MECHANICAL & INDUSTRIAL ENGINEERING COLLOQUIUM: ME 794 001

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MEC 221
2:30pm – 3:30pm

"Advanced Computing for Wind Energy and Environmental Applications"

Computational wind engineering is a broad field that finds applications in renewable energy, emergency response, air pollution, and weather forecasting, where high performance computing is becoming increasingly important. Computational turnaround time is a critical factor to consider when designing a computational model. In this talk, I'll present two applications where rapid simulations can make a tremendous impact on the current practice.

In the first part, I'll describe the development of a short-term wind energy forecasting capability that can resolve wind speed and direction over complex terrain using clusters of graphics processing units (GPUs). An accurate forecasting capability is needed to address load-balancing issues that arise from intermittent winds, and also to increase powerline capacity using the dynamic rating concept. However, there is substantial amount of uncertainty when predicting wind speed and direction over complex terrain, and any wind solver should also operate in the forecasting mode to be a useful tool in real applications. To address these challenges, a multi-scale forecasting engine is proposed. In this engine, a regional weather forecast model will be executed on central processing units (CPU), whereas a micro-scale wind forecasting model will be executed on the GPUs of the same cluster in a multi-scale fashion. The microscale wind solver adopts a large-eddy simulation paradigm with a Cartesian mesh immersed boundary method to resolve arbitrarily complex terrain. The Cartesian mesh topology maps well to the computer architecture of modern GPUs resulting in significant speedups in computations.

In the second part of my talk, I'll present a probabilistic approach to reconstruct a contaminant dispersion event. In emergency situations, a rapid tool is needed to identify what has happened, how much material has been released and where has it been released from. I'll describe a Bayesian method coupled with a data-driven plume model that can infer release parameters of real field tests in minutes on a workstation.

Speaker Bio: *Inanc Senocak is an Associate Professor with the Department of Mechanical and Biomedical Engineering at Boise State University. He received a Ph.D. in aerospace engineering in 2002 from the University of Florida. Prior to joining Boise State in 2007, he held postdoctoral positions at Stanford University's Center for Turbulence Research and at the Los Alamos National Laboratory. His current research interests are computational fluid dynamics (CFD), wind forecasting, atmospheric dispersion and parallel computing with GPUs. Senocak is a recipient of the National Science Foundation's CAREER Award.*