DANISH CENTER FOR APPLIED MATHEMATICS AND MECHANICS

The 2010 DCAMM Annual Seminar Speaker

Charles Meneveau

Professor
Department of Mechanical Engineering and Center for Environmental and Applied Fluid Mechanics
Johns Hopkins University
Baltimore, MD 21218, U.S.A.
meneveau@jhu.edu

Will give the following two lectures at **The Technical University of Denmark** in October 2010:

Fluid Mechanics and Turbulence in the Wind-Turbine Array Boundary Layer

Thursday October 28, at 11:00
in Auditorium 49, *Building 303N, DTU*
Asmussens Allé, 2800 Kgs. Lyngby

See **abstract** of this lecture (1) on the following pages.

Modeling Multiple-Scale Complex Phenomena on Computers: The curious Case of Fluid Turbulence

Thursday, October 28, at 15:00
in Auditorium 49, *Building 303N, DTU*
Asmussens Allé, 2800 Kgs. Lyngby

See **abstract** of this lecture (2) on the following pages.

The lecture aims at popularizing mechanical science to a broad audience of interested students and staff as well as engineers working in industry.

There will be a reception following the lecture, at 16:00 hrs.

The Danish Centre for Applied Mathematics and Mechanics, DCAMM is a framework for internationally oriented scientific collaboration between staff members at a number of departments at the Technical University of Denmark and Aalborg University. One of the DCAMM activities is its International Graduate Research School, which is funded in part by the Danish Agency for Science, Technology, and Innovation. The "DCAMM Annual Seminar Speaker" is an initiative created to disseminate mechanics to a broader audience.

For further information on DCAMM, see www.dcamm.dk.

DTU

AALBORG UNIVERSITET

The 2010 DCAMM
Annual Seminar Speaker

The Technical University of Denmark

Auditorium 49, Building 303N
Asmussens Allé, DTU, 2800 Kgs Lyngby.

Thursday, October 28, 2010 at 11:00

Lecture no. 1:

Fluid Mechanics and Turbulence in the Wind-Turbine Array Boundary Layer

By

Charles Meneveau
Professor
Department of Mechanical Engineering and
Center for Environmental and Applied Fluid Mechanics
Johns Hopkins University
Baltimore, MD 21218, U.S.A.

Abstract:

When wind turbines are deployed in large arrays, their ability to extract kinetic energy from the flow decreases due to complex interactions among them and the atmospheric boundary layer. In order to improve our understanding of the vertical transport of momentum and kinetic energy across a boundary layer flow with wind turbines, Large Eddy Simulations and wind-tunnel experimental studies are undertaken. A suite of LES, in which wind turbines are modeled using the classical "drag disk" concept, are performed for various wind turbine arrangements, turbine loading factors, and surface roughness values. In the wind tunnel studies, the boundary layer flow includes a 3 by 3 array of lightly loaded model wind turbines. The results of both the simulations and experiments are used to shed light on the vertical turbulent transport of momentum and kinetic energy across the boundary layer. The results are also used to develop improved models for effective roughness length scales and to obtain new optimal spacing distances among wind turbines in a large farm. This work is collaboration with M. Calaf, J. Meyers, R. Cal, J. Lebron, H.S. Kang, and L. Castillo, and is supported by the National Science Foundation.

All are welcome!

DANISH CENTER FOR APPLIED MATHEMATICS AND MECHANICS

AALBORG UNIVERSITET

DTU

The 2010 DCAMM Annual Seminar Speaker

The Technical University of Denmark

Auditorium 49, Building 303N
Asmussens Allé, DTU, 2800 Kgs Lyngby.

Thursday, October 28, 2010 at 15:00

Lecture no. 2:

Modeling Multiple-Scale Complex Phenomena on Computers: The curious Case of Fluid Turbulence

By

Charles Meneveau

Professor
Department of Mechanical Engineering and
Center for Environmental and Applied Fluid Mechanics
Johns Hopkins University
Baltimore, MD 21218, U.S.A.

Abstract:

Fluid turbulence is an area of classical physics that is widely recognized to be a formidably difficult problem. The Navier-Stokes equations are the fundamental continuum description of turbulent flows. However, in order to find solutions that are relevant to fields where turbulence matters (environmental and geophysical flows, aeronautics and transportation industry, energy, astrophysics), we need a systematic theory of turbulence. But as Richard Feynman (1979) famously remarked: "With turbulence, it's not just a case of physical theory being able to handle only simple cases—we can't do any. We have no good fundamental theory at all." One of the salient difficulties of turbulent flows is the mixture of randomness and structure. Also, it is multi-scale, meaning that motions of a wide range of length and time-scales are present and interact non-linearly. While a unified theory of turbulence has not yet been found, computer simulations can help "manage" the challenges. In this presentation, the speaker will review these basic challenges and show how computer simulation has stepped in to help. Sample applications of such computer models will be presented during the talk, ranging from predictions of the spread of pollen in the atmospheric boundary layer to understanding the efficiency of large arrays of wind turbines.

There will be a reception after the lecture. **All are welcome!**

DANISH CENTER FOR APPLIED MATHEMATICS AND MECHANICS

AALBORG UNIVERSITET

DTU