Aerospace Engineering Graduate Preliminary Oral Exam:
Experimental and Numerical Investigations on the Flow Characteristics of Rotary Machineries

On behalf of Professor Hui Hu,
Meet our graduate student:

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*** The research work described in this thesis includes two topics: 1). An experimental and computational study on the aerodynamic and acoustic characteristics of case fans for computer cooling applications; and 2). A comparative study on the aeromechanic performances and wake characteristics of innovative dual-rotor wind turbines (DRWTs) and conventional single-rotor wind turbine (SRWT). For the first topic, by using a commercially-available cooling fan as the baseline, a number of acoustically tailored modifications are implemented in order to reduce the noise level of the cooling fan, which includes optimizing the rotating blades and guide vanes according to axial fan design theory, adding an intake cone in the front of the hub to guide the airflow into the axial fan smoothly, and reducing the tip clearance to lower the noise generation due to tip vortex structures. For the second topic, a comprehensive study was conducted to investigate the aerodynamics and wake characteristics of innovative dual-rotor wind turbines (DRWTs) with twin-rotor, co- and counter-rotating configurations, in comparison to a conventional single-rotor wind turbine (SRWT). In addition to measuring the power output and dynamic wind loads acting on the SRWT and DRWT models, conventional 2D and stereoscopic Particle Image Velocimetry (PIV) systems were used for detailed wake flow field measurements to quantify the flow characteristics of the turbine wakes and to quantitatively visualize the time evolution of the unsteady vortex structures in the wake flows in order to elucidate underlying physics for higher total power yield and better durability of the wind turbines.