XX Fluid Mechanics Conference KKMP2012,
Gliwice, 17-20 September 2012

BLENDING THE RANS AND LES STRATEGIES FOR HIGH RE AND RA WALL-BOUNDED FLOWS

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There is a widespread view that after four-decades of exhaustive development and testing, the RANS turbulence modelling has reached its limits. Attention in both the applied-research and industrial communities turned a few years ago to large-eddy simulations (LES), but the past experienced brought some disappointments. While the LES is proving to be a powerful and valuable research tool, because of formidable requirements on grid resolution (especially for wall-bounded flows), it has not so far fulfilled its promise to emerge as a new industrial standard for CFD. RANS methods continue to be the mainstay of industrial and environmental CFD, but are being repeatedly confronted with some new, often contradicting challenges. On one hand, further refinement of advanced models are desired aimed at better accounting for flow three-dimensionality, unsteadiness, effects of body forces and rotation, turbulence anisotropy and vortical dynamics, all aimed at ensuring more accurate computations of complex real-life industrial and environmental flows. Moreover, by realizing that irrespective of the modelling sophistication the conventional single-point RANS cannot capture any spectral features, attention is also focused on sensitising RANS models to flow instabilities, or at combining RANS and LES into a unique "hybrid" method aimed at utilizing advantages of each in different flow regions. On the other hand, some industries continue to insist on ever simpler, more economical and robust models than hitherto available in the commercial CFD codes, to be used on coarse, automatically generated (thus not fully controllable) computational grids in conjunction with fast multi-variant design optimisation.

We consider some recent efforts toward accommodating RANS modelling to computing of complex industrial and environmental flows with heat transfer. Considered are several approaches to combing RANS with LES. Some noted controversies in hybrid RANS/LES are discussed, illustrated by several examples of flows of industrial and environmental relevance.