Direct and Large-Eddy Simulation of Non-Oberbeck-Boussinesq Effects in a Turbulent Differentially Heated Cavity

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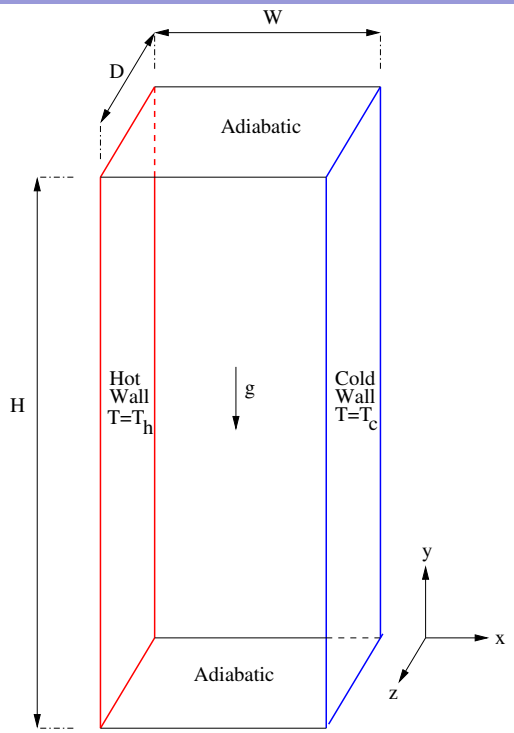

Case Definition

Differentially Heated Cavity

- $Ra = 3 \times 10^{11}$
- $Pr_r = 4.31$
- $\Gamma = H/W = 5$
- $T_h = 60\ ^\circ C$
- $T_c = 20\ ^\circ C$

Governing Eqns for NOB DNS

$$\begin{aligned} \nabla \cdot \mathbf{u} &= 0, \\ \partial_t \mathbf{u} + \mathcal{C}(\mathbf{u}, \mathbf{u}) &= 2\rho_r^{-1} \nabla \cdot (\mu S(\mathbf{u})) - \nabla p + (1 - \rho/\rho_r)\mathbf{g}, \\ \partial_t T + \mathcal{C}(\mathbf{u}, T) &= (\rho_r c_{p,r})^{-1} \nabla \cdot (\lambda \nabla T) \end{aligned}$$

where $\mu(T)$ and $\lambda(T)$ are temperature dependant, whereas $c_{p,r}$ and ρ_r are evaluated at the reference temperature, $T_r = 40\ ^\circ C$.
The viscous dissipation term is discritized as:

$$2\nabla \cdot (\mu S(\mathbf{u})) = \nabla \cdot (\mu \nabla \mathbf{u}) + \nabla(\nabla \cdot (\mu \mathbf{u})) - \mathcal{C}(\mathbf{u}, \nabla \mu),$$

which can be **straighforwardly implemented** by **re-using operators**.

LES models

- the wall adapting local eddy-viscosity (WALE)
- QR
- the WALE model within a variational multiscale framework (VMS-WALE)

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For details, please see our poster.

Thank you for your attention!

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