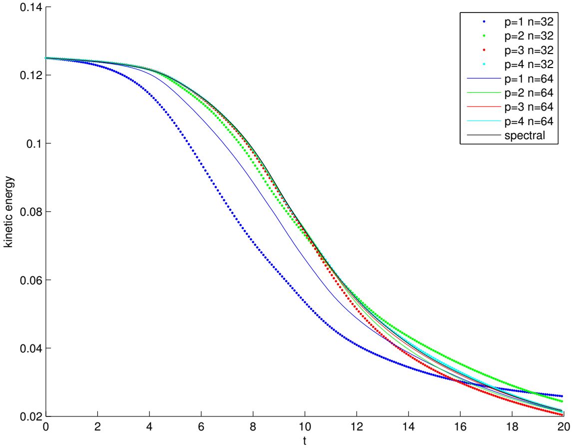
Flow Solver

- Unstructured Discontinuous Galerkin Finite Element Method
- Modal basis functions
- Time discretization: Runge-Kutta 4
- Compressible Navier-Stokes in conservative variables
- Inviscid flux: Lax-Friedrichs, Roe, AUFS
- Viscous flux: symmetric interior penalty (SIP)



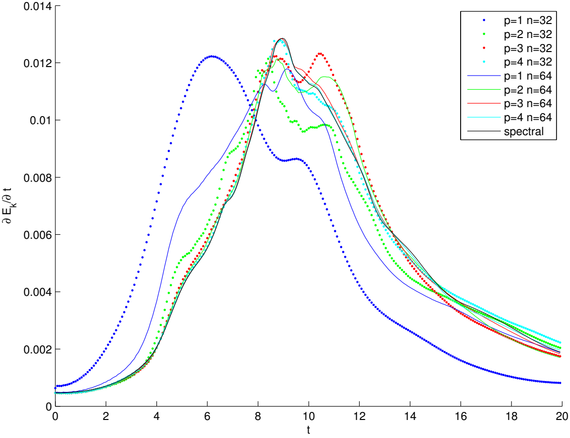
Results

Kinetic energy for the Taylor-Green vortex at $Re = 1600$



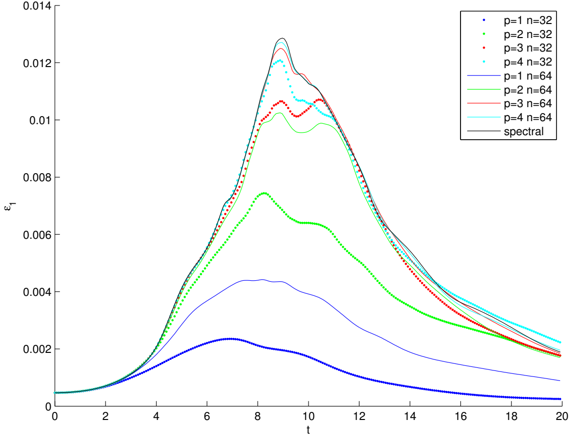
Results

Dissipation rate $\frac{\partial E_k}{\partial t}$ for the Taylor-Green vortex at $Re = 1600$



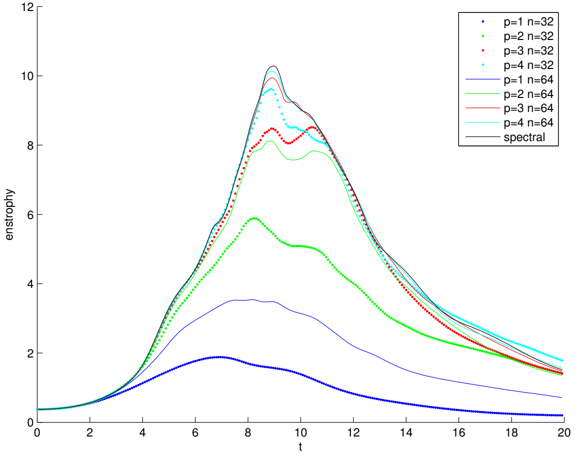
Results

Dissipation rate ϵ_1 for the Taylor-Green vortex at $Re = 1600$



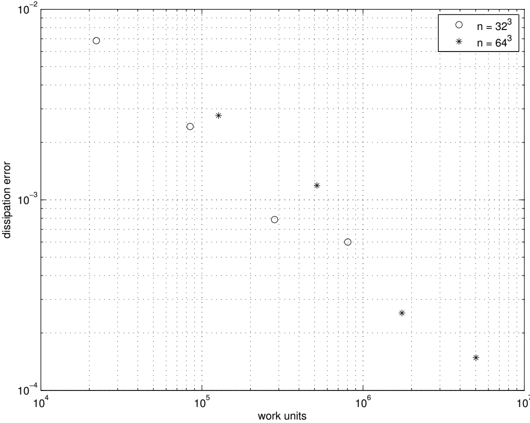
Results

Enstrophy $\mathcal{E}$ for the Taylor-Green vortex at $Re = 1600$



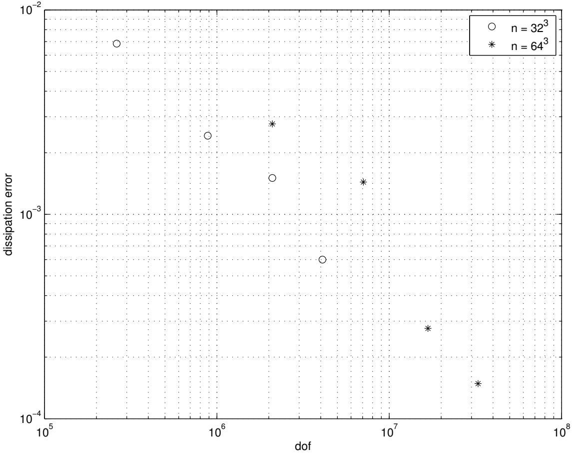
Results

- Dissipation error vs work units for the Taylor-Green vortex at $Re = 1600$
- Time step is fixed and based on stability of most resolved case



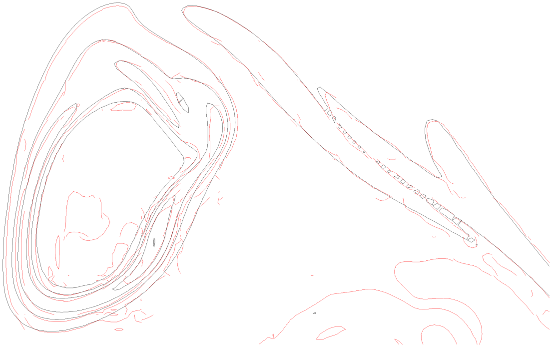
Results

Dissipation error vs DOF for the Taylor-Green vortex at $Re = 1600$



Results

Iso-Contours of vorticity magnitude $\frac{L}{V_0}|\omega| = 15, 10, 20, 30$ at $\frac{t}{t_c} = 8$ and $\frac{x}{L} = -\pi$ for the Taylor-Green vortex at $Re = 1600$, DG $p = 4$, $n = 64^3$ (red), pseudo-spectral (black)



Conclusions

- The resolved simulations match spectral closely
- p-refinement improves accuracy better than h-refinement
- Work units are reasonable considering modal basis and unstructured data structure