Dynamic simulation and 3D visualization of of the CRAFT concept

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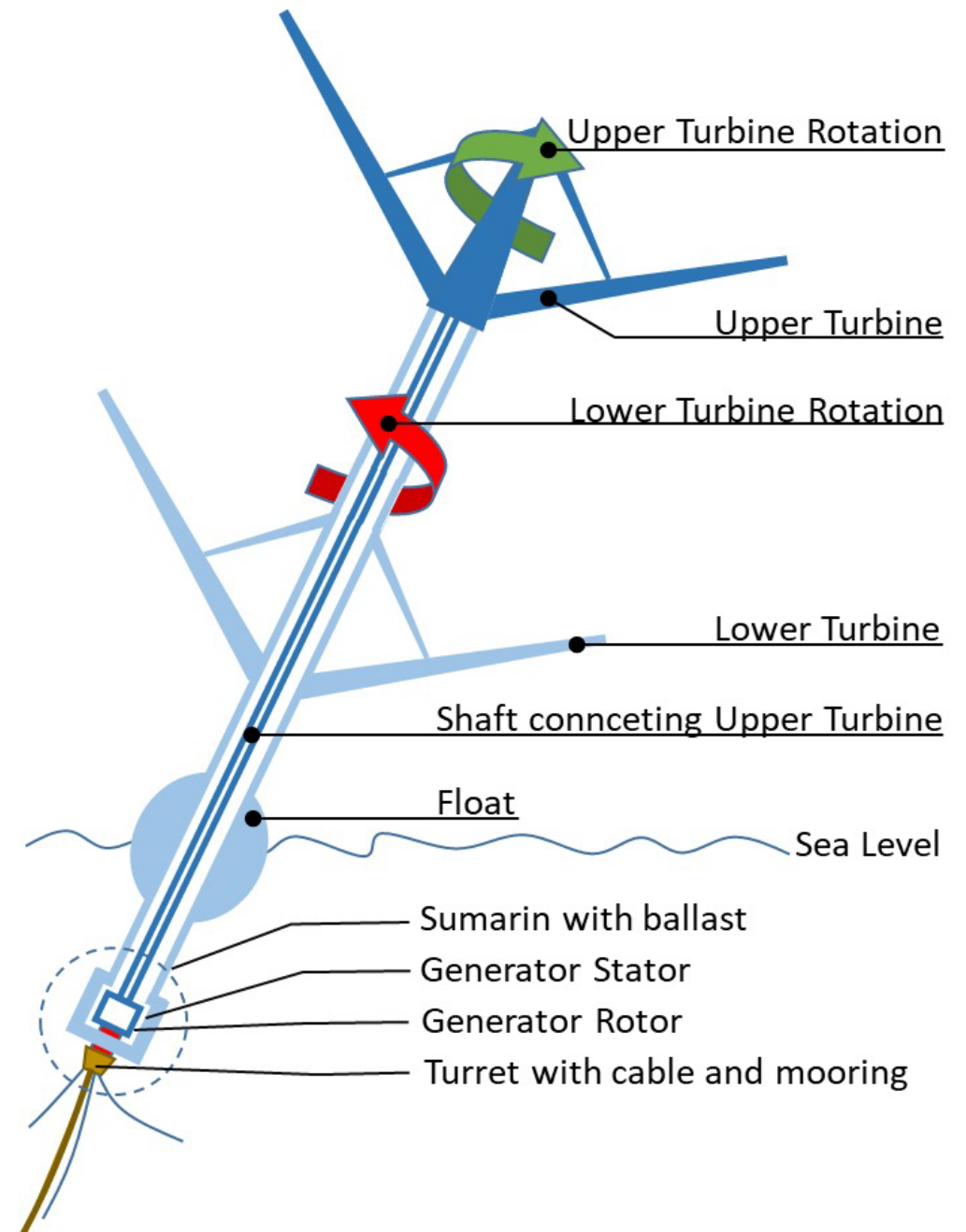Hans Bernhoff and Izabella Simonsson

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CRAFT

Counter Rotating Axis Floating Turbine

- Concept made by World Wide Wind.

- Two counter-rotating turbines drive the rotation of the rotor and stator.

- Floater made of spar buoy.

- Generator acting as ballast.

- Cable and mooring at the bottom.

Upper Turbine Rotation

Upper Turbine

Lower Turbine Rotation

Lower Turbine

Shaft connceting Upper Turbine

Float

Sea Level

Sumarin with ballast

Generator Stator

Generator Rotor

Turret with cable and mooring

Overview

- Dynamic simulation of the movement in 6 degrees of freedom.

- 3D visualization of the simulated motion.

- Calculations made in MATLAB.

- Aim to smoothly incorporate complex force models.

- Utilizing a Vortex model made by Anders Goude.

Structure of dynamic model

Four main parts

1. Geometry

2. Force models

3. Time based dynamic simulation

4. Visualization

Geometry

- CSV file as input with sizing and material parameters
- Masses volumes and inertias calculated for all parts

Maya model of CRAFT

Structure of dynamic model – Force models

Four basic force models

1. Force of gravity

2. Buoyant force

3. Mooring system - 3 springs, 120 degrees apart

4. Waves – Morrison equation with waves as sinus waves

One complex force model

1. Wind and aerodynamic forces
   - Complex model developed by Anders Goude
   - Vortex model

From side:
Freeboard
Water surface
Draft
z
x
L_A
α

Mooring system
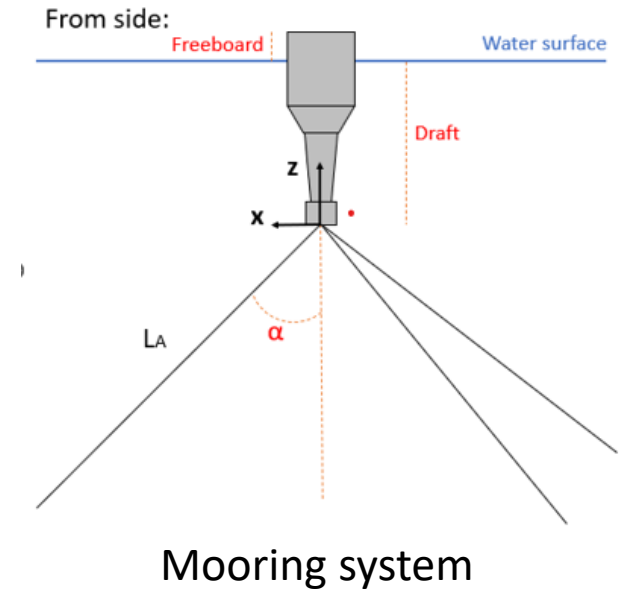
Structure of dynamic model – dynamic simulation

- Two different coordinate systems
  o Fixated in space (Black)
  o Fixated in the CRAFT (Blue)
  o Rotation matrices
  o Tait-Bryan extrinsic counter-clockwise rotation

- Simulated in time using RK4

- Results saved as a CSV file
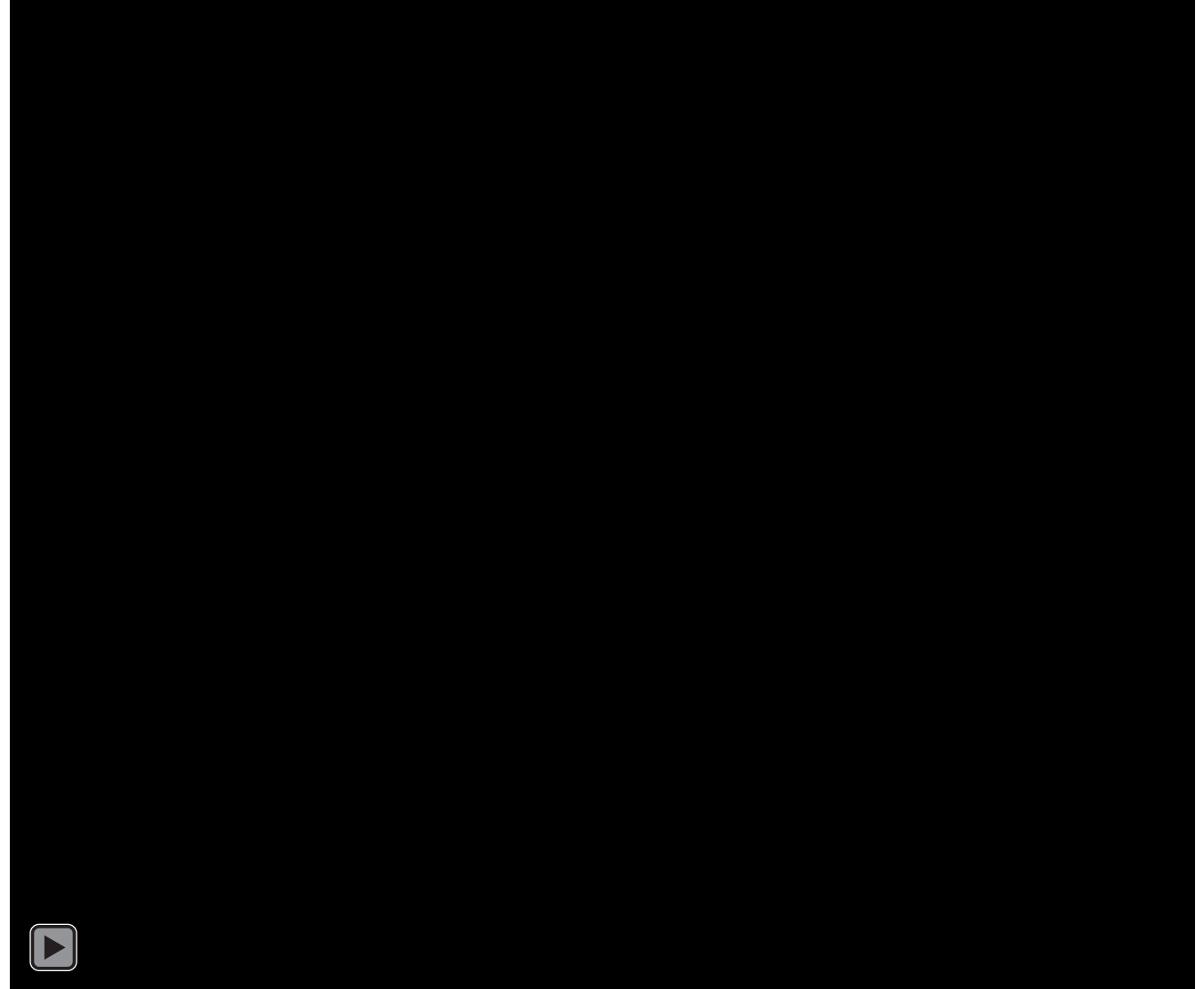
- Result file can be visualized
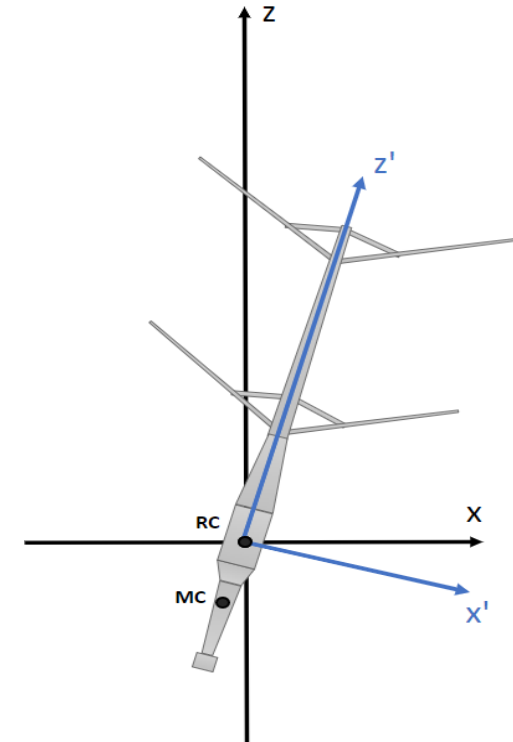
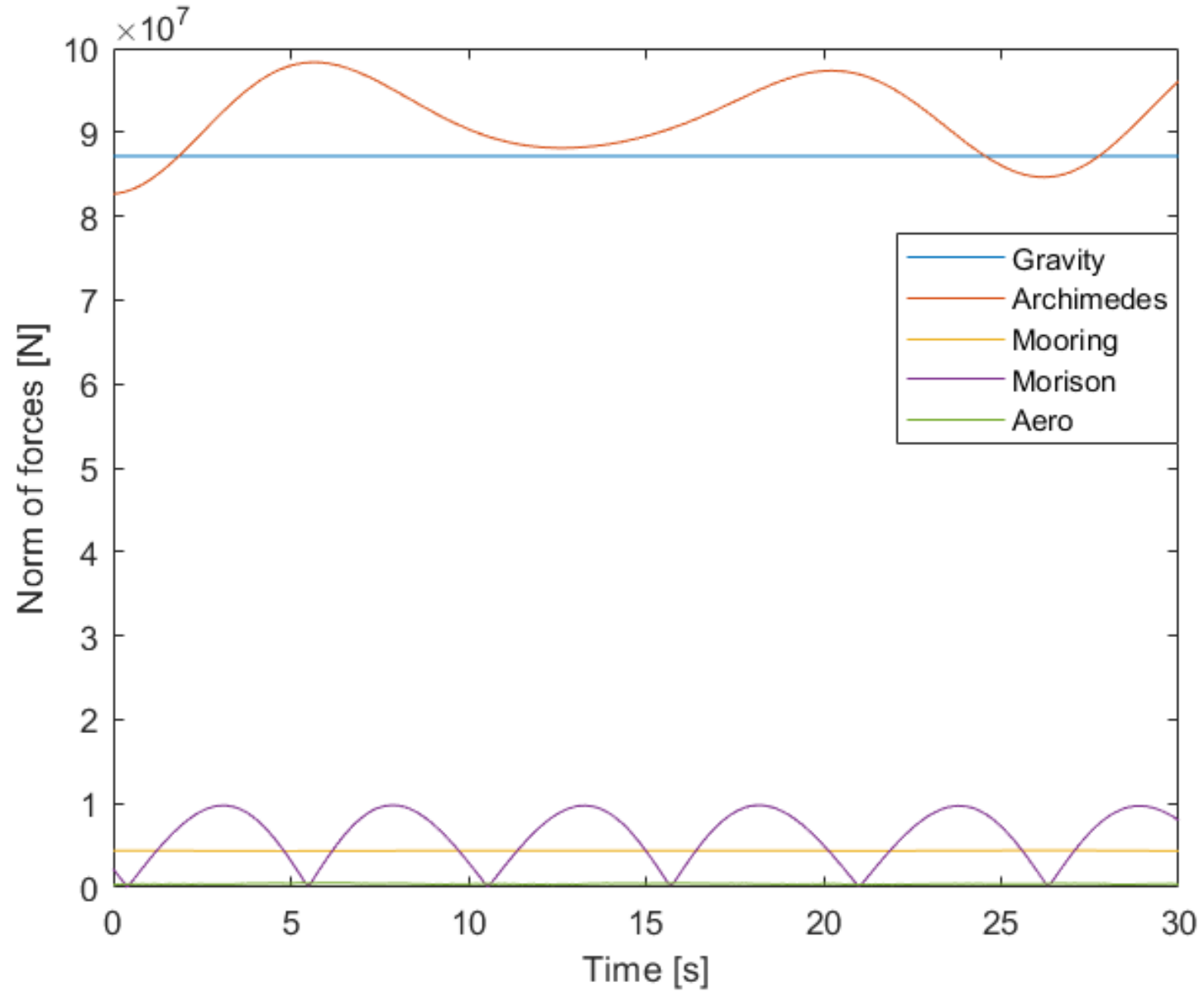Coordinate systems
used in the simulation

Simulation
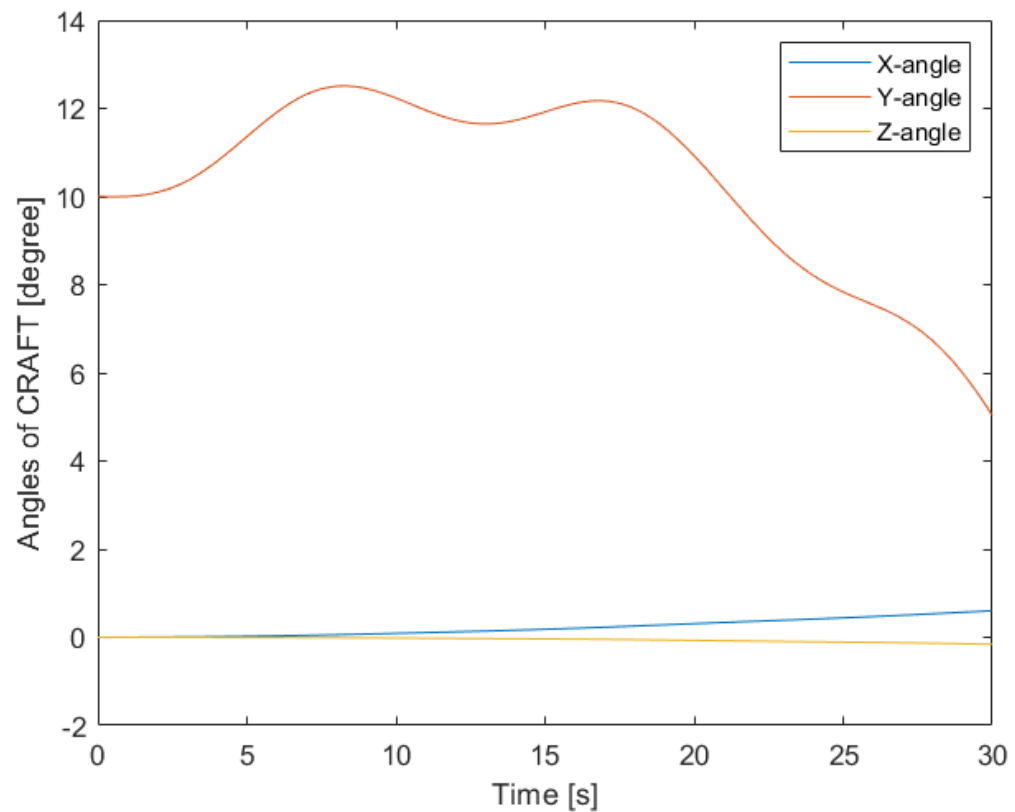
- Wind speed 10 m/s
- Waves 2 m amplitude
- 10° tilt

Norm of forces
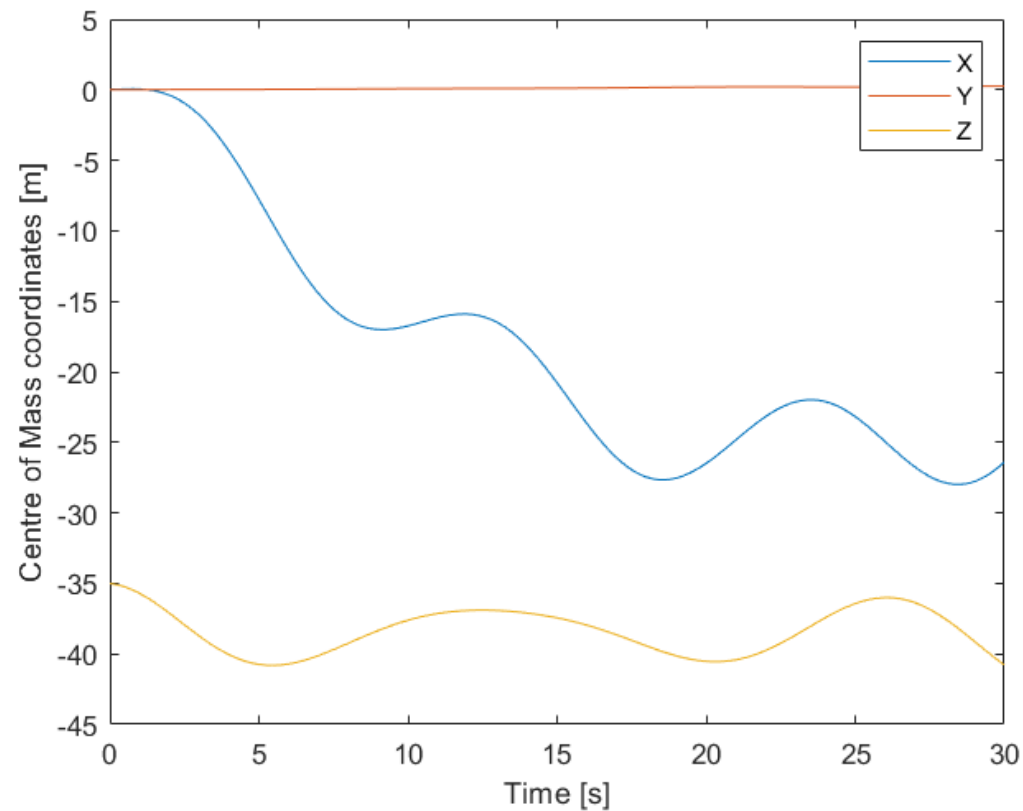
Angles

Position

Conclusion

- Successfully implemented dynamic model in MATLAB
  - Variable parameters
  - Simplified force models
  - Foundation for future model

- Future work for us
  - Validate against OrcaFlex
  - Improve visualization

Thank you!

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