Karlsruher Institut für Technologie

Institut für Hydromechanik (IfH)
Prof. Dr.-Ing. Markus Uhlmann

Institut für Mechanik (IFM)
Prof. Dr.-Ing. Peter Betsch
Prof. Dr.-Ing. Thomas Seelig

Institut für Strömungsmechanik (ISTM)
Prof. Dr.-Ing. Bettina Frohnapfel

Institut für Technische Mechanik (ITM)
Prof. Dr.-Ing. Thomas Böhlke
Prof. Dr.-Ing. Alexander Fidlin
Prof. Dr.-Ing. Carsten Proppe
Prof. Dr.-Ing. Wolfgang Seemann

Kolloquium für Mechanik

Referee: **Mahdi Abkar, Assistant Professor**
Department of Engineering - Mechanical Engineering, Aarhus University, Denmark

Date: Thursday, June 28, 2018
Time: 15:45 h
Location: 10.81, HS 62 (R 153)

Title: **Interaction of thermally stratified atmospheric boundary layers with wind turbines and wind farms**

Abstract

With the thriving wind energy market all around the world, there is an increasing demand for larger, more efficient and more reliable wind farms. Wind farms extract energy from the ambient flow in the turbulent atmospheric boundary layer (ABL). Hence, optimizing the design and operation of wind farms requires a profound understanding of the mutual interaction between the ABL and wind turbines. Also, with the fast-growing number of wind farms being installed worldwide, it becomes of scientific and practical interest to quantify how the large-scale extraction of energy from the wind will affect the structure of the atmosphere and vice versa. The complexity of such flows makes it difficult to obtain all the needed information through field experiments alone and often necessitates high-resolution eddy-resolving numerical tools such as large-eddy simulation (LES). This talk primarily focuses on:

i. LES as the leading numerical technique to study the interaction between thermally stratified ABLs and wind turbines/farms,
ii. Improved theoretical models for prediction of heterogeneous ABL and wake flows under different atmospheric regimes (e.g., new subgrid-scale models for LES, new wind farm parameterizations in large-scale atmospheric models, new analytical wake models, etc.), and
iii. Modeling the velocity and scalar-concentration fluctuations using the hierarchical random additive process (HRAP) formalism, which is a recently proposed interpretation of the Townsend attached eddy hypothesis.

Worth mentioning here is that power extraction from the wind can be achieved using two general types of rotary machines: horizontal-axis and vertical-axis wind turbines. In this talk, both categories are considered and discussed.

Bio: Mahdi Abkar is currently an Assistant Professor of Mechanical Engineering at Aarhus University. He obtained his Ph.D. in 2014 from the Swiss Federal Institute of Technology (EPFL) in Lausanne followed by a postdoctoral fellowship position at the Center for Turbulence Research (CTR) at Stanford University. His research interests lie on computational fluid dynamics, atmospheric turbulence, large-eddy simulation, wind-farm modeling, optimization, and control.

Alle Interessenten sind herzlich eingeladen.

Prof. Dr.-Ing. Bettina Frohnapfel