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Scale-invariance and turbulence models for large eddy simulation. (English) Zbl 0988.76044

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Summary: Relationships between small and large scale motion in turbulent flows are of much interest in large eddy simulation of turbulence, in which small scales are not explicitly resolved and must be modeled. This paper reviews models that are based on scale-invariance properties of high-Reynolds-number turbulence in the inertial range. The review starts with the Smagorinsky model, but the focus is on dynamic and similarity subgrid models, and on evaluating how well these models reproduce the true impact of the small scales on large-scale physics, and how they perform in numerical simulations. Various criteria to evaluate the model performance are discussed, including the so-called a posteriori and a priori studies based on direct numerical simulation and experimental data. Issues are addressed mainly in the context of canonical, incompressible flows, but extensions to scalar-transport, compressible, and reacting flows are also mentioned. Other recent modeling approaches are briefly introduced.

For the entire collection see [Zbl 0944.00031].

MSC:

76F65 Direct numerical and large eddy simulation of turbulence
76-02 Research exposition (monographs, survey articles) pertaining to fluid mechanics

Keywords:

subgrid-scale modeling; dynamic subgrid model; large eddy simulation; scale-invariance; high-Reynolds-number turbulence; Smagorinsky model; similarity subgrid models; direct numerical simulation; incompressible flows