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# Turbulent flow in a Differentially Heated Cavity: DNS and Regularization Modeling

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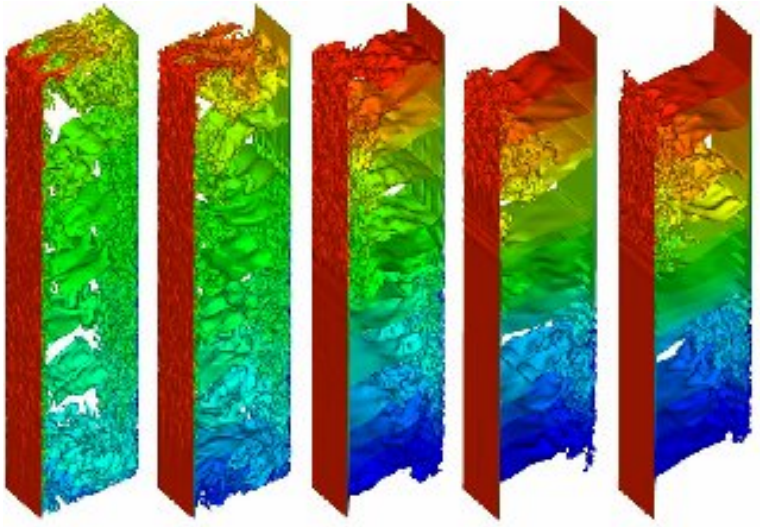
# Symmetry-preserving regularization modeling

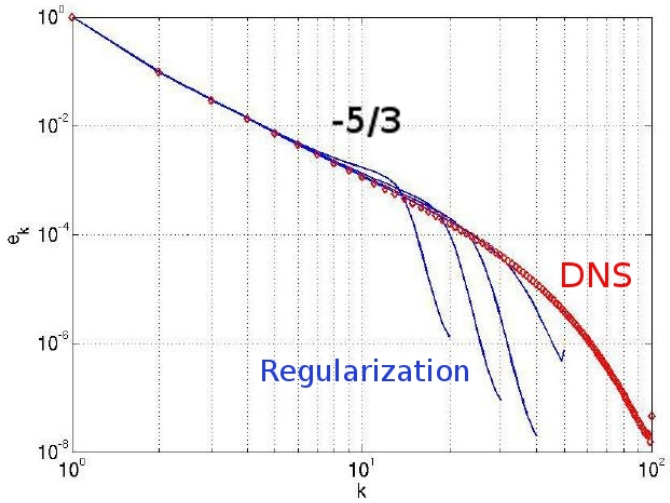
The regularization methods basically **alters the convective term**, $\mathcal{C}(u,v) = (u \cdot \nabla)v$, to **restrain the production of small scales** of motion.

$$\underbrace{\partial_t u + \mathcal{C}(u,u) = \nu \Delta u - \nabla p}_{\text{DNS}} \quad \longrightarrow \quad \underbrace{\partial_t u + \mathcal{C}_4(u,u) = \nu \Delta u - \nabla p}_{\text{Regularization}}$$

$$\mathcal{C}_4(u,v) = \mathcal{C}(\bar{u},\bar{v}) + \overline{\mathcal{C}(\bar{u},v')} + \overline{\mathcal{C}(u',\bar{v})} \qquad \textbf{(C\&F,2008)}$$

The $\mathcal{C}_4$—method **preserves inviscid invariants** of the NS equations, $i.e.$ **energy**, enstrophy, helicity






**Successfully tested for a turbulent differentially heated cavity!** **(C&F,2010)**