Dynamic Positioning Systems for the Offshore Wind Service Industry

Service Operation Vessels

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Dynamic Positioning Conference, October 2018

DP Operations

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01 Introduction

Service operation vessel (SOV)

Offshore wind power market

Diverse fields

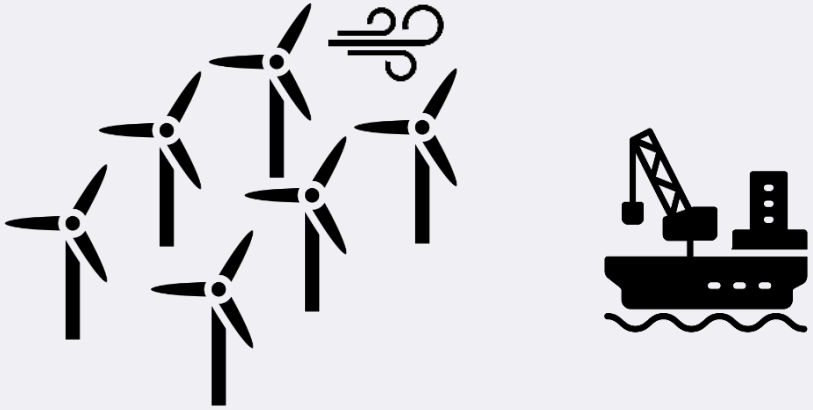
Further offshore

«Base»

Periodic

Currents & wind

Service operation vessel: wind farm



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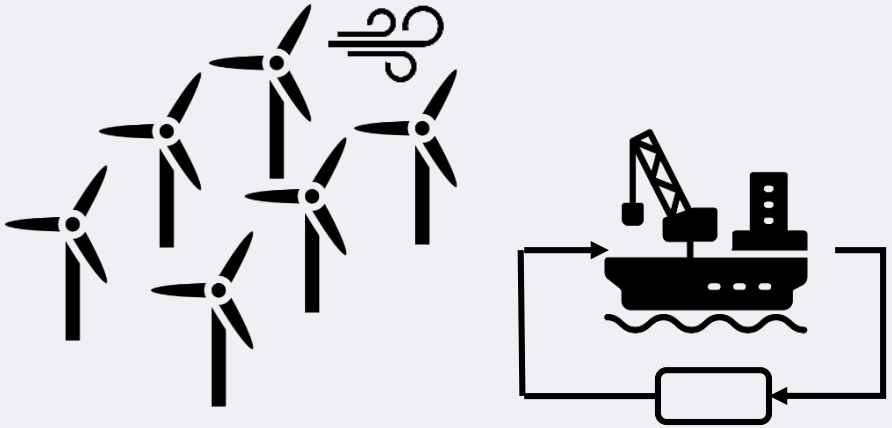
- Repetitions
- Limited available space on turbine
- Heavy time constraint
- Speed variations
- Gangway interaction

Service operation vessel: DP



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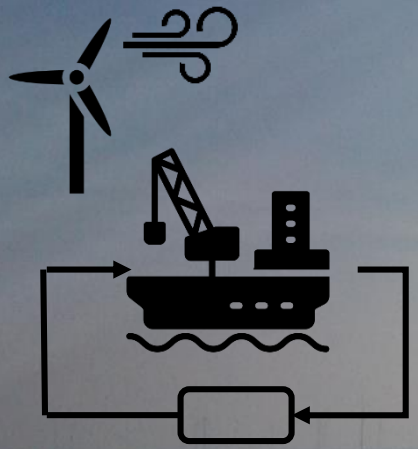
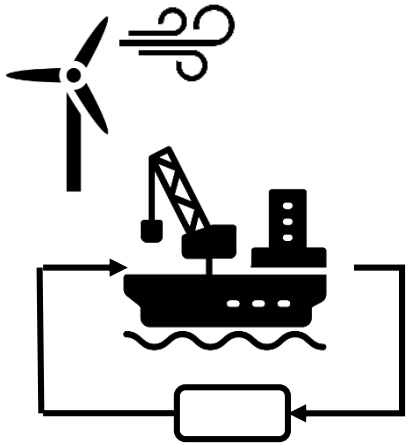


SOV DP lower cost; increase performance

- Transit operation between wind turbines with high-speed automatic control
- High precision DP operation with gangway integration
- Effective mobilization and demobilization at each wind turbine
- Waiting mode with minimum energy consumption

Performance

Cost



Transit and approach

Plan for next step

High-speed

Precision

Limit heading and position variation

Keep gangway connected

Gangway

Limited positioning margin for connecting

Mobilization

Fast connection time

Demobili-zation

Fast and intuitive for increased safety

Waiting mode

Low energy consumption

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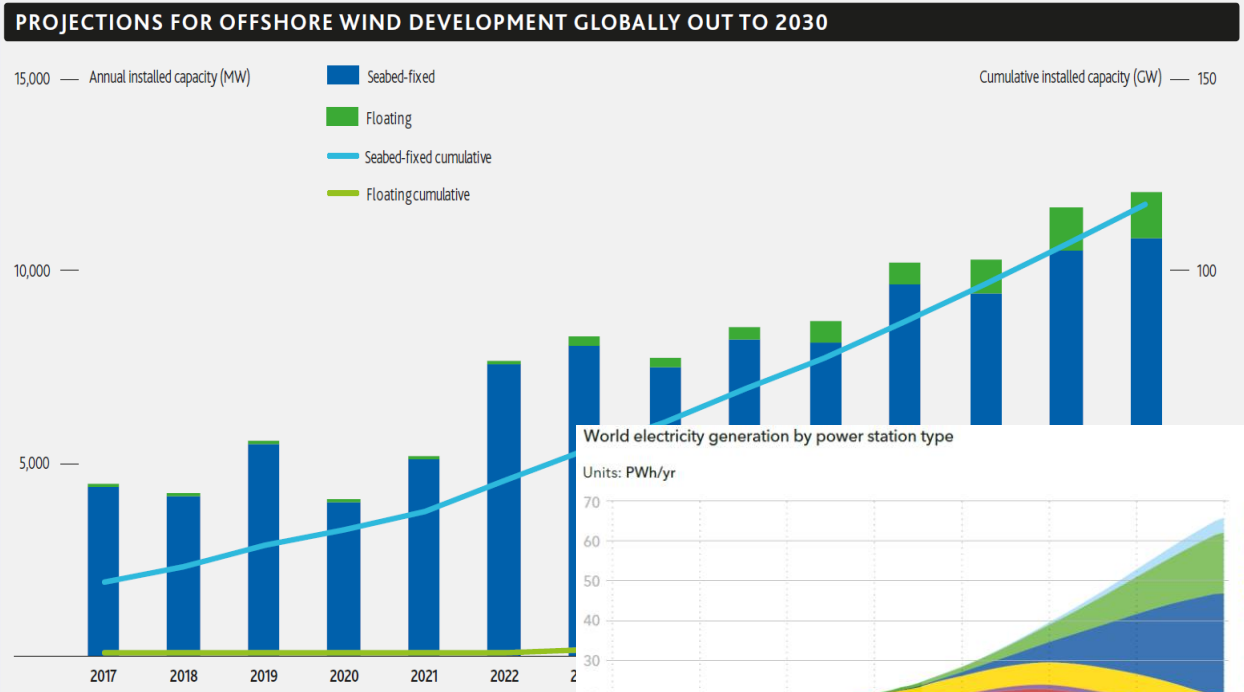
Offshore wind power market and outlook

- Mature tech
- Decreasing cost
- Low carbon footprint
- Grid, offshore power generation



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Room for efficient operations

Control system should enable efficient transitions

- From transit phase to wind turbine arrival
- Movement between wind turbines
- Coordination of gangway and vessel: ideal position for gangway connection
- Enable efficient, faster and safer
- Waiting

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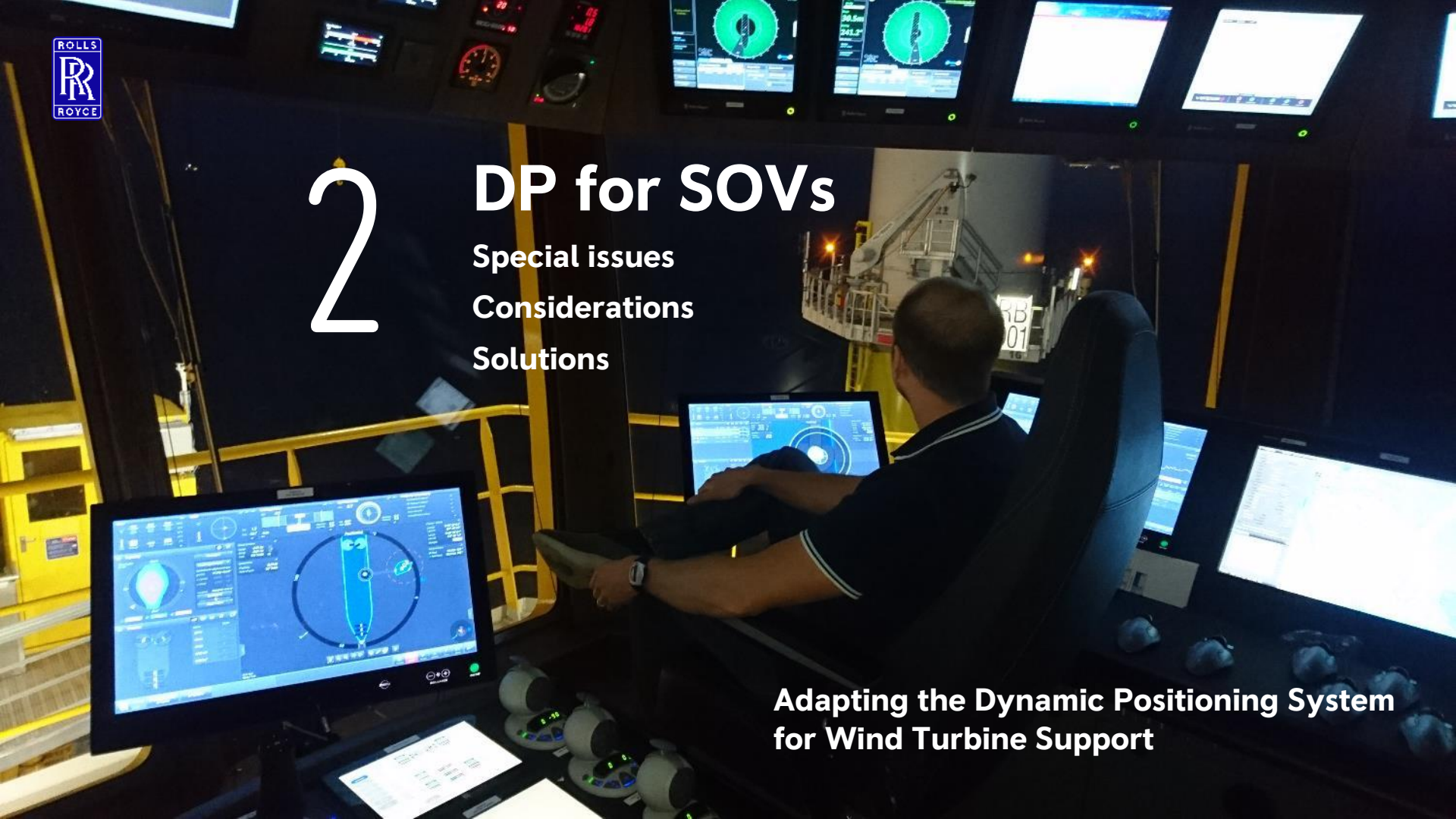
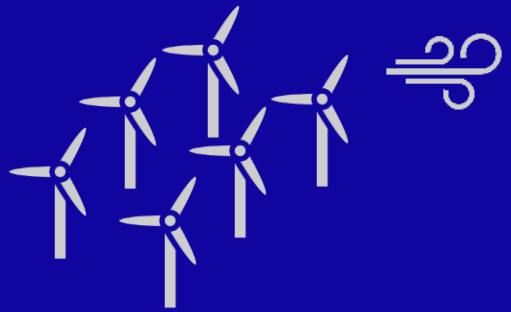


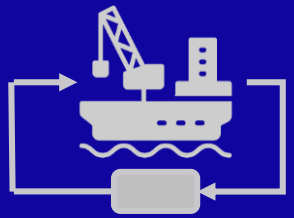
2 DP for SOVs

Special issues
Considerations
Solutions

Adapting the Dynamic Positioning System for Wind Turbine Support

DP challenges for SOVs





Operations

- Procedures
- Repeatable
- Sequential
- Safety
- Gangway
- Time constraint
- Movement

All-speed control system

- High-speed/transit regime
- Maneuvering/positioning
- Handle unknown effects

Environment

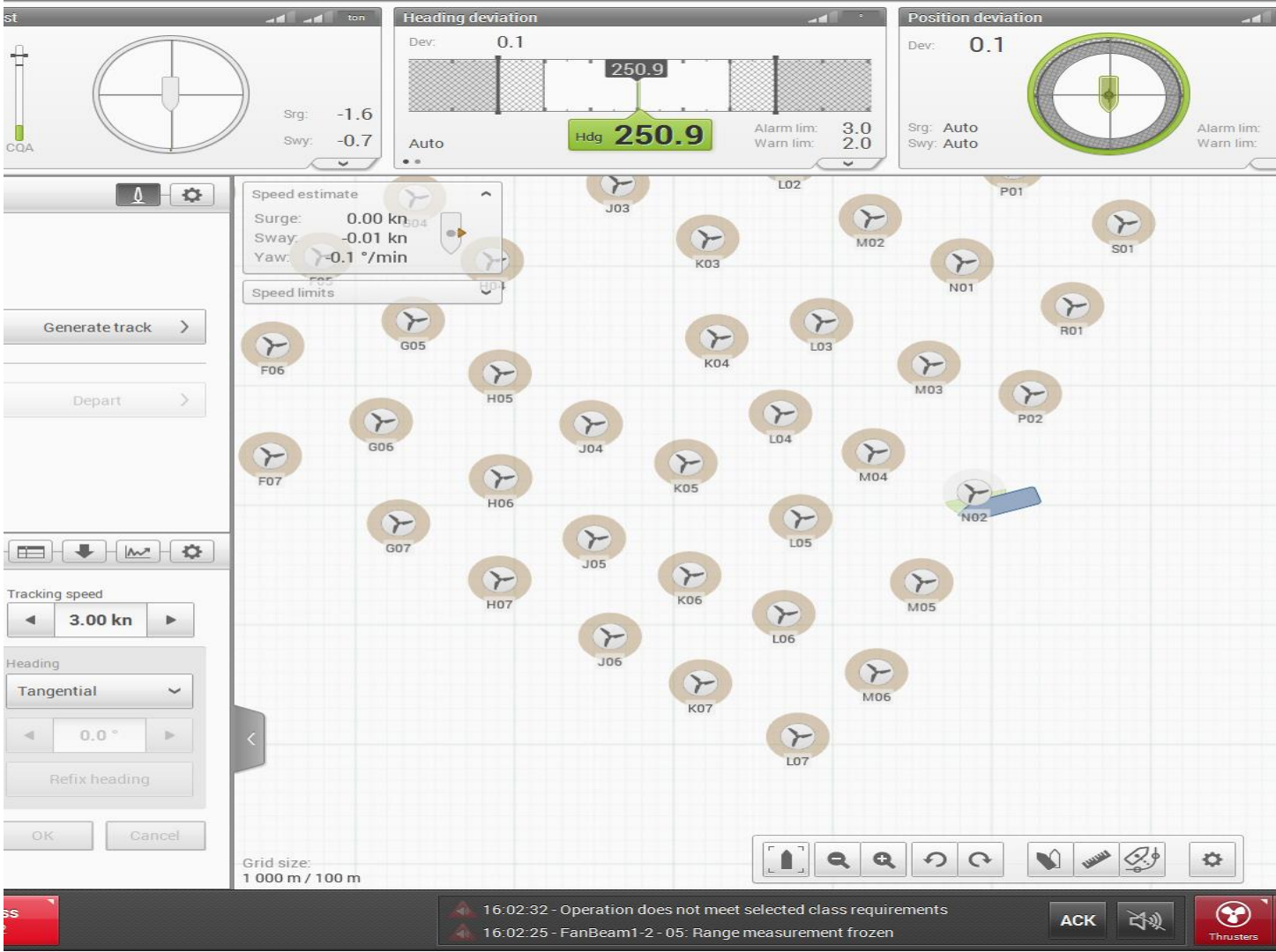
- Wind
- Current

Sensors

- Relative positioning
- Gangway

Wind farm overview

- Support for different turbines and wind farms
- Operational planning



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Operations

DP capability important for vessel performance

- Operational procedures embedded in control system
- Standardized controlled vessel movements
- Automatic positioning of vessel ease connecting phase

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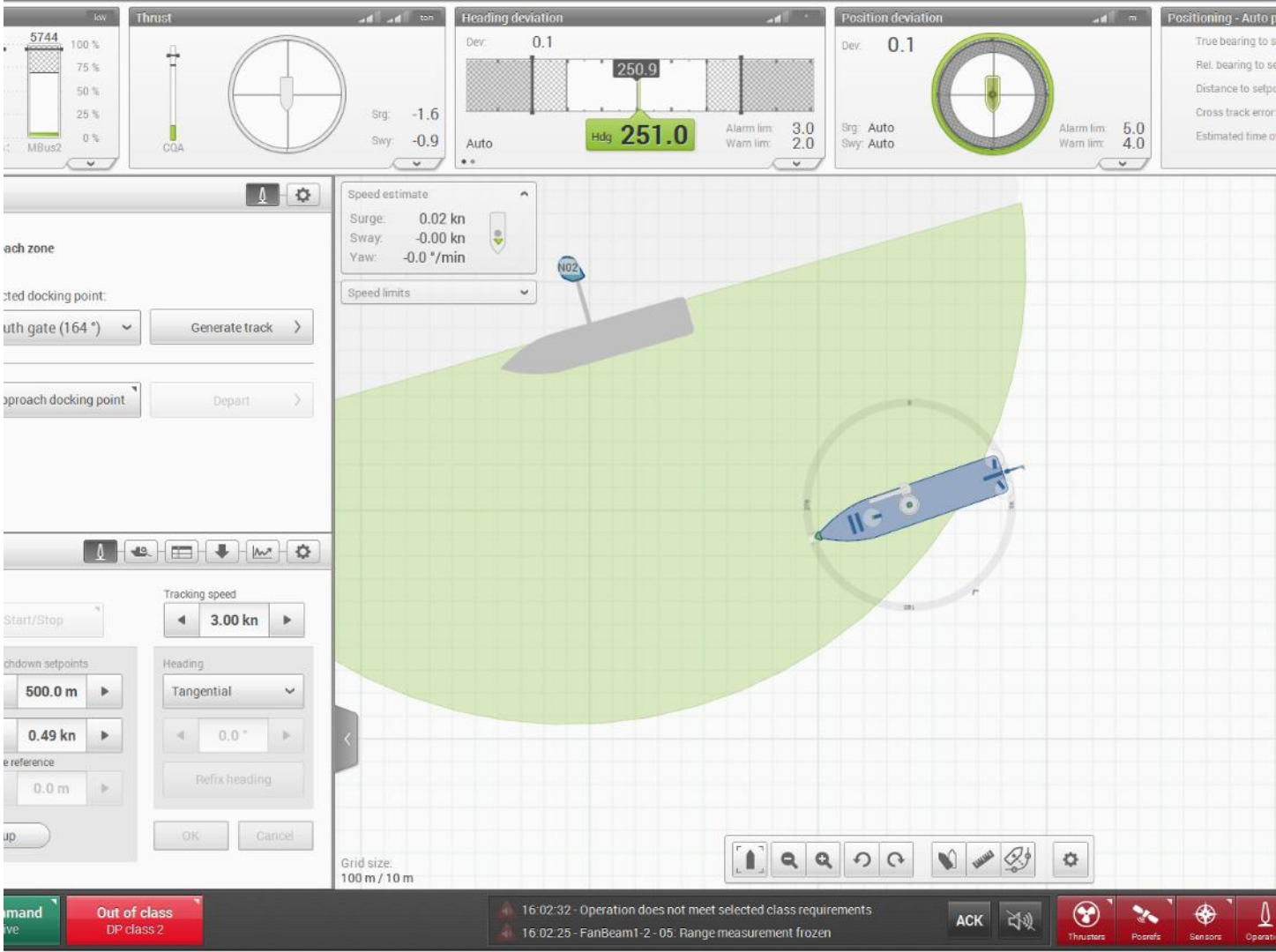
Turbine area



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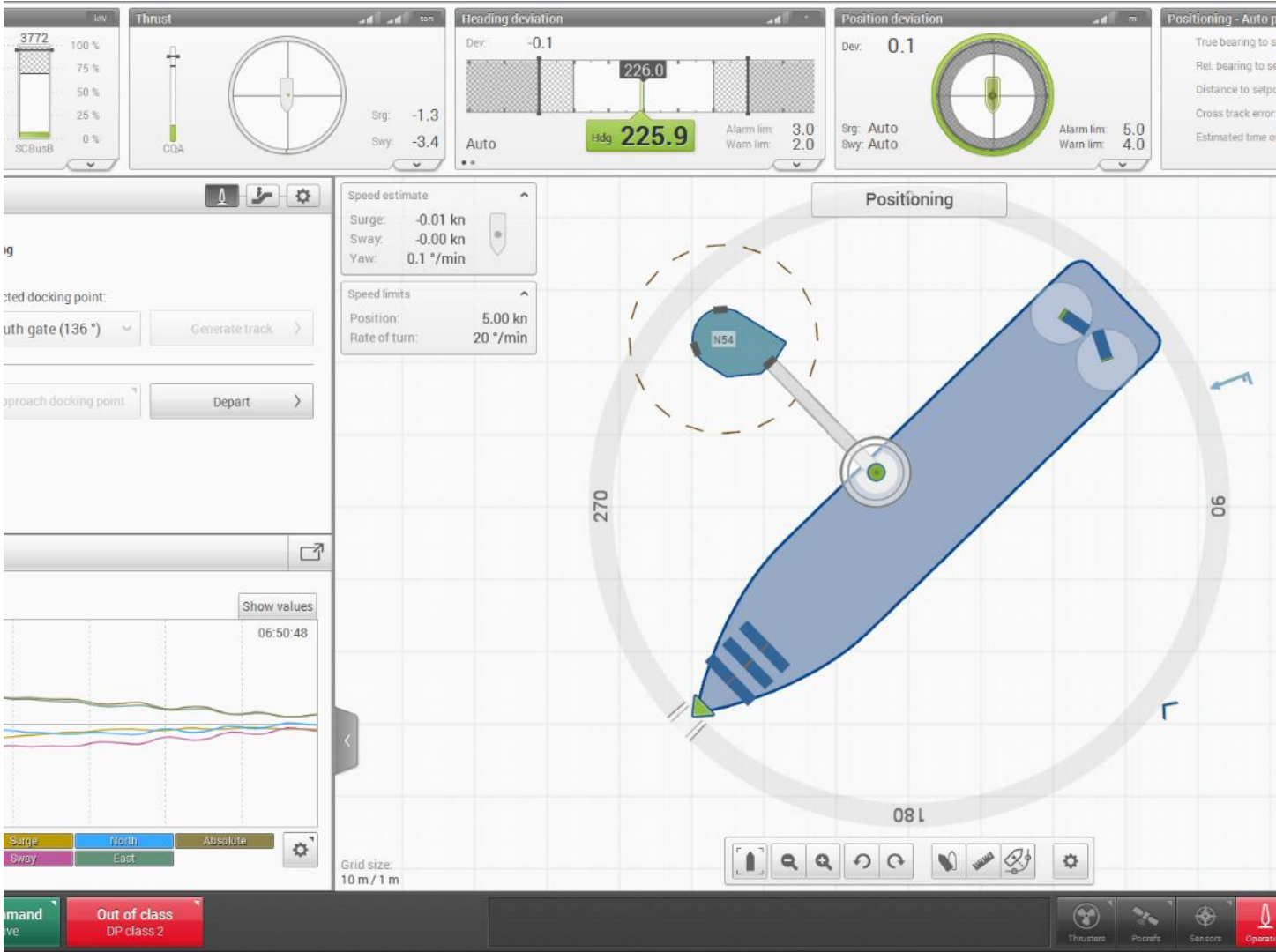
Turbine zoom-in



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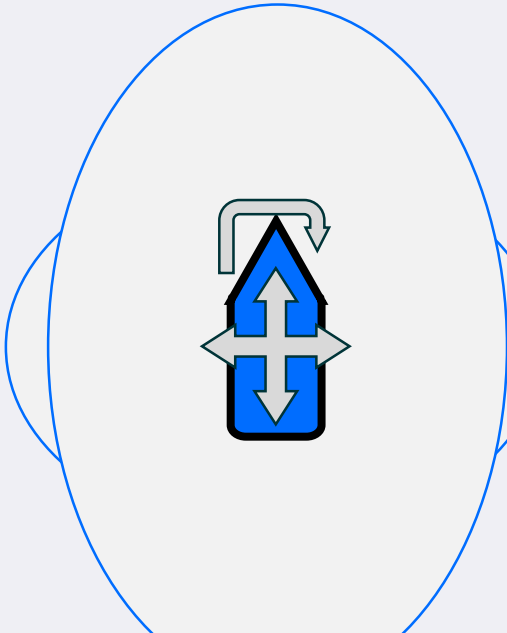
Effective vessel motion control

Challenging to control vessel in different speed regimes

- Low-speed: DP controls position, heading and speed
- DP model

- Assume zero water velocity inflow
- Assume equal thrust in all directions



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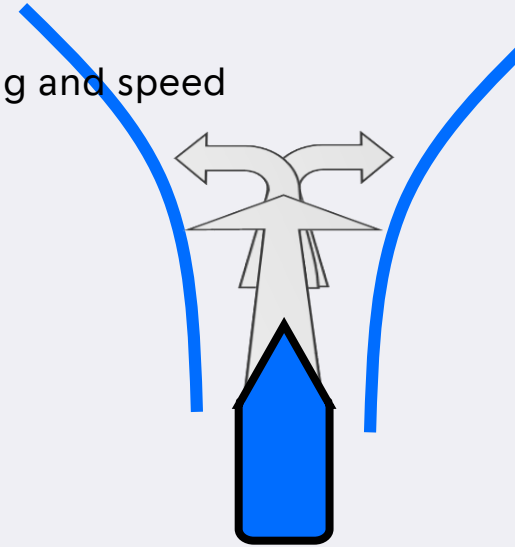
Effective vessel motion control

Challenging to control vessel in different speed regimes

- Transit: Autopilot controls vessel heading and speed
- Nomoto model



- Limited or zero tunnel thruster effect
- Azipull – rudder effect

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Effective vessel motion control

DP System Adaptions for AllSpeed

- AllSpeed control: detailed control of transitions
- Generalized thruster model suitable for all speeds
- Thrust allocation considers speed, environmental condition

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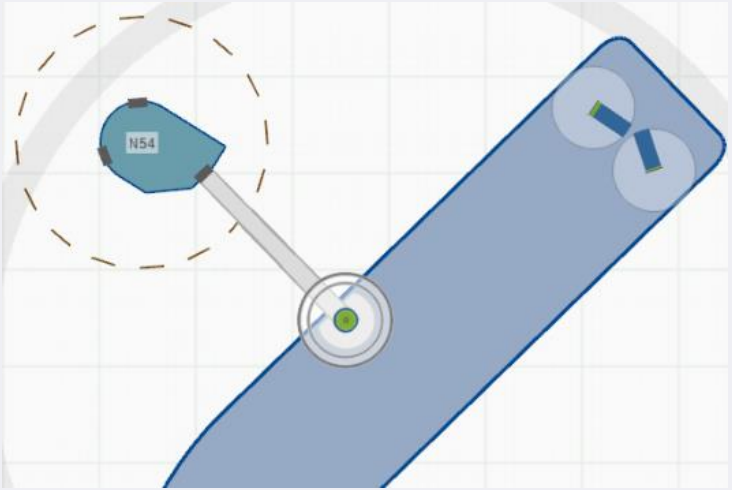
Control loop & position reference

- Gangway feed-forward to compensate for push against structure
- Gangway sensors provide information to serve as additonal positioning information



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Operational experiences

Service operation vessel March 2018

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Operation Service Vessel experience

SOV Edda Passat UT540WP design

Diesel-electric propulsion and batteries.
Equipped with 23 m Uptime heave compensated walk-to-work gangway

- Operates for Ørsted on Race Bank Offshore Wind Farm
- Home port: Grimsby

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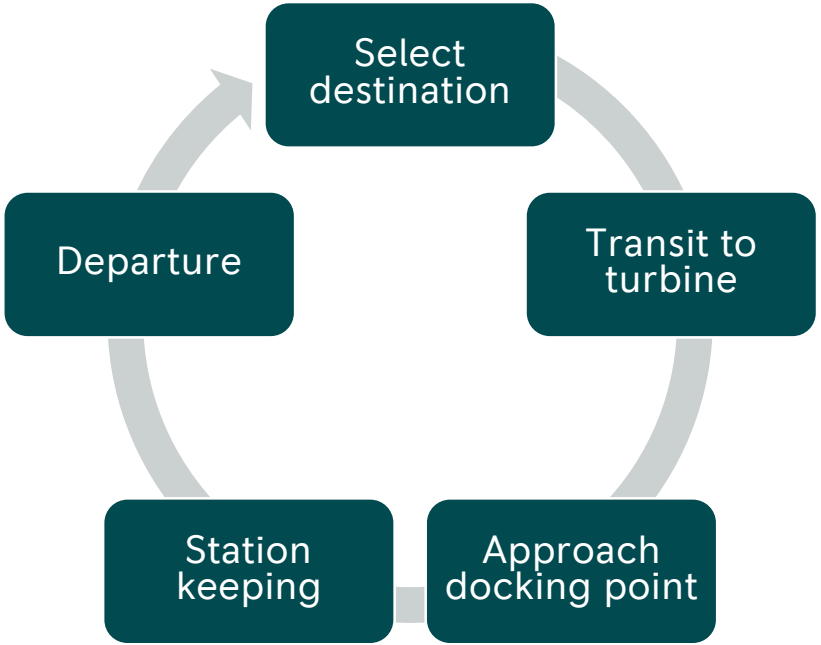
Wind turbine support stages



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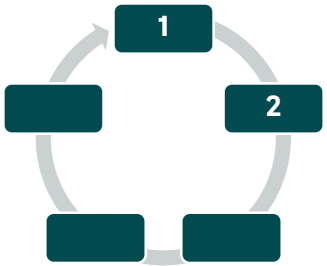
Select and transit to turbine



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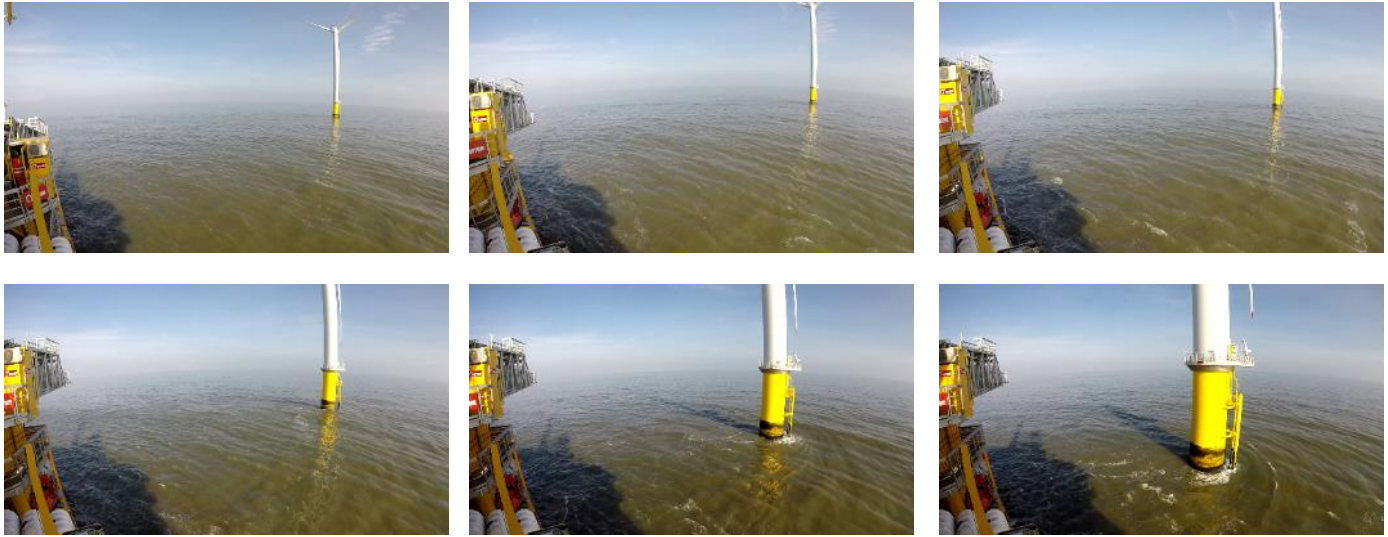
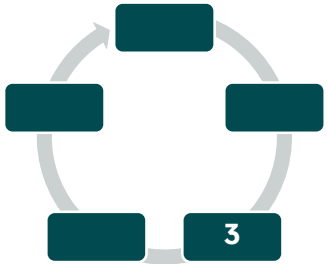
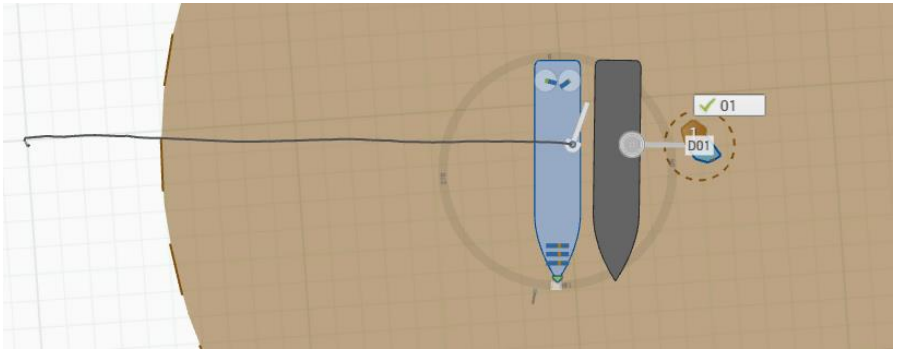
Turbine approach #1

- Alignment







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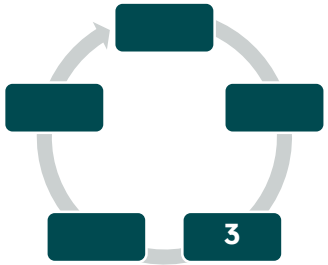
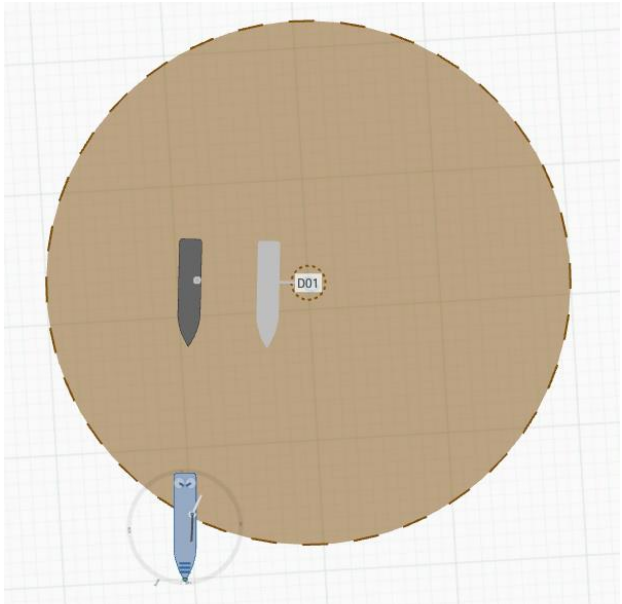
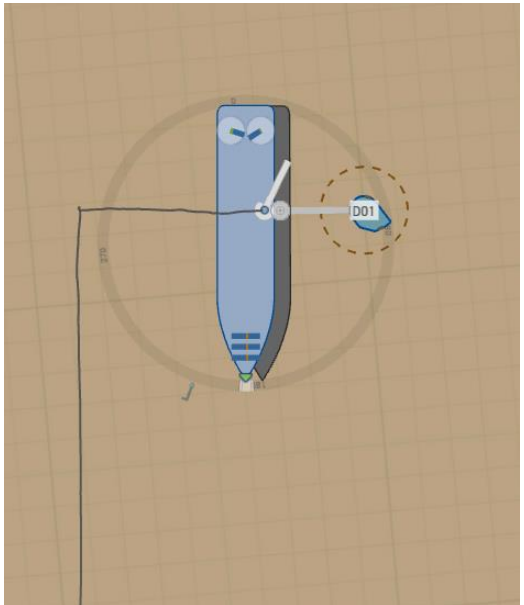
Turbine approach #2

- Across before towards







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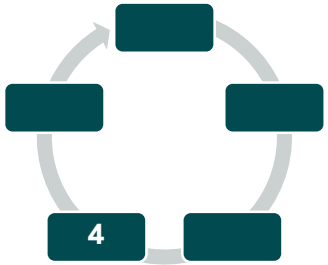
Station-keeping

- Connected to gangway



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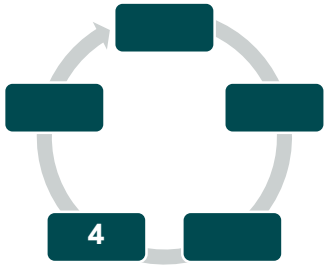
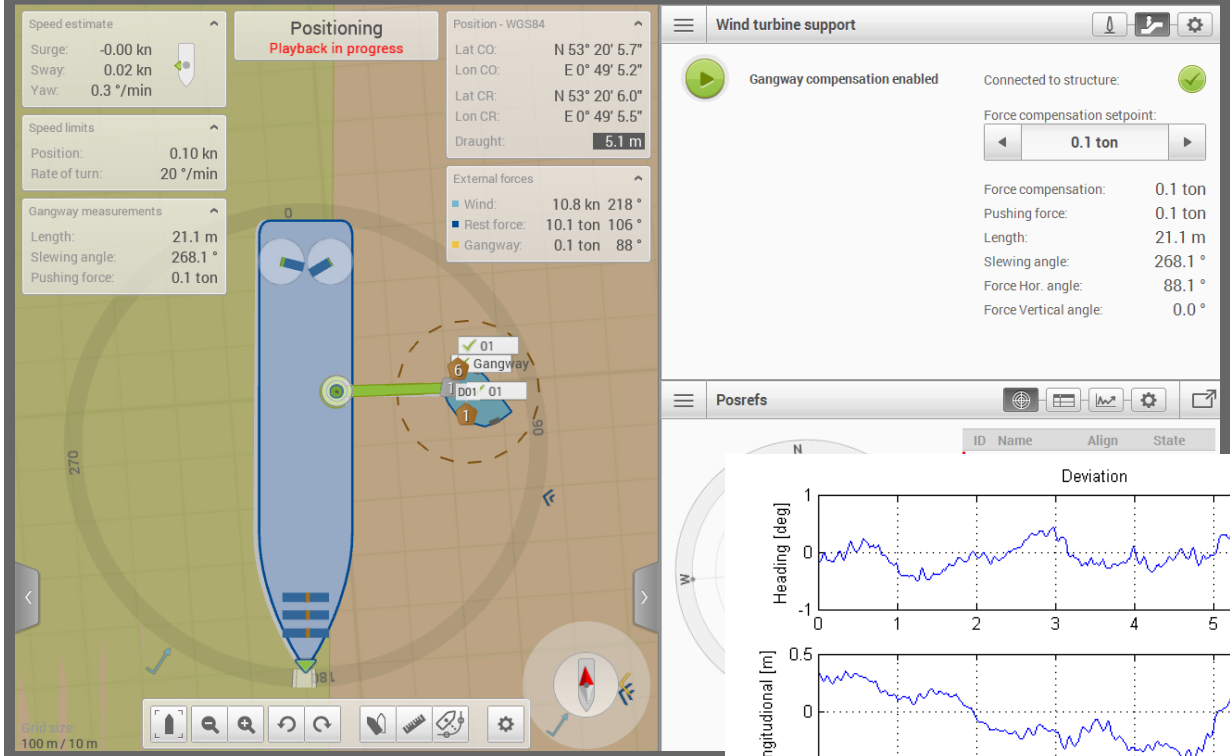
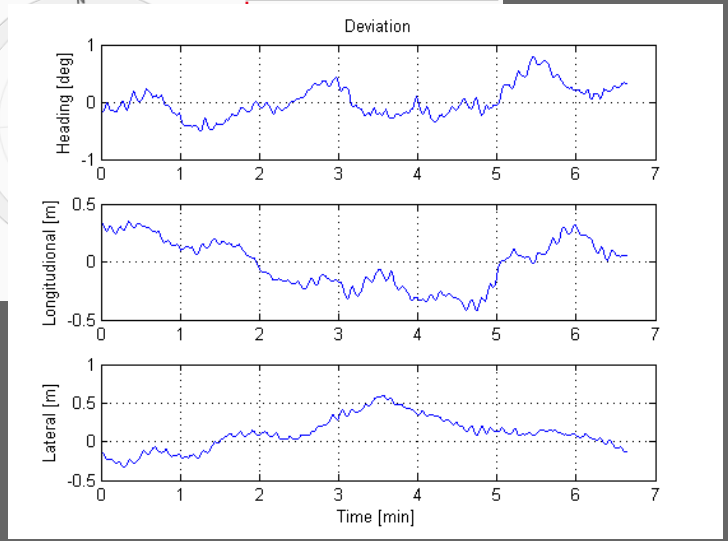
Gangway







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Wrap-up

Ongoing work

Future research

Conclusions

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Continuous development

Product improvement

- Field operator and vessel crew comments and feedback during development phase
- The NEXUS research project

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DP for Service Operation Vessel

- Growing market for offshore wind and services
- Wind turbine service: Repetable task
- Efficient to embed operations in control system
- Gangway feed-forward important for smaller vessels

Offshore oil & gas

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Thank you for your attention!