

TWIND

Twinning for an Offshore Wind Energy Partnership

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D3.2 – Report on the summer schools



Lead beneficiary	TU DELFT
Authors List	Pranav Chandramouli, Axelle Viré
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1 EXECUTIVE SUMMARY

Two one-week courses were organised in TWIND. Firstly, a summer school was conducted in July 2021. The regulations surrounding COVID resulted in an online version of the summer school. The school focused on floating wind energy and contained a combination of keynote speakers and short presentations. The summer school included 10 keynote presenters from within the partner organisations and 2 keynote speakers from partner collaborations. An additional 30 short presenters participated in the event under 10 different topics related to floating offshore wind energy. The summer school attracted 170 registrations from partner and associated organisations, spread across the week. The highest unique participation was 79 members on the first day of the summer school.

Secondly, a short course was organised in-person in Delft (The Netherlands) in October 2022. The course focused on the design and testing of offshore wind turbines and farms. Thus, the scope was more general than the summer school. Also, it was organised as an interactive course, with a combination of slots of 45-min lectures given by staff members from the Delft University Wind Energy Institute (DUWIND) and discussion sessions to further enhance the learning process. In total, 11 different topics related to the design of offshore wind farms were covered in the course. 18 participants from all the project partners attended the 4-day course. A dinner was organised at the end of the course to facilitate discussions and networking between the course participants, the lecturers, and the senior staff arriving in Delft for the TWIND think-tank session on 21 October.



2 INTRODUCTION

Within TWIND, TU Delft leads WP3 on training and mentoring of early-stage researchers. A key deliverable related to this objective is to transfer knowledge across the partner institutions through two courses: a summer school on floating offshore wind energy, and a short course on offshore wind energy and the disciplines relevant to the design of offshore wind farms (both fixed and floating). Both topics are particularly interesting for Portugal, given the large offshore wind potential. Note that floating offshore wind energy is of interest in that region because water depths along the Portuguese coast are too large to economically install conventional bottom-fixed wind turbines. In waters deeper than 60 metres, it is necessary to place wind turbines on floating support structures that are moored to the seabed. This technology can unlock the potential of Portugal to play a key role in the further development of offshore wind.

3 SUMMER SCHOOL

3.1 ORGANISATION

The summer school was originally planned to be a physical event to be held in July 2021. However, due to the global COVID pandemic, the event was shifted online using the Zoom webinar platform. The summer school was organised from the 5th to the 9th of July, 2021. The event was split into 10 topics covering various aspects of floating offshore wind (see Table 1 Topics covered in the TWIND online summer school)

Table 1 Topics covered in the TWIND online summer school

Topics
A - Aerodynamics
B – Control Systems
C – Data-driven Modelling
D – Electrical Systems
E – Energy storage & Hydrogen
F – Experimental Methods
G – Hydrodynamics
H – Operations & Maintenance
I – Offshore Wind Potential
J – Project Management/Farm Design

Keynote presenters were invited from the TWIND partners and short presentations were invited from partner and associated organisations resulting in 12 keynote speakers (see Table 2 for details) and 30 short presentations (see

Table 3 for organisational split).



Table 2 Keynote speakers

Keynote Speaker	Topic	Organisation
Axelle Viré	Aerodynamics	TU Delft
Guilherme Vaz	Aerodynamics	Wavec
Jan-Willem van Wingerden	Control Systems	TU Delft
Jan-Willem van Wingerden	Data-driven Modelling	TU Delft
Paul McKeever	Electrical Systems	ORE Catapult
Francesco Boscolo Papo	Electrical Systems	ORE Catapult
Ad van Wijk	Energy Storage & Hydrogen	TU Delft
Sara Muggiasca	Experimental Methods	Partner Organisation – Polimi ¹
Miren J. Sánchez Lara	Hydrodynamics	Tecnalia
Iñigo Mendikoa	Hydrodynamics	Tecnalia
Donatella Zappala	Operations & Maintenance	TU Delft
Rodrigo Rojas	Offshore Wind Potential	Partner Organisation – NUCR ²

Table 3 Organisational contribution to short presentations

Organisation	Short Presentations
TU Delft	10
Wavec	4
Tecnalia	2
ORE Catapult	7
Partner organisations	7

Two sessions (morning and afternoon) were held each day beginning with a keynote speaker and followed by short presentations for a given topic. Q&A sessions were held periodically to cover all presentations within the sessions with participants encouraged to pose questions through the webinar platform. This enabled good interactions between participants and speakers throughout the school. The morning sessions started at 11:00 until 12:30 followed by a lunch break. The afternoon session began at 14:00 until 16:15 when the day was brought to a close³. Efforts were made to accommodate the different time zones of participating members by beginning the morning sessions at 11:00. The schedule for the summer school is given in Figure 1: TWIND summer school schedule

¹ Politecnico di Milano

² NUCR – National University of Costa Rica

³ Please note that all times are in CET



	Timings (CET)	05/07/2021 - Monday	06/07/2021 - Tuesday	07/07/2021 - Wednesday	08/07/2021 - Thursday	09/07/2021 - Friday
Morning Session	10:50 - 11:00	Welcome				
	11:00 - 11:15	Richard P. Dwight C-KN1	Miren J. Sánchez Lara G-KN1	Jan-Willem van Wingerden B-KN1	Donatella Zappala H-KN1	Paul McKeever D-KN1
	11:15 - 11:30					
	11:30 - 11:45	C - SP1	Iñigo Mendikoa G-KN2	B - SP1	H - SP1	Francesco Boscolo Papo D-KN2
	11:45 - 12:00	C - SP2		B - SP2	H - SP2	
	12:00 - 12:15	Q&A	Q&A	B - SP3	Q&A	D - SP1
	12:15 - 12:30			Q&A		Q&A
Lunch (12:30 - 14:00)						
Afternoon Sessions	14:00 - 14:15	Axelle Viré A-KN1	G - SP1	Ad van Wijk E-KN1	H - SP3	D - SP2
	14:15 - 14:30		G - SP2		H - SP4	D - SP3
	14:30 - 14:45	Guilherme N. Vasconcelos Vaz A-KN2	G - SP3	E - SP1	Q&A	Q&A
	14:45 - 15:00		Q&A	Q&A	Sara Muggiasca F-KN1	J - SP1
	15:00 - 15:15	Q&A	G - SP4	E - SP2		J - SP2
	15:15 - 15:30	A - SP1	G - SP5	E - SP3	F - SP1	Q&A
	15:30 - 15:45	A - SP2	Q&A	E - SP4	F - SP2	Rodrigo Rojas I-KN1
	15:45 - 16:00	A - SP3		Q&A	F - SP3	
	16:00 - 16:15	Q&A		G - SP6	Q&A	Q&A

Key	
Aerodynamics - A	Experimental Methods - F
Control Systems - B	Hydrodynamics - G
Data-driven Modelling - C	Operations and Maintenance - H
Electrical systems - D	Offshore Wind Potential - I
Energy Storage & Hydrogen - E	Project Management/Farm Design - J

Abbreviations	
KN	Keynote
SP	Short Presentation

▲ Please note that all timings are in CET

Figure 1: TWIND summer school schedule

3.2 DETAILED SCIENTIFIC CONTENT

Day 1 – 5th July, 2021

The first day of the summer school began at 10:50 with a short welcome from Dr. Axelle Viré and Dr. Pranav Chandramouli to the participants. This was followed by the session on data-driven modelling beginning with the keynote of Dr. Richard Dwight and two short presentations. The afternoon session was on aerodynamics with two keynote lectures and 3 short presentations. The two sessions had a combined 79 unique attendees.

Data-driven Modelling - C			
Type	Presenter	Affiliation	Title
C - KN1	Richard P. Dwight	TU Delft	Data-driven approaches to physical modelling in CFD in CFD
C - SP1	Craig White	Wavec Offshore Renewables	Techno-economic assessment of floating offshore wind turbines to reduce LCOE
C - SP2	Deepali Singh	TU Delft	Data driven surrogate modeling for load prediction on offshore wind turbines

Aerodynamics - A			
Type	Presenter	Affiliation	Title
A - KN1	Axelle Viré	TU Delft	Floating offshore wind energy at TU Delft
A - KN2	Guilherme N.	Wavec	Aerodynamics of Offshore Wind Turbines
A - SP1	Ricardo Amaral	TU Delft	Aerodynamics of floating offshore wind turbines undergoing large motions
A - SP2	Claudia Muscari	TU Delft, Polimi	On the free stream velocity sampling in AL Models: review and assessment with respect to wake description
A - SP3	Marinos Manolesos	Swansea University	Thick airfoils, Vortex Generators, Gurney Flaps and Flatback Solutions: How to get better performance out of the blade inner region?



Day 2 – 6th July, 2021

The second day began at 11:00 with the keynote lectures from hydrodynamics given by experts from Tecnia followed by a Q&A session culminating in lunch. The 6 short presentations from hydrodynamics took place in the afternoon session with two Q&A sessions for every 3 short presentations. The two sessions had a combined 65 unique viewers.

Hydrodynamics - G			
Type	Presenter	Affiliation	Title
G - KN1	Miren J. Sánchez Lara	Tecnia R&I	Challenges in the hydrodynamics modelling of FOWT
G - KN2	Iñigo Mendikoa	Tecnia Research & Innovation	Mooring System Design for Floating Platforms
G - SP1	Federica Perassi	TU Delft	Fluid structure interaction between vertical-axis tidal turbine and floating structure
G - SP2	Manuel Rentschler	WavEC Offshore Renewables	CFD code comparison, verification and validation for a floating wind semi-submersible platform
G - SP3	Likhitha Ramesh Reddy	Delft University of Technology	Hydrodynamic modeling of floating offshore wind turbines
G - SP4	Alistair Lee	Offshore Renewable Energy Catapult	Mooring System Design
G - SP5	Daniel Milano	ORE Catapult	Floating Offshore Wind design and modelling
G - SP6	Razieh Jalal Abadi	University College London	Large Eddy Simulation of open-channel flow over square bars at different Reynolds numbers

Day 3 – 7th July, 2021

The morning session of Day 3 was dedicated to control systems with 1 keynote and 3 short presentations followed by a Q&A. The afternoon session was focused on energy storage & hydrogen with 1 keynote and 4 short presentations. One short presentation from hydrodynamics (G-SP6) was also incorporated in the afternoon session as it was postponed from day 2 due to a scheduling conflict. A total of 57 unique participants were registered on the webinar platform.

Control Systems - B			
Type	Presenter	Affiliation	Title
B - KN1	Jan-Willem van Wingerden	TU Delft	Smart wind farms
B - SP1	Javier Lopez	Tecnia	Floating offshore wind turbine vibration control
B - SP2	Michael Smailes; Ampea Karikari-Boateng	ORE Catapult	Wind Turbine & Wind Farm Control
B - SP3	Daniel van den Berg	TU Delft	Enhanced Wake-Mixing with Floating Offshore Wind Turbines

Energy Storage & Hydrogen - E			
Type	Presenter	Affiliation	Title
E - KN1	Ad van Wijk	TU Delft	Hydrogen the global zero carbon energy carrier
E - SP1	Andre Novgorodcev	TU Delft	Development of a Underwater Gravity Energy Storage (UGES) concept for offshore applications.
E - SP2	Omar Ibrahim	University College Cork	Coupling Floating Offshore Wind Turbine Farms with Green Hydrogen Production and Transportation
E - SP3	Dr. John Nwobu	Offshore Renewable Energy Catapult	Battery Energy Storage in Offshore Wind Farms
E - SP4	Dr. John Nwobu	Offshore Renewable Energy Catapult	Towards Achieving Net Zero: Green Hydrogen from Offshore Wind



Day 4 – 8th July, 2021

The penultimate day had sessions on operations and maintenance in the morning and experimental methods in the afternoon. The morning session had 1 keynote and 2 short presentations followed by a Q&A. The afternoon session carried forward two short presentations from operations and maintenance followed by a keynote and 3 short presentations from experimental methods. The sessions were viewed by 54 unique viewers.

Operations and Maintenance - H			
Type	Presenter	Affiliation	Title
H - KN1	Donatella Zappalá	TU Delft	Optimization of Wind Farm Maintenance: Reliability and Condition Monitoring
H - SP1	Mário Alberto Vieira	+ATLANTIC CoLAB	Introducing O&M in Marine Energy Technologies
H - SP2	Laurie Wilkins	Jeremy Benn Associates (JBA) Consultings	The effects of climate change on offshore wind operations and maintenance
H - SP3	Mingxin Li	TU Delft	An optimized opportunistic maintenance strategy for offshore wind farms
H - SP4	Chunjiang Jia	ORE Catapult	Data-driven modelling for power module condition monitoring

Experimental Methods - F			
Type	Presenter	Affiliation	Title
F - KN1	Sara Muggiasca	Politecnico di Milano	Experimental tests on FOWT models
F - SP1	German Perez	Tecnalia	Wave tank and wind tunnel experimental campaigns in H2020 LIFES50+ project (GA640741)
F - SP2	Felipe Novais	Politecnico di Milano	A Hardware-in-The-Loop System for Model Testing of Floating Offshore Wind Turbines in a Wind Tunnel
F - SP3	Alejandro Jimenez del Toro	ÉireComposites Teo.	Automated tape placement of carbon fibre reinforced thermoplastics for offshore wind turbine blades

Day 5 – 9th July, 2021

The final day of the summer school covered three topics with electrical systems covering the morning sessions and the first half of the afternoon session with 2 keynotes, 3 short presentations, and 2 Q&A. This was followed by two short presentations on project management/farm design and the final keynote on offshore wind potential by Dr. Rodrigo Rogas. The school ended with concluding remarks.

Electrical systems - D			
Type	Presenter	Affiliation	Title
D - KN1	Paul McKeever	ORE Catapult	The changing role of electrical systems in the offshore wind sector
D - KN2	Francesco Boscolo Papo	Tecnalia Research and Innovation	Design of dynamic cable for floating platforms
D - SP1	Will Brindley	ORE Catapult	Dynamic Cable Design
D - SP2	Pan Fang	Delft University of Technology 3ME	Bending test of dynamic power cables
D - SP3	Manuel Rentschler	WavEC Offshore Renewables	Dynamic cable research at WavEC – Layout optimization & bending experiments

Project Management/Farm Design - J			
Type	Presenter	Affiliation	Title
I - SP1	Amorina Gonzalez Armayor	WavEC	The use of project management to reduce costs
I - SP2	Matteo Baudino Bessone	Delft University of Technology	Review on floating offshore wind farm design: identification of the interactions between subsystems

Offshore Wind Potential - I			
Type	Presenter	Affiliation	Title
I - KN1	Rodrigo Rojas	National University of Costa Rica	Offshore wind potential in Costa Rica: Boosting a plan towards road map



3.3 FEEDBACK

Upon completion of the summer school, a feedback form was sent to all the participants. The main points of the feedback received are presented succinctly below:

- A total of 11 responses were received for the feedback form.
- Equal number of participants could not attend certain sessions due to either time schedule or due to previous commitments
- “Interesting for their work” was the primary motive (63,6%) for registering to the TWIND summer school followed by “a way to showcase research” (18,2%).
- The participants were split mainly into technology developer/supplier (36.4%), followed by students (27,3%) and project managers (18,2%).
- The summer school was scored 4.27/5 on content, 4.82/5 on organisation, 4.73/5 on the platform (zoom).
- Majority of the feedback (90.9%) found the summer school format to be suitable while a preference was mentioned for a physical event next time.
- The course met 100% of the expectation and a unilateral interest was expressed for a second edition of the summer school.

4 SHORT COURSE

4.1 ORGANISATION

The 4-day course took place in Delft from the 17th to 20th of October 2022, just before a TWIND think-tank session. This enables to maximise networking between the two groups of participants, through a dinner on the last day of the course. The event was split into 11 topics, covering various aspects of offshore wind farm design, and lectured by senior staff members of the Delft University Wind Energy Institute (DUWIND) spread across different faculties (see Table 4).

Table 4 Topics and lecturers covered in the TWIND short course

Lecturers	Faculty involved at TU Delft	Topics
Axelle Viré	Aerospace Engineering	Trends in wind energy
Dominic von Terzi	Aerospace Engineering	Wind turbine rotor design
Michiel Zaaier	Aerospace Engineering	Wind farm design
Dries Allaerts	Aerospace Engineering	Atmospheric phenomena
George Lavidas	Civil Engineering	Offshore resource
Bart Ummels	Civil Engineering	Electrical infrastructure
Sebastian Schreier	Mechanical Engineering	Floating structures and moorings
Jan-Willem van Wingerden	Mechanical Engineering	Control (fixed & floating turbines)
Wim Bierbooms	Aerospace Engineering	Wind loads
Donatella Zappala	Aerospace Engineering	Wind farm maintenance
Pim van der Male	Civil Engineering	Dynamics and loads

The schedule for the summer school is given in Figure 2. Three discussion sessions were organised per day to enhance interactions between learners and lecturers, and also address the specific interests of the participants.



	Monday 17/10 - Meeting room 1 (LR)	Tuesday 18/10 - Meeting room 1 (LR)	Wednesday 19/10 - Meeting room 1 (LR)	Thursday 20/10 - Fellowship (instruction room 5)
9:30-9:45	Welcome coffee			
9:45-10:00	Welcome and course introduction (Axelle Viré)			
10:00-10:45	Trends in wind energy: future needs and challenges (Axelle Viré)	Atmospheric phenomena I (Dries Allaerts)	Floating support structures and moorings (Sebastian Schreier)	
10:45-11:00	Coffee break			
11:00-11:45	Wind turbine rotor design I (drivers, objectives, process) (Dominic von Terzi)	Atmospheric phenomena II (Dries Allaerts)	Floating support structures and moorings (Sebastian Schreier)	Wind loads (Wim Bierbooms)
11:45-12:15	Discussions			
12:15-13:15	Lunch			
13:15-14:00	Wind turbine rotor design II (drivers, objectives, process) (Dominic von Terzi)	Offshore resource I (George Lavidas)	Control - fixed turbines (Jan-Willem van Wingerden)	Wind farm maintenance (Donatella Zappalá)
14:00-14:30	Discussions			
14:30-15:15	Wind farm design I (Michiel Zaaijer)	Offshore resource II (George Lavidas)	Control - floating turbines (Jan-Willem van Wingerden)	Dynamics and loads I (Pim van der Male)
15:15-15:45	Coffee break			
15:45-16:30	Wind farm design II (Michiel Zaaijer)	Electrical Infrastructure (Bart Ummels)		Dynamics and loads II (Pim van der Male)
16:30-17:00	Discussions			
Evening				Dinner

Figure 2: TWIND short course schedule

The course was organised in-person, on the campus of TU Delft, and attended by participants from the 4 TWIND partners, as summarised in Table 5.

TWIND partner organisation	Number of participants in the course
WavEC	5
Tecnalia	2
OREC	1
TU Delft	10
Total number of participants	18

4.2 FEEDBACK

Due to sicknesses in the organiser team, TU Delft did not organise a formal feedback form after the course. However, the organisers received positive feedback from the participants orally or by email. The PhD candidates who attended the course could receive a certificate for the course to count in the credits of their doctoral education programme.

5 CREDITS IN GRADUATE SCHOOL PROGRAMMES

For all the TWIND training events, the participants could request a certificate of attendance containing the number of working hours spent on these activities. It was then up to the graduate school of the participants' organisation to recognise these credits in their graduate programmes. We are glad to confirm that the TWIND credits were recognised by the graduate school at TU Delft.

6 CONCLUSIONS

This report details the organisation, programme, and output of the TWIND training schools. Despite the unusual circumstances and additional work required to organise the summer school online (due to COVID-19 pandemic) and postponed short course to be able to meet in-person, the participants were highly satisfied by the events. The objective of transferring knowledge to the partners and training early-stage researchers in the field of both offshore and floating offshore wind energy has been achieved.

