Date: **November 19, 2004**

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Location: **Olin 305**

Speaker: **Dr. Assad A. Oberai**
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Title: **"Dynamic Closure of Subgrid Models in Fluid Mechanics"**

Abstract

Almost all interesting solutions of the equations of fluid mechanics involve features that are challenging to represent numerically. These include sharp boundary layers in wall bounded flows, shocks in compressible flows and a hierarchy of energetic vortices in turbulent flows. The computational cost of explicitly resolving such features in a numerical simulation is prohibitive. To overcome this, several numerical methods have been developed wherein such features are assumed to lie below the grid resolution and subgrid models are added to account for their effect on the resolved components of the flow.

In designing a subgrid model (which is often a non-linear differential term), analytical solutions of the original partial differential equation are required. However, such solutions are seldom known and typically approximations are utilized. The net result is a subgrid model where the form of the differential term is known, whereas the values of the parameters that appear in it are not. These must be guessed or inferred in some other way. This difficulty is compounded by the fact that these parameters vary in space and time and from one flow to another.

In this talk I will present a general methodology for determining unknown parameters in a subgrid model. This approach, which is an extension of the Germano identity in LES, requires the resulting numerical solution to be optimal in a user-defined norm. This is required not only on the grid on which it is computed, but also on a finite set of nested grids. Through several examples, I will demonstrate the utility of the proposed approach and also describe its extensions to applications other than fluid mechanics.