Center for Wind Turbine Aerodynamics and Atmospheric Turbulence

# Wakes and Wind Farms
# Tasks 2 and 3

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Steering group meeting
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# Objectives

## Task 2: Wind Turbine Wakes and Clusters

Analyse and simulate turbulent wakes and turbine to turbine interaction subject to

- Wind shear
- Turbulent inflow
- Different wind directions
- Wind veer

**Overall goals**:

- Understanding of wake aerodynamics
- Development of turbulent wake model

# Milestones Task 2

- **M7:** Parabolized stand-alone N-S park model. **Month 14.**
- **M8:** Validation of N-S model for wake behind a single wind turbine. **Month 24.**
- **M9**: Refined far wake model. **Month 24.**
- **M10**: Parametric study of wake interaction. **Month 36.**
- **M11:** Parametric study of wake stability. **Month 36.**
- **M12:** Refined Dynamic Wake model. **Month 48.**

# PhD-project: Søren Juhl Andersen
# Simulation and prediction of wakes and wake interaction in wind farms

**Year 1:**

**Literature review on wake models.**
**Courses**
**Further development of an existing CFD code to conduct a thorough parametric study of the flow field in the wake of a single wind turbine. The parametric study aims at investigating the following:**

- **The influence of shear in the inflow(i.e. a gradient in the atmospheric boundary layer)**
- **Vortex collapsing**
- **Transition between near- and far-wake**
- **Relation between induced turbulence and thrust**
- **How to correctly add ambient and induced turbulence**

**Year 2:**

**Develop guidelines based on the parametric study of a single wind turbine**
**Continued parametric study on the flow field within wind turbine farms investigating the following influences:**

- **The spacing between individual wind turbines.**
- **Stable or unstable atmospheric boundary layer, including vertical mixing.**
- **Wake meandering**

**Year 3:**

**Analysis and interpretation of parametric studies leading to a procedure to optimize wind farms.**

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# Objectives

## Task 3: Wind Farms

Analyse and simulate wind farms and farm to farm interaction subject to

- Wind shear/stratification
- Turbulent inflow
- Different wind directions
- Wind veer

**Overall goals**:

- Understanding of flows in wind farms
- Development of optimization tools for farm siting

# Milestones Task 3

- **M13**: LES simulations of wind farms; Compariosns to experiments. **Month 24.**
- **M14:** Low-dimensional turbulence model for wind farms. **Month 36.**
- **M15:** LES simulations subject to neutrally stable ABL . **Month 36.**
- **M16**: Simulation of influence of stratification on wind farm performance. **Month 48.**
- **M17:** Simulation of mutual influence between two wind farms. **Month 60.**

## PhD Project: Hamid Sarlak

## "Simulation and prediction of wakes in offshore wind farms subject to turbulent and stratified atmospheric boundary layers"

- **Literature survey on wake models based on CFD. Further development of an existing CFD code to include modelling of inflow effects on scales relevant for offshore wind farms**
- **Modelling of turbulent and thermal atmospheric boundary layer with existing CFD code. Development of engineering predictive tool. Comparison to experiments with particular emphasis on densely located wind turbines, such as the Lillgrund wind farm.**
- **Interaction between wind farms.**
- **Numerical experiments and parametrical studies. Guidelines/recommendations.**

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