The Future of Vertical - Axis Wind Turbines: X-ROTOR

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X-Rotor Concept:

The X-Rotor is a new offshore VAWT configuration which is designed in two parts - the primary and secondary rotors. The **Primary Rotor** comprises a set of **upper and lower blades.** Its purpose is to increase the incident wind speed for the secondary rotors. The **Secondary rotors** consist of two small horizontal rotors placed at the tips of the lower blades. These produce **power** via generators attached behind them through **direct-drive** (no gearboxes).

X-Rotor Advantages:

- **No gearbox -** makes turbine lighter, and lowers capital & operational costs
- **Low center of gravity -** reduces overturning moments of the rotor
- **Low altitude of machinery -** easier access for repair and increases safety
- **Improves self-starting -** upper blades can be pitched to assist with starts

My PhD Research:

The goal of my PhD is to investigate the **aerodynamic and aeroelastic** effects observed in the X-Rotor and its flowfield through **numerical methods.** This includes building an aero-elastic model capable of describing the effects of blade-vortex interactions and the impact it has on the performance of the X-Rotor.

Numerical Approach:

Aerodynamic Model — Structural Model

Aero-elastic Model

Secondary Rotors (Tip Rotors):

High RPM with direct drive to generators. Optimised for minimal thrust and not for maximimum power extraction.

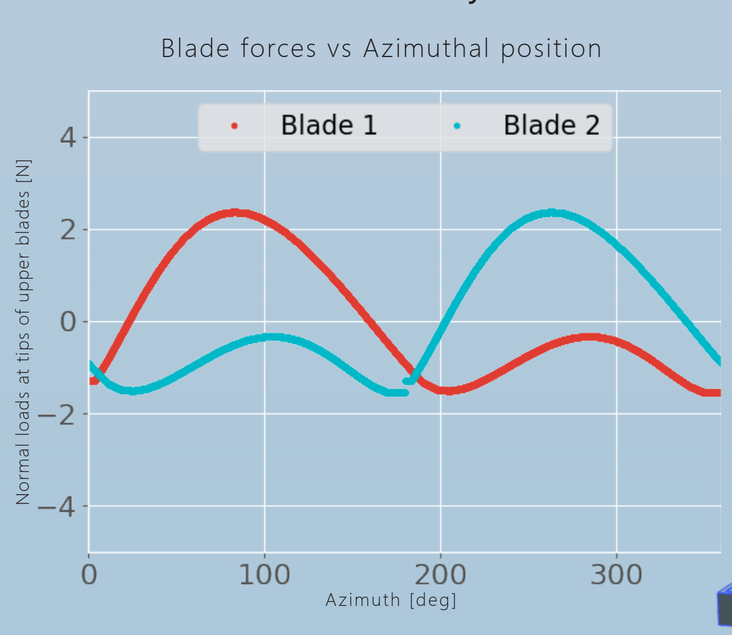
Structural analysis for scaled X-Rotor Model

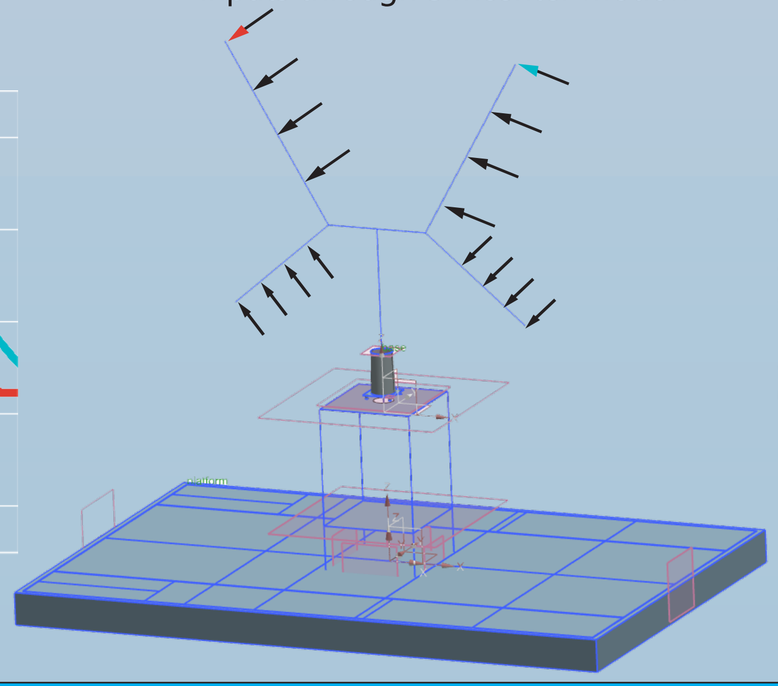
Preliminary results: 2D Actuator Cylinder (Aero) + Simcenter Motion (Struct)

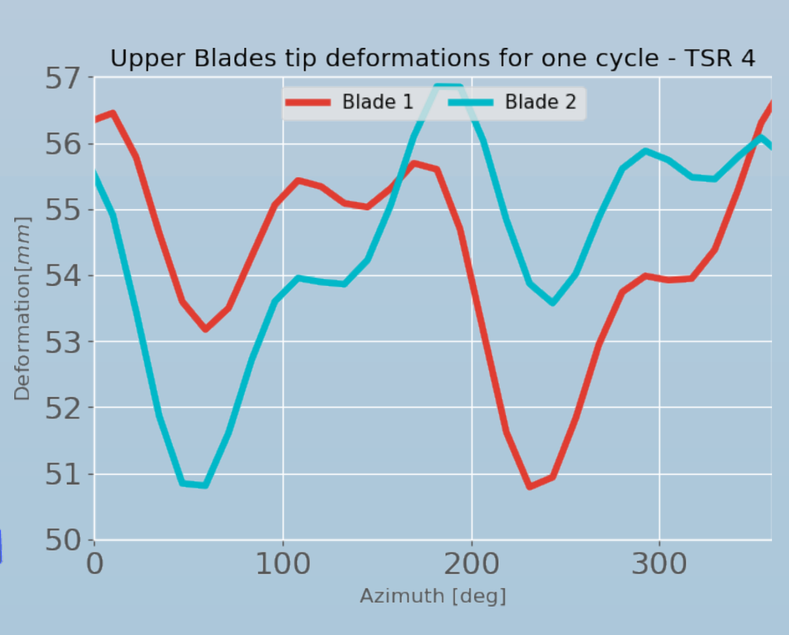
Aerodynamic force evaluation through 2D Actuator Cylinder

Structural dynamic model with aero load inputs through Simcenter Motion

Aero-elastic simulation results







X-Rotor simulation video

TU Delft

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X-ROTOR