14th International Heat Transfer Conference - IHTC14
8 - 13 August 2010, Washington DC, USA

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

F.Xavier Trias*, *, Andrey Gorobets*, Assensi Oliva*, Roel Verstappen*

*Heat and Mass Transfer Technological Center, Technical University of Catalonia
C/ Colom 11, 08222 Terrassa, Barcelona, Spain, E-mail: cttc@cttc.upc.edu

*Institute of Mathematics and Computing Science, University of Groningen
P.O. Box 407, 9700 AK Groningen, The Netherlands, E-mail: R.W.C.P.Verstappen@rug.nl
Symmetry-preserving regularization modeling

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

\[
\partial_t u + C(u, u) = \nu \Delta u - \nabla p \quad \rightarrow \quad \partial_t u + C_4(u, u) = \nu \Delta u - \nabla p
\]

**DNS**

**Regularization**

\[
C_4(u, v) = C(\bar{u}, \bar{v}) + \overline{C(\bar{u}, v')} + \overline{C(u', \bar{v})}
\]  

(C&F, 2008)

The *\( C_4 \) — method preserves inviscid invariants* of the NS equations, *i.e. energy*, enstrophy, helicity

Successfully tested for a turbulent differentially heated cavity!  

(C&F, 2010)