

Mathematics Graduate Seminar

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1:00p.m., HH-3017

*A brief introduction to Large
Eddy Simulation of atmospheric turbulence*

Abstract:

Large Eddy Simulation (LES) is a numerical method for turbulent fluid flow in which large scale motion is computed directly and small scale motion is parameterized. The cost of such LES is weakly dependent on the Reynolds number, $O(\log Re)$. In the presence of a solid boundary (wall), the energetic scales decrease in the near wall region, thereby requiring an adaptive mesh, which increases the cost of LES to $O(Re^2)$ as close as that of direct numerical simulation (DNS), $O(Re^{2.25})$. Thus, LES of atmospheric turbulence around complex geometries, such as vehicles, buildings, and mountains, remains nearly as costly as DNS, which takes weeks to months wall clock time for typical applications. There is thus a strong demand for a robust and efficient LES model of turbulence in a computationally efficient manner that is suitable for industries. In this lecture, I will briefly outline the LES methodology, and will explain why the unstructured and adaptive mesh techniques drastically increase the cost of LES. A purpose of the talk is to review schemes for capturing large eddies, as well as techniques for modeling near wall energetic scales. I will outline examples of atmospheric turbulence, where LES is the most efficient methodology to understand turbulence induced drag. The lecture will cover material, e.g. elementary techniques of turbulence modeling, lift and drag force, and turbulence in porous media, which is suitable for graduate level without a prior background on turbulence modeling