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## Implicit/explicit SGS modelling: pros and cons

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### Abstract

After a brief reminding of the general principle of Large Eddy Simulation (LES), the mismatch between practice and theory in LES is discussed through the contribution of numerical errors. Then, the concept of regularization is introduced as the foundation of implicit LES. In the first part of the presentation, the notion of implicit filtering is addressed. The guideline turbulent flow is the 3D Taylor-Green problem at high Reynolds number. LES free of any subgrid-scale (SGS) modelling is found to lead to an overdissipative behaviour that can be significantly reduced using standard or dynamic Smagorinsky SGS model. These counterintuitive results are discussed while exhibiting the crucial role of numerical errors and the very poor filtering (if not defiltering) effect of the standard or dynamic Smagorinsky SGS model. Then, it is shown that implicit LES can fix these problems with a clear improvement of results. In the second part of the presentation, it is shown that in a more demanding context at higher Reynolds number, the improvement provided by implicit LES is significantly reduced. A posteriori and a priori analyses show that this loss of accuracy is due to the lack of modelling of distant interaction between very large scales and SGS. It is suggested that implicit SGS modelling must be combined with explicit SGS dissipation applied at very large scale.

### Brief Bio

Eric LAMBALLAIS is born on March 7th 1967 in Angers (France).  
Professor of Fluid Mechanics at the University of Poitiers Mechanical Engineering, Scientific computing.

### Research Activities

Computational Fluid Dynamics  
Direct Numerical Simulation, Large Eddy Simulation, High Performance Computing of Turbulence, High-Order Numerical Schemes, Unsteady Flow, Separated Flow, Rotating Flow, Non-Isothermal Flow.

### Teaching

Mechanical Engineering, Fluid Mechanics, Physics of Turbulence, Large Eddy Simulation, Vortex Dynamics, Scientific Computing, Heat Transfer, Structural Analysis.

### Supervision and Expertise

Supervision or co-supervision of 16 PhD Thesis et 13 Master Thesis  
Member of 64 PhD and Habilitation Thesis Committees  
Reviewer for : AIAA Journal, Aerospace Science and Technology, Acta Mechanica, Comptes rendus de l'Académie des Sciences, Computers and Fluids, Experiments in Fluids, Flow, Turbulence and Combustion, Fluid Dynamic Research, International Journal of Heat and Fluid Flow, International Journal for Numerical Methods in Fluids, Journal of Computational Physics, Journal of Fluid Mechanics, Journal of Fluids Engineering, Journal of Scientific Computing, Journal of Turbulence, Ocean Engineering, Physics of Fluids  
Member of Visiting Committees of laboratory (4 times) and Recruitment Committees of Lecturer and Professor (8 times)  
Reviewer for the ANR (8 times), ANRT (once), ERC (once) and PRACE (5 times)

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