

Contents

1	Scope of the lecture and references	3
2	Large-Eddy Simulation: from practice to theory	5
2.1	LES: statement of the problem	5
2.2	LES: mathematical models	8
2.2.1	The filtered Navier-Stokes equations model	9
2.2.2	A more realistic model: the twice-filtered Navier-Stokes equations	12
2.2.3	Statistical mathematical models	13
3	Finding a LES model for multifluid flows	15
3.1	Generals	15
3.2	Filtering approach for interfacial flows	16
3.2.1	Statement of the problem	16
3.2.2	Definition of filtered variables and parasitic jump contributions	17
3.2.3	Filtered governing equations and generalized jump relations	19
3.3	Microscopic, mesoscopic and macroscopic LES approximations for interfacial flows	22
4	Explicit subgrid scale models	24
4.1	Functional subgrid scale models	24
4.1.1	The basic model	24
4.1.2	A few improvement strategies	27
4.2	Structural subgrid scale models	32
4.2.1	Soft deconvolution models	32
4.2.2	Full reconstruction of subgrid scales	34
4.3	Extension for the compressible flows	35
5	The boundary condition issue	38
5.1	General statement of the problem	38
5.2	Turbulent inflow conditions	39
5.2.1	Stochastic turbulence generation methods	39
5.2.2	Deterministic methods	40

5.3	Solid walls on coarse grids: wall models	42
5.3.1	Statement of the problem	42
5.3.2	A few wall models	44
6	LES validation	46
6.1	Sensitivity and efficiency	46
6.2	Validation procedures	47
7	Open problems in the explicit LES approach	48
8	Appendix: the filtered Navier-Stokes equations	51
8.1	Incompressible flows	51
8.2	Compressible flows	52
8.2.1	Definition of the filtered variables	52