DYNAMIC POSITIONING CONFERENCE
October 13-14, 2015

DESIGN 2

DYNCAP – Full Scale Validation of a Vessel's Station-Keeping Capability Analysis

Øyvind Smogeli
Nguyen Dong Trong, Kristoffer Eide, Luca Pivano
Marine Cybernetics

DESIGN SESSION 2

DYNCAP – FULL SCALE VALIDATION OF A VESSEL'S STATION-KEEPING CAPABILITY ANALYSIS

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MTS DYNAMIC POSITIONING CONFERENCE
Houston, October 13-14, 2015

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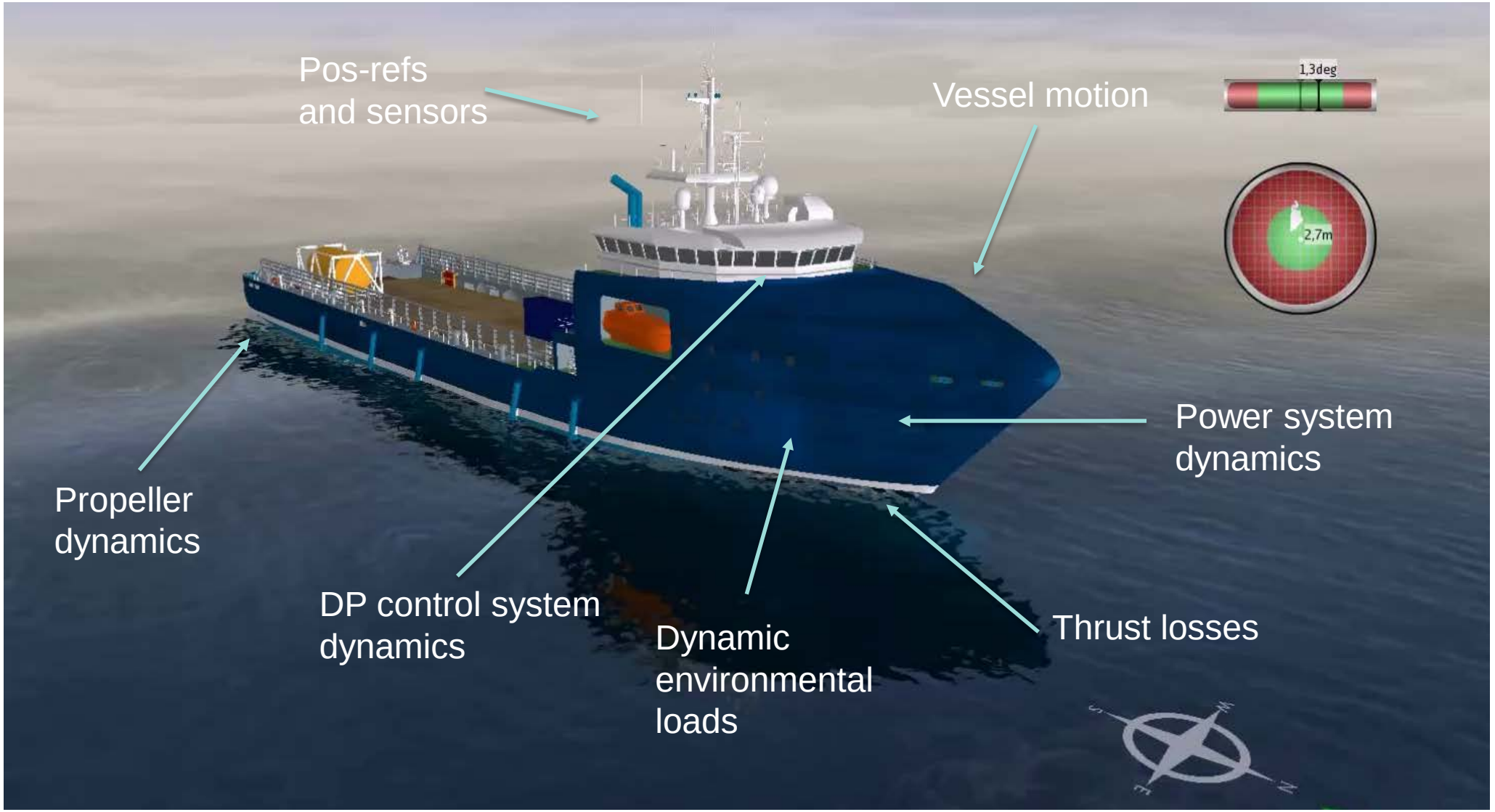
WHAT IS DYNCAP?



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BRIEF HISTORY

- The beginning: FlexShuttle JIP 2009-2011
- Presented at IMCA Annual Seminar 2010
- MTS DP conference 2013: DynCap concept
- MTS DP conference 2014: Diving vessel case study
- DP Brasil 2015: Offshore windmill service vessel case study
- MTS DP conference 2015: Full-scale validation
- Various commercial projects and other conferences
- DNV GL: New DP-CAP standard in 2016

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- Vessel motion
- Acceptance criteria
- Slowly-varying wave drift forces
- Sea state discretization
- Vessel model fidelity
- DP tuning
- Search algorithms
- Statistical significance

Next step: full-scale validation

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Sea Trials and Model Tests for Validation of Shiphandling Simulation Models – SimVal

Goal:

Improve present validation methodology for ship-handling simulation models

Partners:

The Research Council of Norway
MARINTEK
NTNU
Rolls-Royce
TORGHATTEN NORD
ET SELSKAP I TORGHATTEN-KONSERNET
TRANSPETRO
flanders HYDRAULICS RESEARCH
MARITIME TECHNOLOGY
GHENT UNIVERSITY
ISLAND OFFSHORE
MARINE CYBERNETICS
SMA
Singapore Maritime Academy
SINGAPORE POLYTECHNIC
USP
Universidade de São Paulo
TOKYO UNIVERSITY OF MARINE SCIENCE AND TECHNOLOGY
SINTEF

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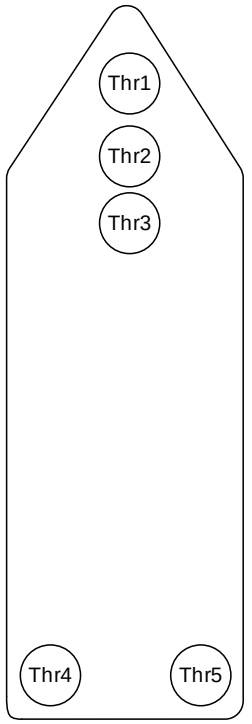
THE VESSEL: MV ISLAND CONDOR



Owner: Island Offshore

Design: UT 776 CD

Type: Platform service vessel

Length: 97m

Width: 20m

Diesel electric main propulsion

Two CP azipulls @ 2200 kW

Two CP bow tunnels @ 883 kW

Bow CP VROS @ 883 kW

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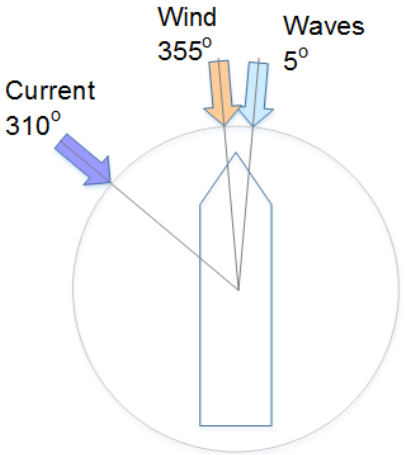
TRIALS AND MEASUREMENTS

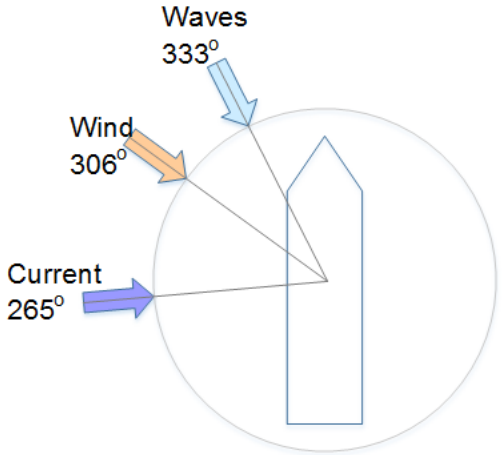
- All trials conducted off Norwegian west coast 13th to 17th of November 2014
  - Step responses
  - Maneuvering
  - Station-keeping

- Onboard measurements taken by MARINTEK
  - Position, velocity, heading
  - Heave, roll and pitch
  - Power distribution and generation
  - DP thruster command and feedback
  - Wind speed and direction
  - Sea state measured by a wave buoy
  - Current speed and direction only estimated

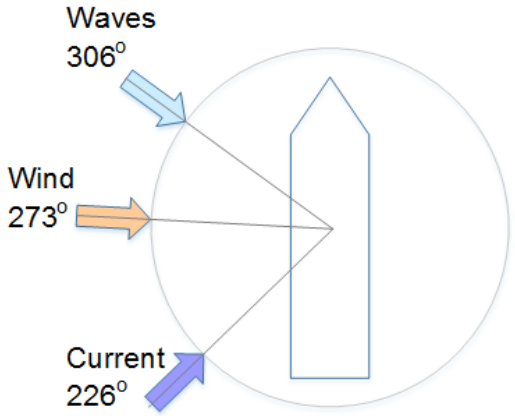
ENVIRONMENTAL CONDITIONS



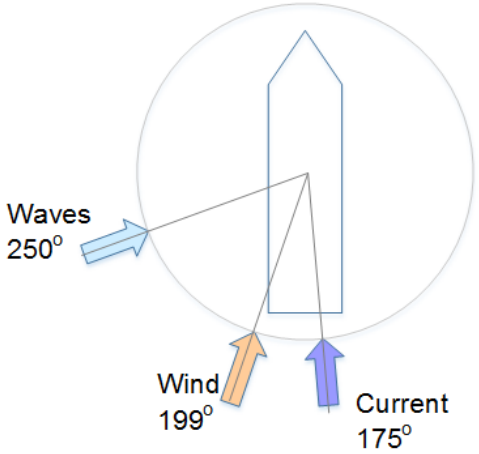
Head wind



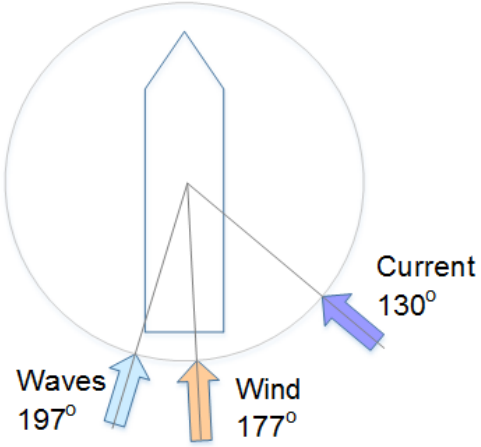
Bow quartering wind



Beam wind



Stern quartering wind



Following wind

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HEAVE, ROLL AND PITCH RESULTS

Case	1		2		3		4		5	
Description	**Head sea**		**Bow quartering sea**		**Beam sea**		**Stern quartering sea**		**Following sea**	
	Exp	**Sim**	**Exp**	**Sim**	**Exp**	**Sim**	**Exp**	**Sim**	**Exp**	**Sim**
Max heave (m)	1.80	1.05	1.89	1.33	2.13	1.77	1.47	1.81	1.54	0.94
Std heave (m)	0.60	0.31	0.53	0.36	0.59	0.54	0.46	0.57	0.49	0.28
Max roll (deg)	1.47	0.94	1.48	1.64	1.72	2.45	2.44	2.51	2.02	1.14
Std roll (deg)	0.39	0.25	0.37	0.34	0.44	0.50	0.70	0.60	0.64	0.39
Max pitch (deg)	2.32	3.14	2.61	2.99	2.66	2.61	1.78	2.50	2.85	2.73
Std pitch (deg)	0.71	0.91	0.73	0.90	0.72	0.83	0.53	0.76	0.88	0.92

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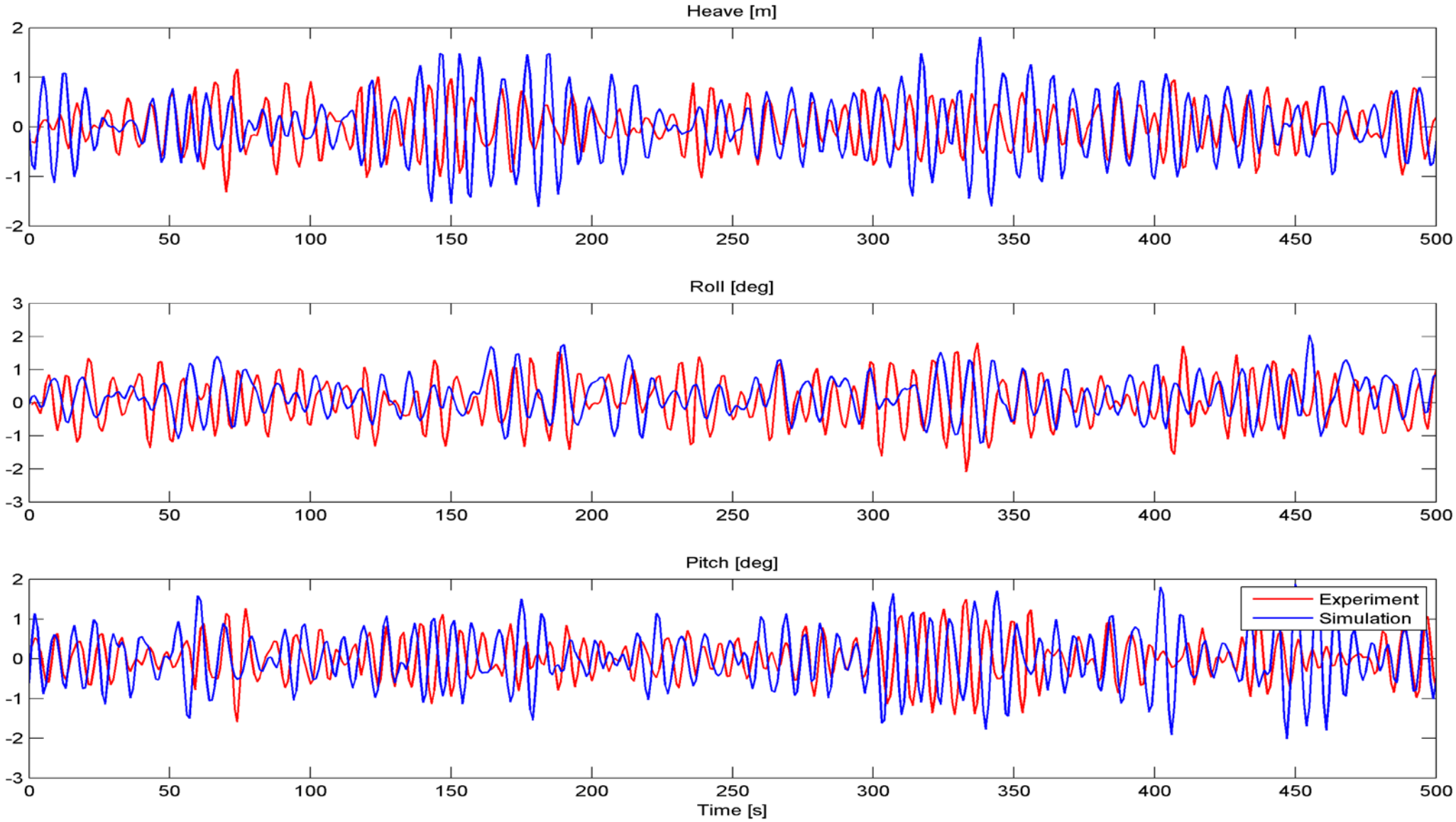
HEAVE, ROLL AND PITCH TIME SERIES



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STATION-KEEPING RESULTS – SURGE, SWAY AND YAW

Case	1		2		3		4		5	
Description	**Head wind**		**Bow quartering wind**		**Beam wind**		**Stern quartering wind**		**Following wind**	
	Exp	**Sim**	**Exp**	**Sim**	**Exp**	**Sim**	**Exp**	**Sim**	**Exp**	**Sim**
Max position deviation (m)	2.48	1.78	4.28	3.77	3.07	2.52	2.94	3.09	3.97	1.80
Std position deviation (m)	0.44	0.31	1.03	0.59	0.58	0.45	0.49	0.55	0.53	0.31
Max heading devation (deg)	2.92	1.66	2.36	4.84	2.49	3.32	2.22	1.61	2.21	1.41
Std heading devation (deg)	0.85	0.43	0.83	0.95	0.73	0.74	0.78	0.64	0.59	0.59
Average power all thrusters (kW)	2124	1902	2857	3058	2515	2238	899	1167	1320	1226

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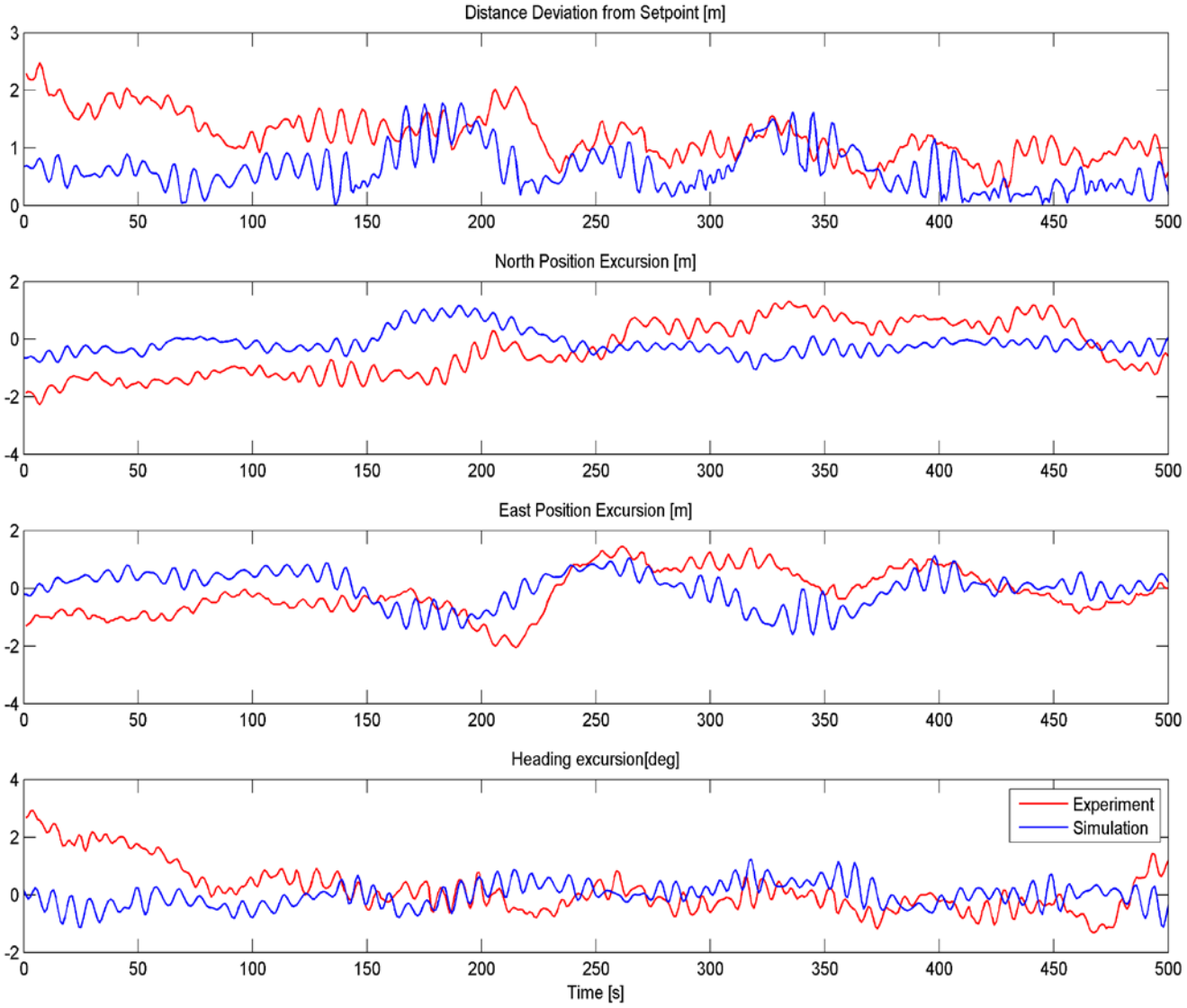
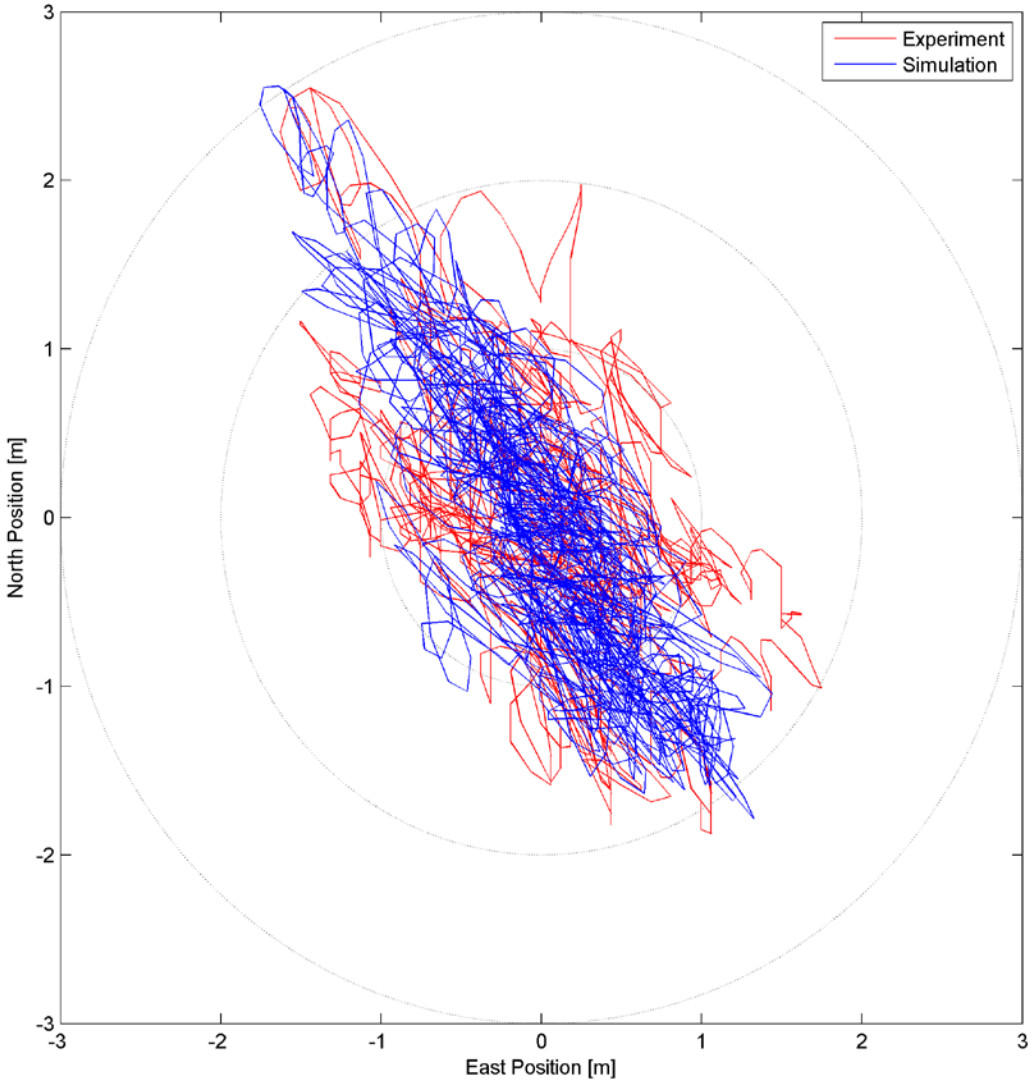
FOOTPRINT COMPARISON





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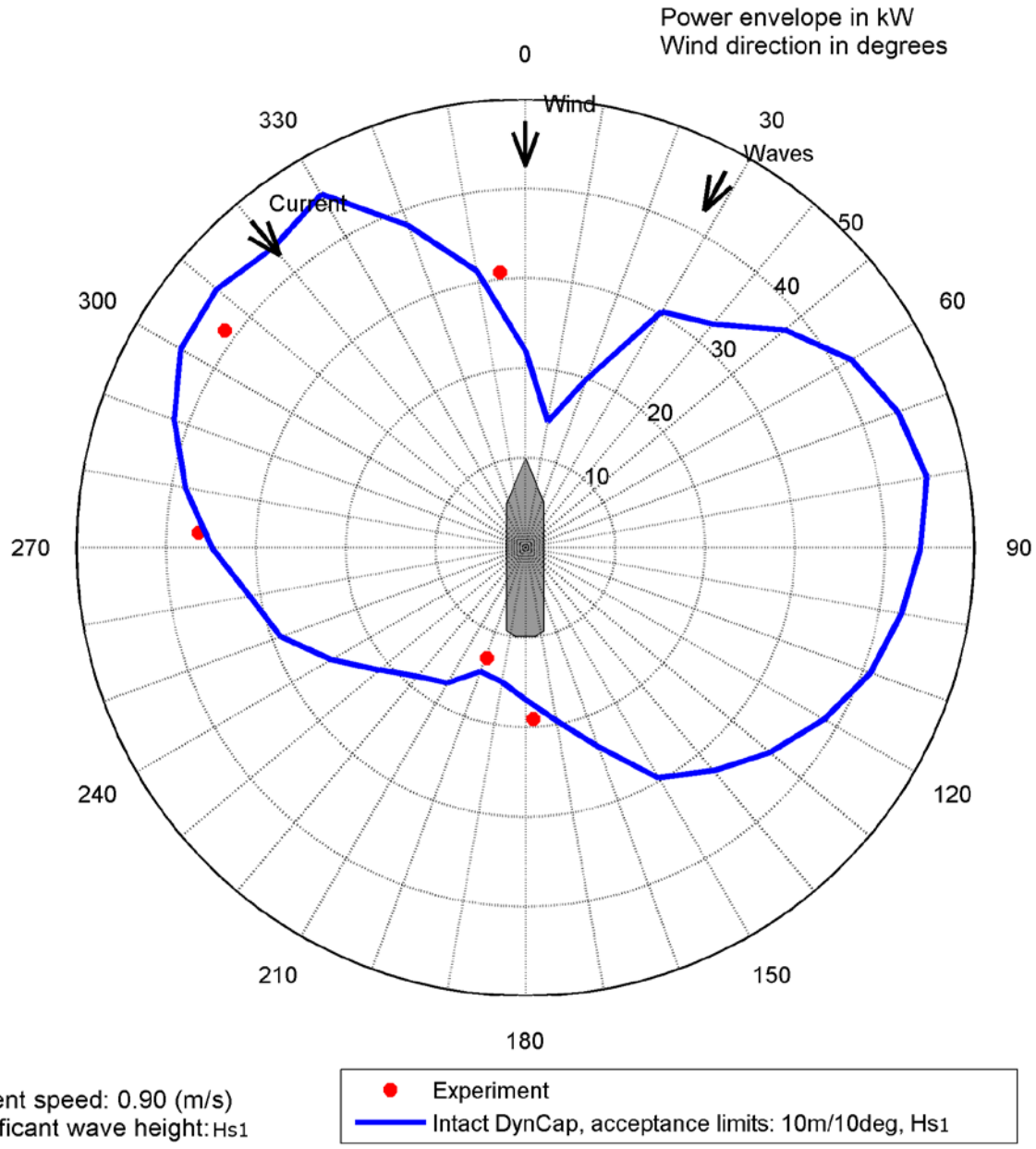
DYNCAP POWER



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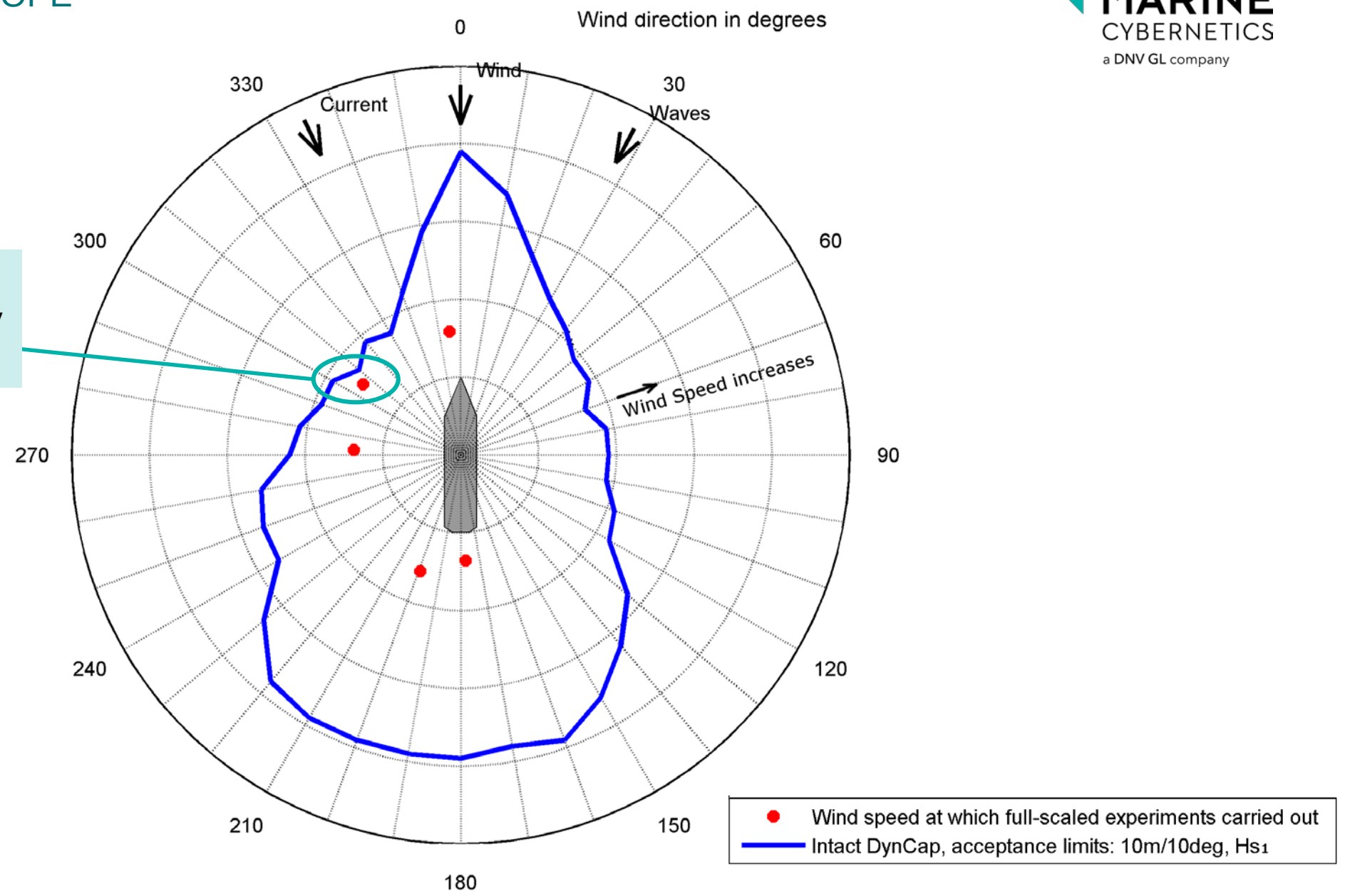
DYNCAP WIND ENVELOPE



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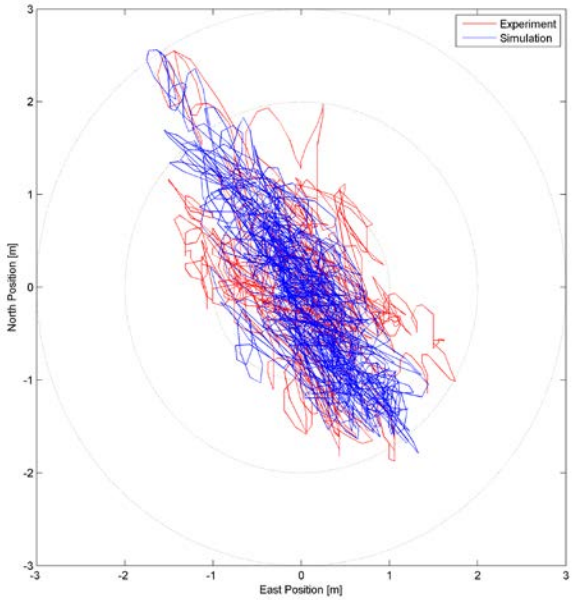
SUMMARY

- Summarized a brief history and rationale of the DynCap concept
- Shared experiences in configuring, running and analysing results
- Key contribution: full-scale validation with MV Island Condor
  - Step responses
  - DP station-keeping
- Results show satisfactory correlation between experiments and simulations
  - Obtaining sufficient data from full-scala trials is challenging…
- Complete power envelope and wind envelope demonstrated added value
- *Demonstrated that DynCap is a valuable tool for in-depth DP capability studies*



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