Topics for Theses and Student Projects at LWET

General Information:

- The topics listed in this document are suggestions for theses and student projects including
  - Bachelor theses,
  - Software Lab Projects / Pre-Theses and
  - Master theses.
- The specific task will be concretized in consultation with the student.
- Interested students are asked to contact the responsible person stated under contact via phone or e-mail.

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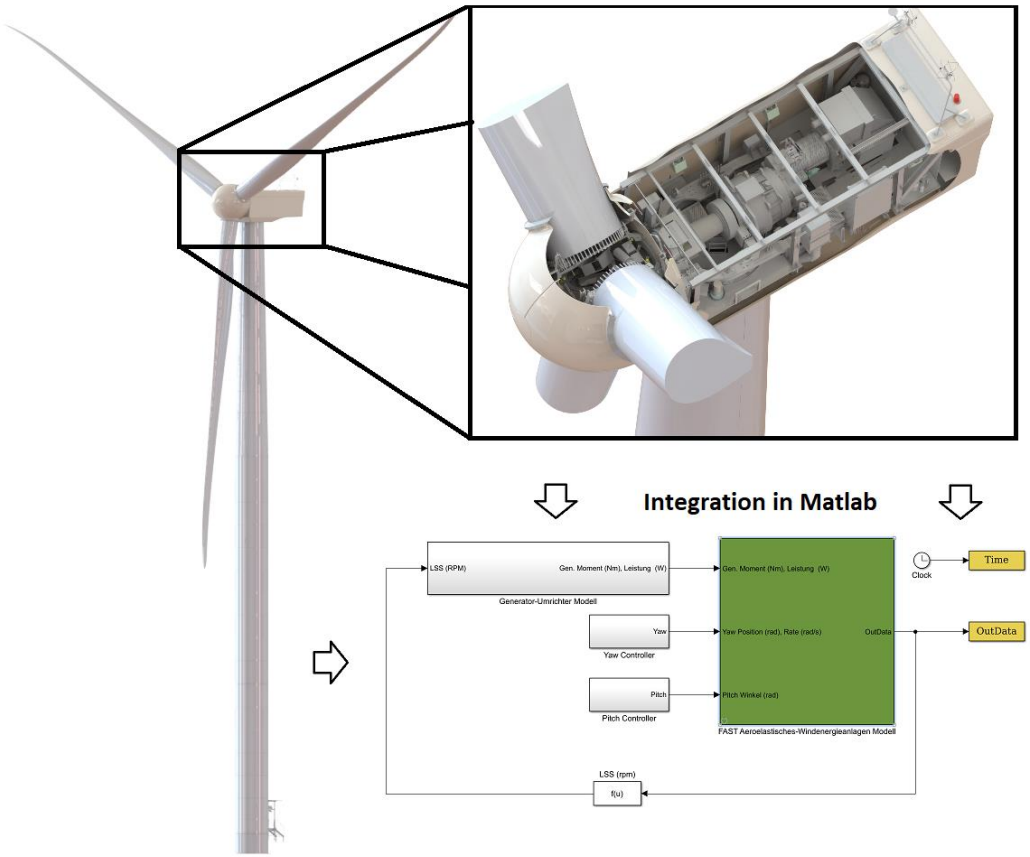
Modeling of the electrical system of wind turbines



Responsibilities

- Development of mathematical models of electromechanical components for wind turbines
- Design and development of control strategies for single wind turbines and windfarms
- Modeling with MATLAB, Simulink and OpenFAST

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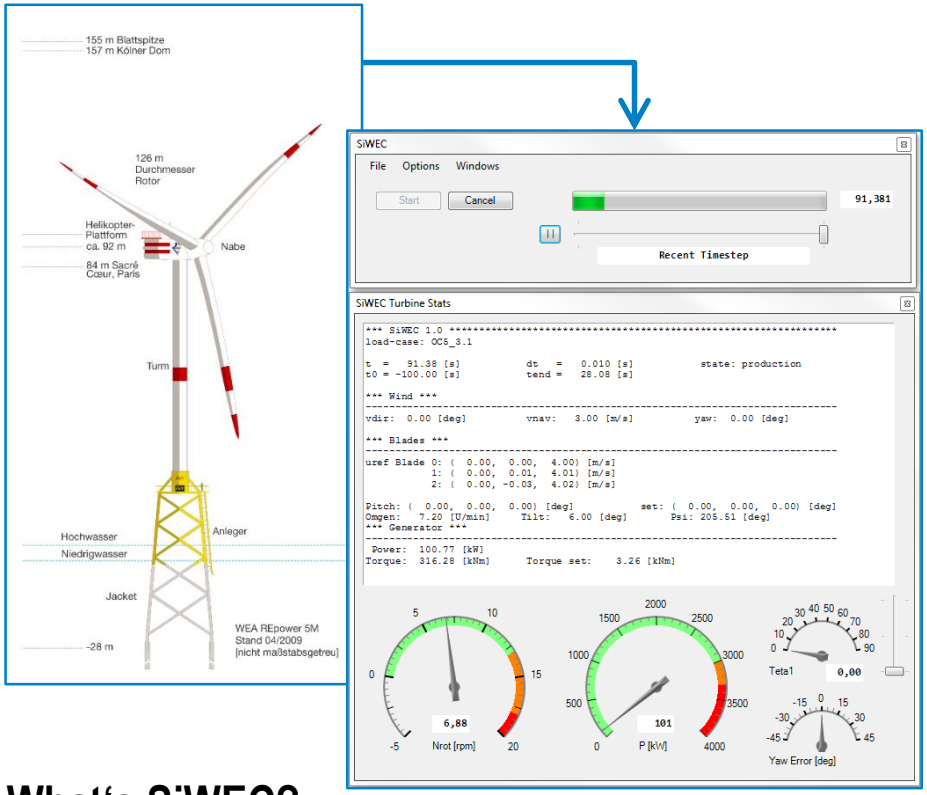
Modeling of the Structural Mechanics within the Simulation Tool SiWEC



What's SiWEC?

- SiWEC is an aero-elastic code for load simulations of wind turbines written in C#.

Rotor Blades and Tower

- Extensions in the mathematical description of the tower by modal shape functions
- Implementation of enhanced modal decomposition methods for the rotor blade model
- Development of new structural models for rotor blades based on the finite element method (FEM)

Jacket / Foundation

- Enhancement of the structural mechanic model for jacket and foundation
- Implementation of external forces on the jacket (e.g. wave forces)
- Validation of simulation results against measurements

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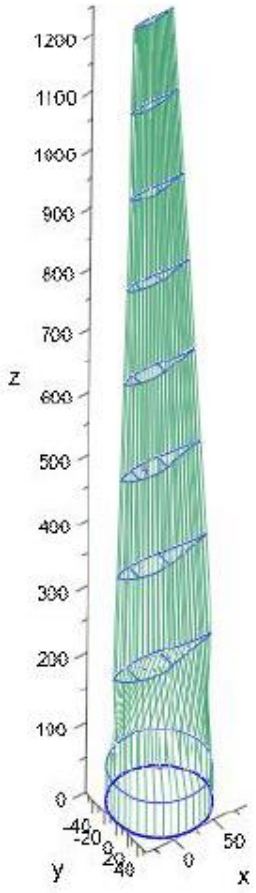
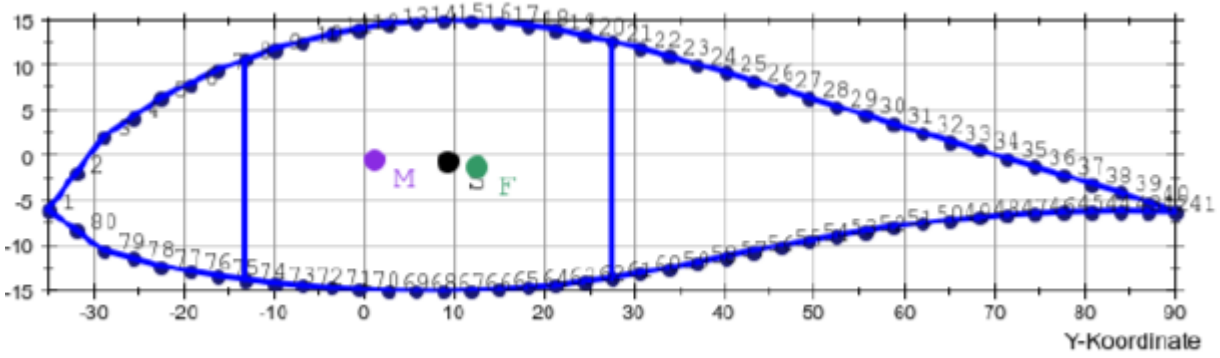
Computer Tools for Calculation of Mass and Stiffness data of Rotor Blades



Scope

- Enhancement of a MATLAB tool for calculating the profile data of thin-walled rotor blades
- Programming of an object oriented computer tool for calculating the cross section stiffness and mass data for rotor blade airfoils in C#



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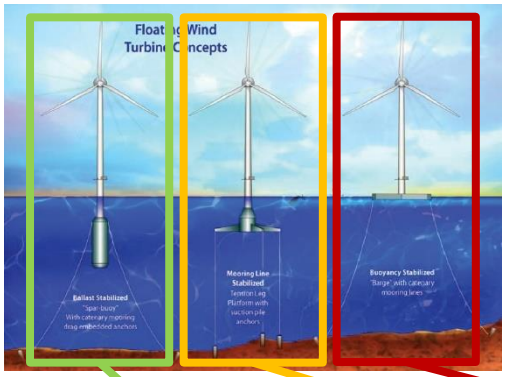
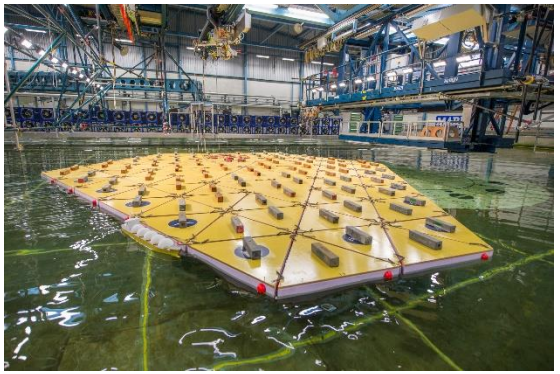
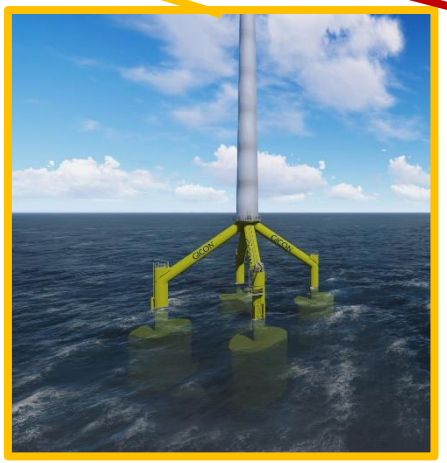
Floating Sub-Structures for Offshore Applications





Scope

- Application of novel materials and manufacturing techniques for offshore substructures
- Optimizing the structure of floating substructures using FEM
- Logistics for installation, operation and dismantling



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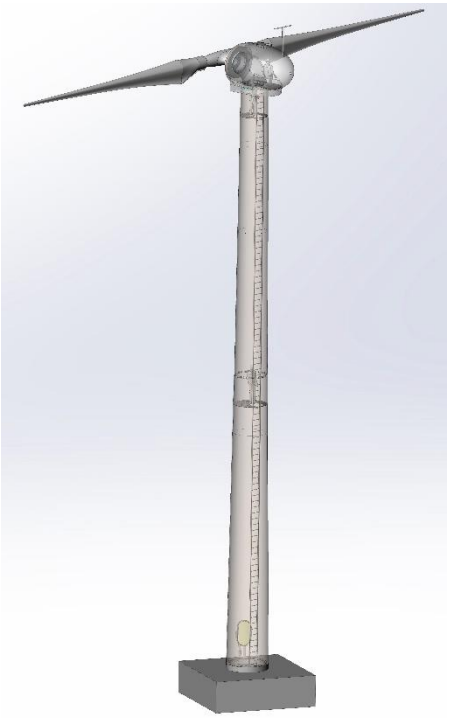
Compact Design Solutions for Wind Turbines



Scope

- Constructive extension and further development of wind turbine concepts and / or wind turbine components
- Economic structure optimization with ANSYS and CAD for wind turbines and / or its components
- Sector coupling with a wind turbine as the core of a renewable energy system

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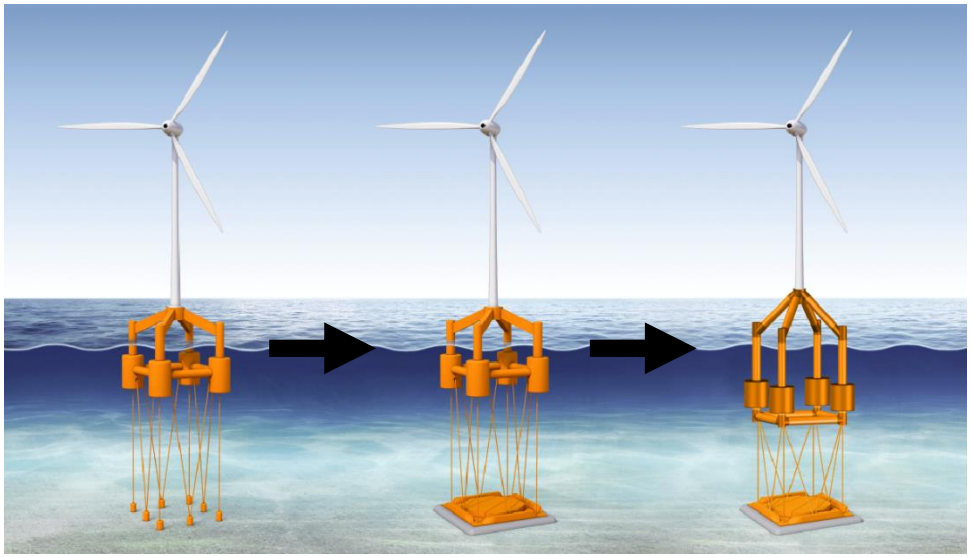
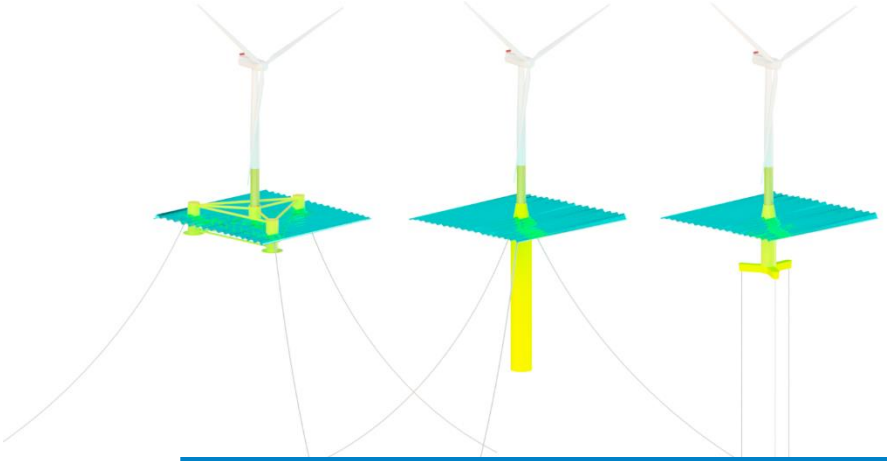
Design Optimization & Concept Development for Floating Wind Turbines



Scope:

- Concept development for the design of innovative substructures and their single parts
- Parameter study based design optimization with Bentley Moses
- Design of various floating substructures with ANSYS Aqwa



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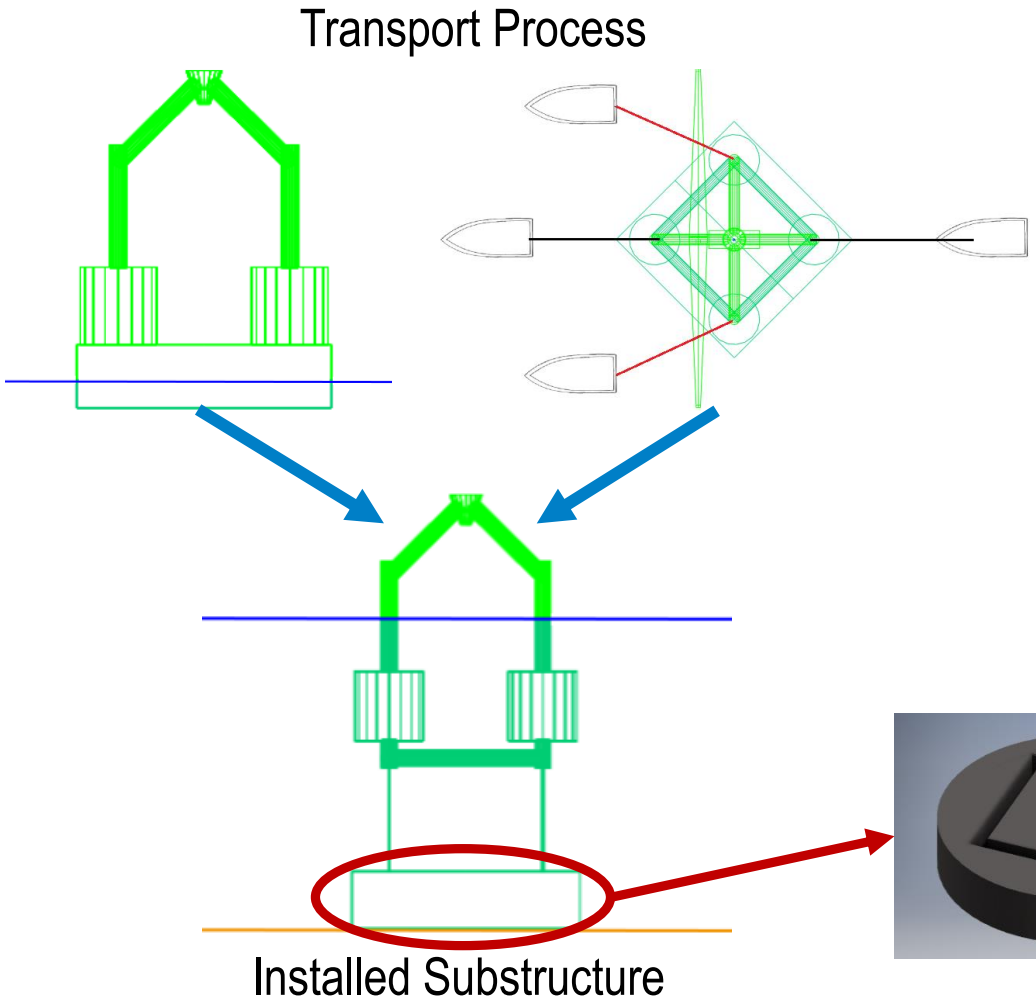
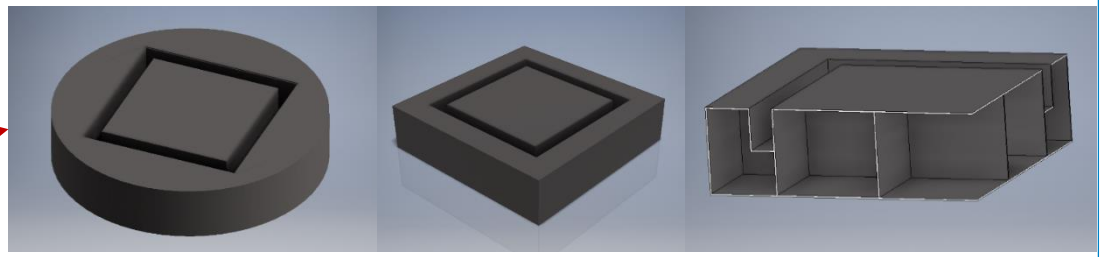
Installation of Floating Offshore Structures



Scope:

- Simulation of hydrodynamic effects during the installation process with ANSYS Aqwa and via CFD
- Design and optimization of gravity based anchor systems using ANSYS Aqwa
- Performing feasibility studies for installation concepts



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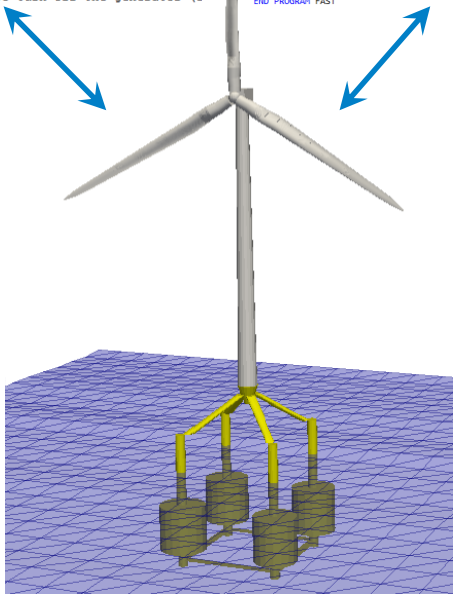
Investigation of Operational Loads of Floating Wind Turbines

Tasks

- Modal analysis of floating wind turbines
- Investigation of the dynamic behaviour of platform and wind turbine with OpenFAST
- Comparison of different mooring models (quasistatic, dynamic) in OpenFAST
- Study on the impact of certain simulation parameters of OpenFAST
- Implementation of substructures in ANSYS Aqwa and coupling with OpenFAST

```
------- SERVODYN v1.05.* INPUT FILE ------------------------
DOWEC 6MW control system properties for use of DISCON_x64.dll
---------------------- SIMULATION CONTROL --------------------
True          Echo          - Echo input data to <RootName>.ech
"default"     DT            - Communication interval for contrc
---------------------- PITCH CONTROL -------------------------
          5   PCMode        - Pitch control mode {0: none, 3: u
          0   TPCOn         - Time to enable active pitch contr
     9999.9   TPitManS(1)   - Time to start override pitch mane
     9999.9   TPitManS(2)   - Time to start override pitch mane
     9999.9   TPitManS(3)   - Time to start override pitch mane
          2   PitManRat(1)  - Pitch rate at which override pitc
          2   PitManRat(2)  - Pitch rate at which override pitc
          2   PitManRat(3)  - Pitch rate at which override pitc
          0   BlPitchF(1)   - Blade 1 final pitch for pitch man
          0   BlPitchF(2)   - Blade 2 final pitch for pitch man
          0   BlPitchF(3)   - Blade 3 final pitch for pitch man
---------------------- GENERATOR AND TORQUE CONTROL ----------
          5   VSContrl      - Variable-speed control mode {0: n
          2   GenModel      - Generator model {1: simple, 2: Th
       94.4   GenEff        - Generator efficiency [ignored by
True          GenTiStr      - Method to start the generator {T:
True          GenTiStp      - Method to stop the generator {T:
     9999.9   SpdGenOn      - Generator speed to turn on the ge
          0   TimGenOn      - Time to turn on the generator for
     9999.9   TimGenOf      - Time to turn off the generator (s
```

```
PROGRAM FAST
USE FAST_Subs   ! all of the ModuleName and ModuleName_types modules are inherited from

IMPLICIT  NONE

   ! Local parameters:
REAL(DbKi),             PARAMETER     :: t_initial = 0.0_DbKi
INTEGER(IntKi),         PARAMETER     :: NumTurbines = 1

   ! Other/Misc variables
TYPE(FAST_TurbineType)                :: Turbine(NumTurbines)

INTEGER(IntKi)                        :: i_turb
INTEGER(IntKi)                        :: n_t_global
INTEGER(IntKi)                        :: ErrStat
CHARACTER(1024)                       :: ErrMsg

   CALL NWTC_Init() ! open console for writing
   ProgName = 'FAST'
   CheckpointRoot = ""
   CALL CheckArgs( CheckpointRoot, ErrStat, Flag=FlagArg )

    Restart_step = 0

    DO i_turb = 1,NumTurbines

        CALL FAST_InitializeAll_T( t_initial, i_turb, Turbine(i_turb), ErrStat, ErrMsg )
        CALL CheckError( ErrStat, ErrMsg, 'during module initialization' )

        CALL FAST_Solution0_T( Turbine(i_turb), ErrStat, ErrMsg )
        CALL CheckError( ErrStat, ErrMsg, 'during simulation initialization'  )

    END DO

    ![....]

END PROGRAM FAST
```



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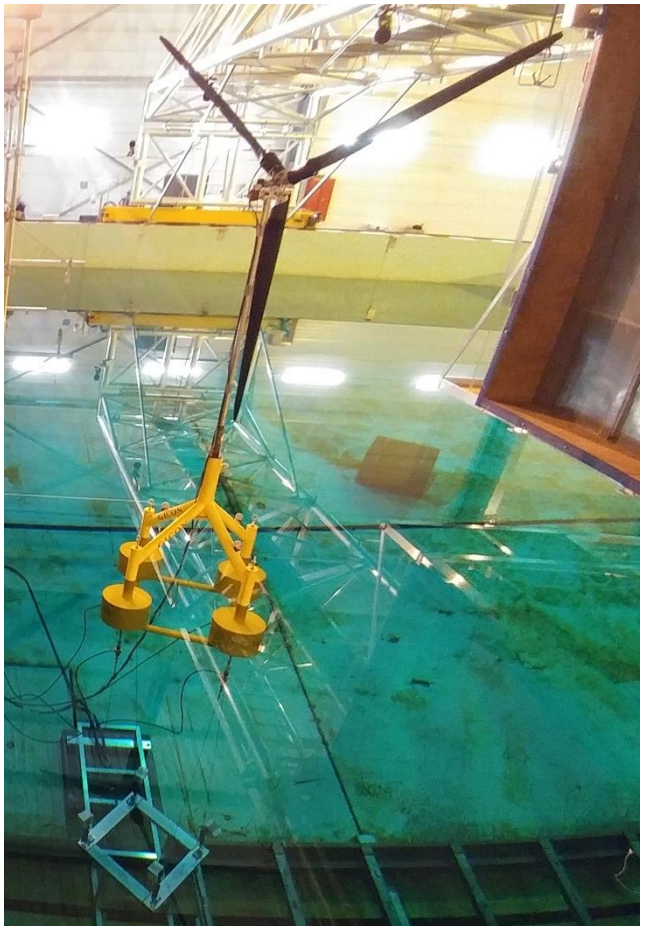
Physical and Computational Model Tests of Floating Wind Turbines

Scope:

- Preparation and construction of models for scaled towing and installation (T&I) tests including a lowerable gravity foundation
- Evaluation of results of T&I tests
- Evaluation of model tests for the determination of operating loads
- Creation of a 1:50 model in OpenFAST and comparison of results of physical model tests and simulations



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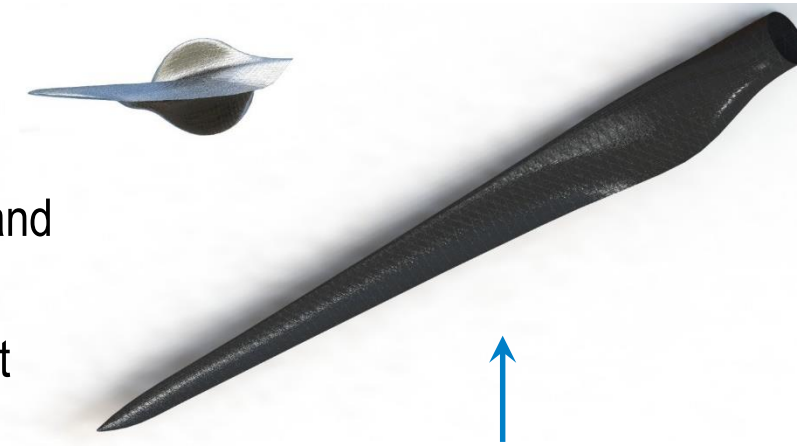
Design and Test of a Scaled Wind Turbine for Tank Tests

Tasks

- Design of optimized scaled rotor blades
- CFD-Analysis of different airfoils to determine lift and drag coefficients
- CFD-Analysis of a turning rotor to determine thrust and power coefficients
- Experimental Analysis of scaled rotor blades and rotors in a wind tunnel



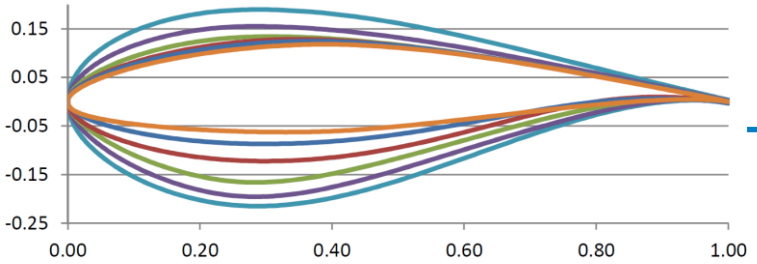


Abb. 1: Außenkontur ausgewählter Blattprofiltypen

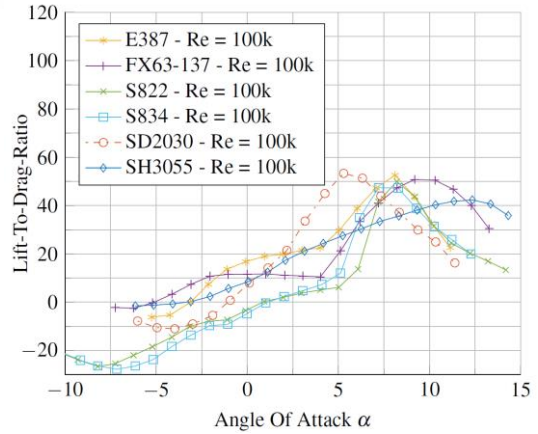


Abb. 2: Gleitzahlen ausgewählter Blattprofiltypen in Abhängigkeit vom Anstellwinkel

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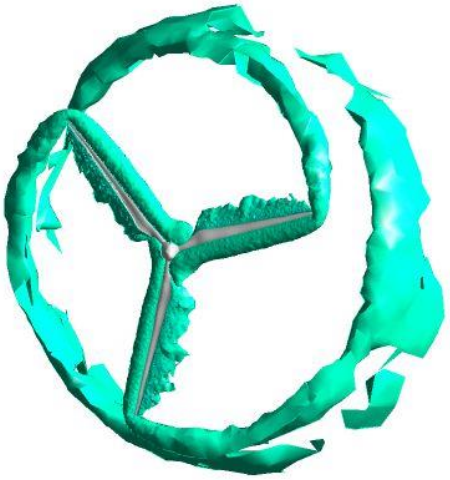
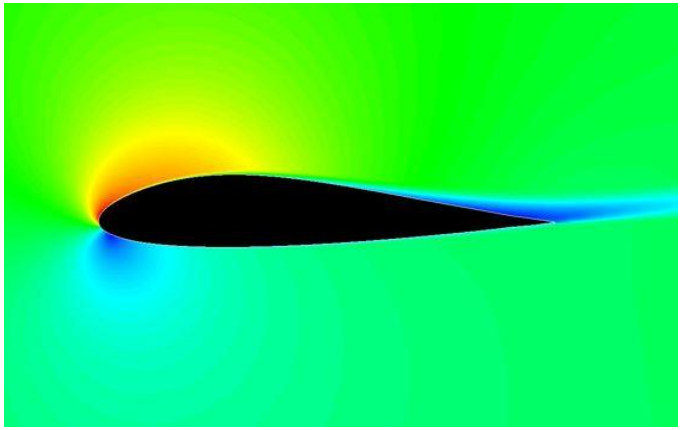
Computational Fluid Dynamics for Wind Turbines

Scope

- CFD for wind turbine rotors
- Airfoil development for wind turbines
- Analysis of blade surface properties





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