

## 2<sup>nd</sup> AAU and ECN affiliated PhD course on:

# ‘Numerical and experimental modelling and control of Wave Energy Converters’

### Aim of the course:

The main objective of this course is to train each participant to the numerical and experimental modelling and control of Wave Energy Converters (WECs).

The following topics will be taught:

- The State of the Art of wave energy conversion techniques
- The State of the Art of numerical modelling of WECs, the limitations and the alternative numerical approaches
- The State of the Art of experimental modelling of WECs, the limitations
- The State of the Art of control of WECs

By the end of the course, the participants will have carried out the following tasks:

- Wave measurement and generation in wave tank
- Numerical investigation of the performance of a WEC
- Experimental investigation of the performance of a WEC with and without control

### Venue and date:

The course will take place at the Ecole Centrale Nantes, city of Nantes, France. Nantes can easily be reached from Paris by train (2hrs), or directly by flying to Nantes Atlantique Airport (Air France/KLM service from/to Amsterdam and Paris).

The course will be held on two weeks from Monday, August 24 to Friday, September 4, 2015.

### Pre-requisites

- Degree in Engineering
- Basic knowledge of Matlab or any other programming language

### Registration:

Registration fees are 800€ for students and 2 400€ in other cases.

For registration, contact [aurelien.babarit@ec-nantes.fr](mailto:aurelien.babarit@ec-nantes.fr), +33 240 371 631 or [jpk@civil.aau.dk](mailto:jpk@civil.aau.dk)

### Organizing committee:

This course is organized by Jens Peter Kofoed from Aalborg University and Aurélien Babarit from Ecole Centrale de Nantes in collaboration with OceaNET (Marie Curie Actions of the European Commission, FP7-PEOPLE-2013-ITN) and WavEC Offshore Renewables.

Financial support from :

Course program: Numerical and experimental modelling and control of Wave Energy Converters

Week 1/2

	Tuesday 25	Wednesday 26	Thursday 27	Friday 28	Saturday 29
	Introduction to wave energy utilization	Ocean waves	Wave structure interaction	Wave to wire modelling	SEMREV visit
8:30 - 9:00			Follow-up AB	Follow-up AB	
9:00 - 9:30	General introduction to the course AB & JPK	Ocean Waves 1: time and frequency domain time series analysis JPK	Ocean Waves 2: Linear waves GD	PTO modeling, from floating body to WEC AB	Drive to Le Croisic AB
9:30 - 10:00	Introduction to wave energy utilization JPK				Visit of ECN facilities + introduction of exercise JPK & MK & SB & FB
10:00 - 10:30					
10:30 - 11:00					
11:00 - 11:30					
11:30 - 12:00					
12:00 - 12:30					
12:30 - 13:00					Lunch at Le Croisic
13:00 - 13:30					
13:30 - 14:00	Introduction to wave energy utilization JPK	Wave measurement and generation in ECN's wave tank JPK & MK & SB & FB	Linear floating body response - open source BEM code Nemoh (cont.) AB	W2W modeling - frequency domain AB - MA	Outdoor activities AB
14:00 - 14:30			Numerical investigation of response of floating structures in waves AB - MA		
14:30 - 15:00					
15:00 - 15:30	Experimental performance investigation of WECs JPK				Drive back to Nantes AB
15:30 - 16:00					
16:00 - 16:30					
16:30 - 17:00					
17:00 - 17:30					

AB: Aurélien Babarit - JPK: Jens Peter Kofoed - MK: Morten Kramer - SB: Sylvain Bourdier - FB : Félicien Bonnefoy - GD: Guillaume Ducrozet - LG : Lionel Gentaz - DLT: David Le Touzé - MA: Marco Alves

Lecture  Visit   
 Exercise  Guest lecture

Financial support from :



Course program: Numerical and experimental modelling and control of Wave Energy Converters

Week 2/2

	Monday 31	Tuesday 1	Wednesday 2	Thursday 3	Friday 4
	<b>Wave to wire modelling</b>	<b>Wave to wire modelling</b>	<b>Control of WECs</b>	<b>Control of WECs</b>	<b>Control of WECs, resource, arrays</b>
8:30 - 9:00	Follow-up AB	Follow-up AB	Follow-up AB	Follow-up AB	Follow-up
9:00 - 9:30	Ocean Waves 3: advanced wave analysis and modelling GD	Time domain modeling / viscous effects / uncertainties AB	Control of wave energy converters MK	Control of wave energy converters MK	Wave propagation modelling FA
9:30 - 10:00					
10:00 - 10:30				Practical experience with the modelling of the Pelamis wave energy converter CR	Wave interaction in arrays of wave energy converters MF
10:30 - 11:00					
11:00 - 11:30	CFD modeling - SPH DLT	InWave: a multibody dynamic solver for WEC simulation AC	Practical experience with control of WECs MK		
11:30 - 12:00					
12:00 - 12:30					
12:30 - 13:00					
13:00 - 13:30					
13:30 - 14:00	W2W modeling - frequency domain AB - MA	Experimental performance investigation of WEC's with and without control / W2W modelling - time domain MK & SB & FB / AB MA	Experimental performance investigation of WEC's with and without control / W2W modelling - time domain MK & SB & FB / AB MA	Experimental performance investigation of WEC's with and without control / W2W modelling - time domain MK & SB & FB / AB MA	Reporting & evaluation of the course AB
14:00 - 14:30					
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16:30 - 17:00					
17:00 - 17:30					

AB: Aurélien Babarit - MF: Matt Folley - MK: Morten Kramer - SB: Sylvain Bourdier - FB : Félicien Bonnefoy - CB: Christian Berhaut - AC: Adrien Combourieu - FA: Fabrice Arduin - CR: Chris Retzler - MA : Marco Alves

Lecture  Visit   
 Exercise  Guest lecture 

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