Wake interaction and power production of variable height model wind farms

Understanding wake dynamics is an ongoing research topic in wind energy, since wakes have considerable effects on the power production when wind turbines are placed in a wind farm. Wind tunnel experiments have been conducted to study the wake to wake interaction in a model wind farm in tandem with measurements of the extracted power. The aim is to investigate how alternating mast height influences the interaction of the wakes and the power production. Via the use of stereo-particle image velocimetry, the flow field was obtained in the first and last rows of the wind turbine array as a basis of comparison. It was found that downstream of the exit row wind turbine, the power was increased by 25% in the case of a staggered height configuration. This is partly due to the fact that the taller turbines reach into a flow area with a softened velocity gradient. Another aspect is that the wake downstream of a tall wind turbine to some extent passes above the standard height wind turbine. Overall the experiments show that the velocity field downstream of the exit row changes considerably when the mast height is alternating.