Boulder Fluid and Thermal Sciences Seminar Series

Tuesday, August 15, 2017
10:00am-11:00am (refreshments at 9:45am)
ATOC Conference Room, SEEC N224
Sustainability, Energy, and Environment Complex (SEEC)
University of Colorado, Boulder

Recent developments in actuator methods to model lifting surfaces and their applications to wind turbines

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Several actuator methods to model lifting surfaces (fixed wings as well as rotors) exist today. These methods vary in fidelity, starting from actuator-disk method being the lowest fidelity, followed by actuator-line method, and then by actuator-surface method. Actuator-line method (ALM) has recently found great importance in modeling wind turbines in a stand-alone mode as well as in wind farm. The medium-level fidelity and the proportional computational cost makes modeling of the flow-field in a wind farm using ALM affordable. However, in order to predict the blade loads, power produced, fatigue, the strength of the tip vortices, their break down, turbine-turbine interaction, etc. accurately, the rotors must be modeled as accurately as possible. The work done by the speaker, on the accuracy assessment of state-of-the art ALM and proposal of a modified ALM, has helped enhance the state-of-the-art in rotor modeling. This modified ALM (ALM*) was then applied to a turbine-turbine interaction problem where wake-wake and wake-atmospheric turbulence interaction were studied. The turbulence statistics and unsteadiness of blade loads were studied in detail. Having gained insight into the turbine-turbine interaction problem, ALM* was used to study the flow-field in a mini wind farm. An attempt was made to understand the wake recovery and meandering pattern in a wind farm using a unique wake-plane integration technique. An Actuator Curve Embedding (ACE) method was developed to model a general-shaped blade/curve. This new method takes the state-of-the-art of modeling lifting surfaces a step further and addresses some of the limitations of ALM.

Biography: Dr. Pankaj K. Jha is a senior researcher in CFD and UQ at Envision Energy, based in Houston. He holds a B.S. and M.S. in Mathematics and Computing from India's premier institute, IIT Kharagpur and a Ph.D. in Aerospace Engineering from Penn State. He has worked for GE Aviation in Bangalore, India as a database developer and for CMSoft Inc. in Palo Alto as a CFD software developer earlier.