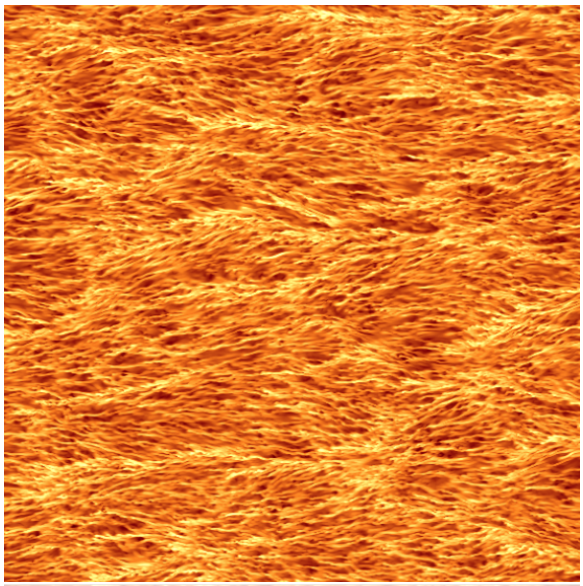
ME EN 7960-003: Large-Eddy Simulation of Turbulent Flows

Fall 2016
Instructor: Jeremy Gibbs

Course Description

This course covers topics related to Large-Eddy Simulation (LES), an advanced Computational Fluid Dynamics (CFD) technique. LES is quickly replacing traditional Reynolds Averaged Navier-Stokes (RANS) modeling as the method of choice for researchers and practitioners studying turbulent fluid flow phenomena in engineering and environmental problems. LES explicitly solves for the larger scale turbulent motions that are highly dependent on boundary conditions (e.g., geometry, large scale forcing) while using a turbulence model only for the smaller (and presumably more universal) motions. This is a distinct advantage over traditional RANS models where the effects of turbulence on the flow field are entirely dependent on the turbulence parameterizations.



Horizontal cross section of potential temperature from a large-eddy simulation of a shear-driven atmospheric boundary layer

Course Objectives

This course will provide students with an introduction to the concepts and principles of the LES technique for numerical simulation of turbulent flows. The course will start by discussing filtering and the turbulence closure problem in the context of LES. It will then move on to derive and examine the filtered forms of the governing equations. Modeling the effect of unresolved turbulence, with Subgrid-Scale (SGS) models, will constitute a significant portion of the course content. Students will learn how to formulate SGS models, how to test SGS models off-line with experimental data and evaluate the performance of SGS models from the results of turbulent flow simulations. The last part of the class will examine issues pertaining to LES of specific flow cases of interest to the class. This will include wall-boundary conditions for wall bounded flows, SGS models for high-Reynolds number flows and SGS modeling for turbulent reacting flows. Time permitting, other topics specific to student interests will be covered.

Prerequisites

ME EN 5700/6700 (or equivalent)

For more information, email: jeremy.gibbs@utah.edu