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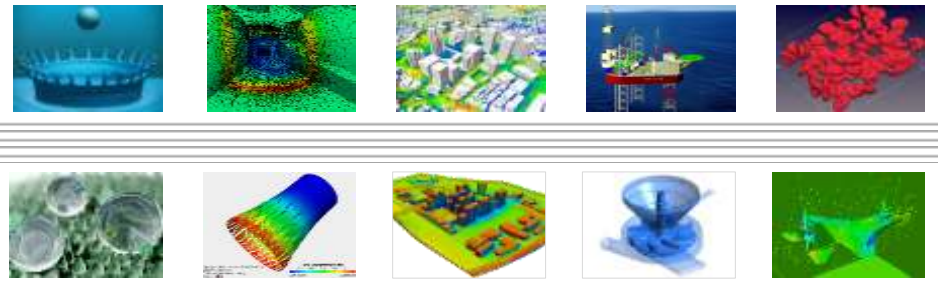
A*STAR

SMI Forum 2016



Numerical Modeling of Strong Wave Impact on Deep-Sea Semi-Submersible (WID-Sea)

IHPC

Keppel Offshore & Marine Technology Centre

Motivation

- Realistic sea state conditions; *which commercial software cannot do*
- Large displacement of structures; *which conventional methods failed*
- Open source & avoid high cost burden of commercial software; *enable future development & applications freely*
- Accurate yet efficient solution
- Parallel solutions from the beginning, scaled up solution with available computing power
- The model will be fully tested, verified with industry applications (Keppel Offshore & Marine Technology Centre)

Project Team

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Keppel Offshore & Marine Technology Centre

Name	Organisation
Lou Jing (PI)	IHPC, A*STAR
Lu Xin (Co-PI)	IHPC, A*STAR
Kang Chang Wei (Co-PI)	IHPC, A*STAR
Dominic Chandar	IHPC, A*STAR
Yu Peng	IHPC, A*STAR (Left in Aug. 2015)
Chen Yu	IHPC, A*STAR
Anis Hussian	KOMTech
Aziz Merchant	KOMTech
Tay Zhi Yung	KOMTech
Ankit Choudhary	KOMTech

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DEEPWATER TECHNOLOGY R&D PROGRAMME (DWT)
(SMI-2014-OF-14)

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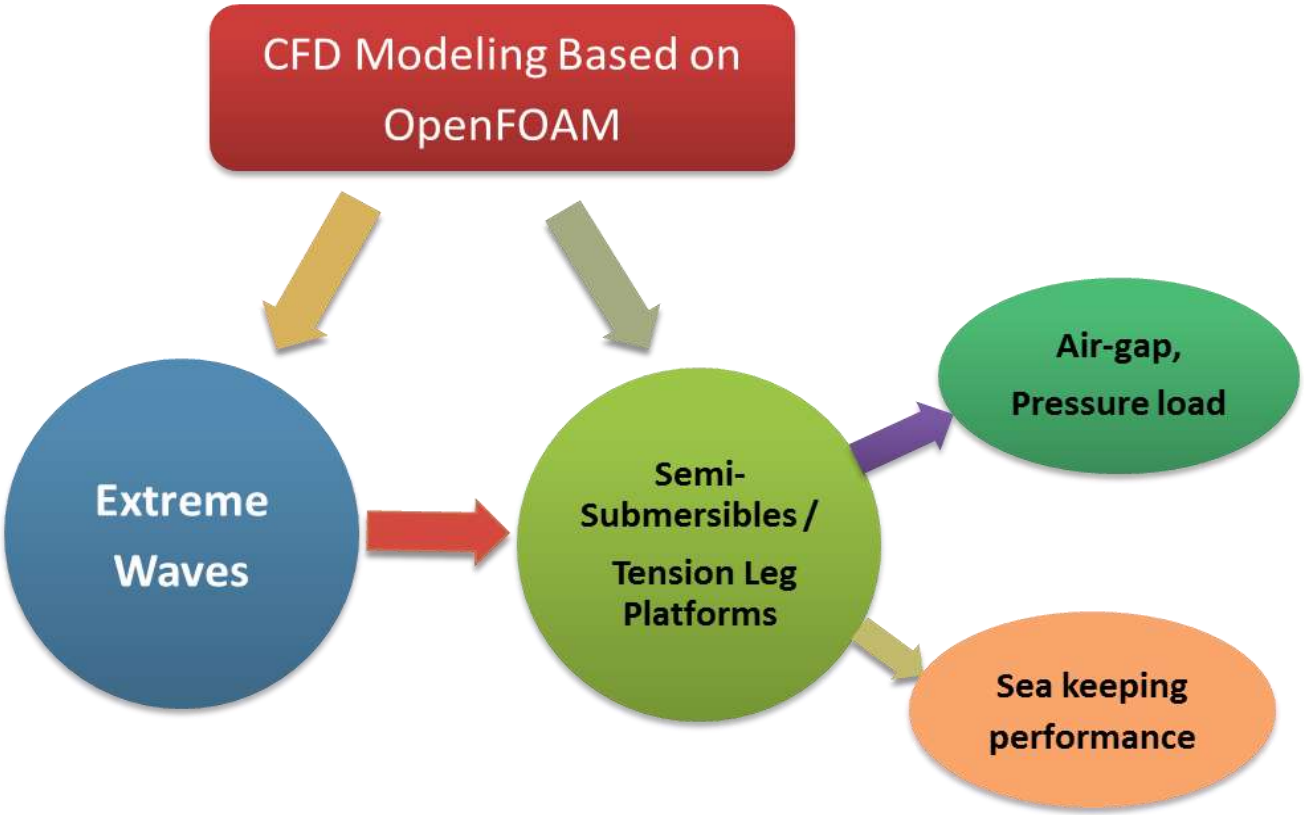
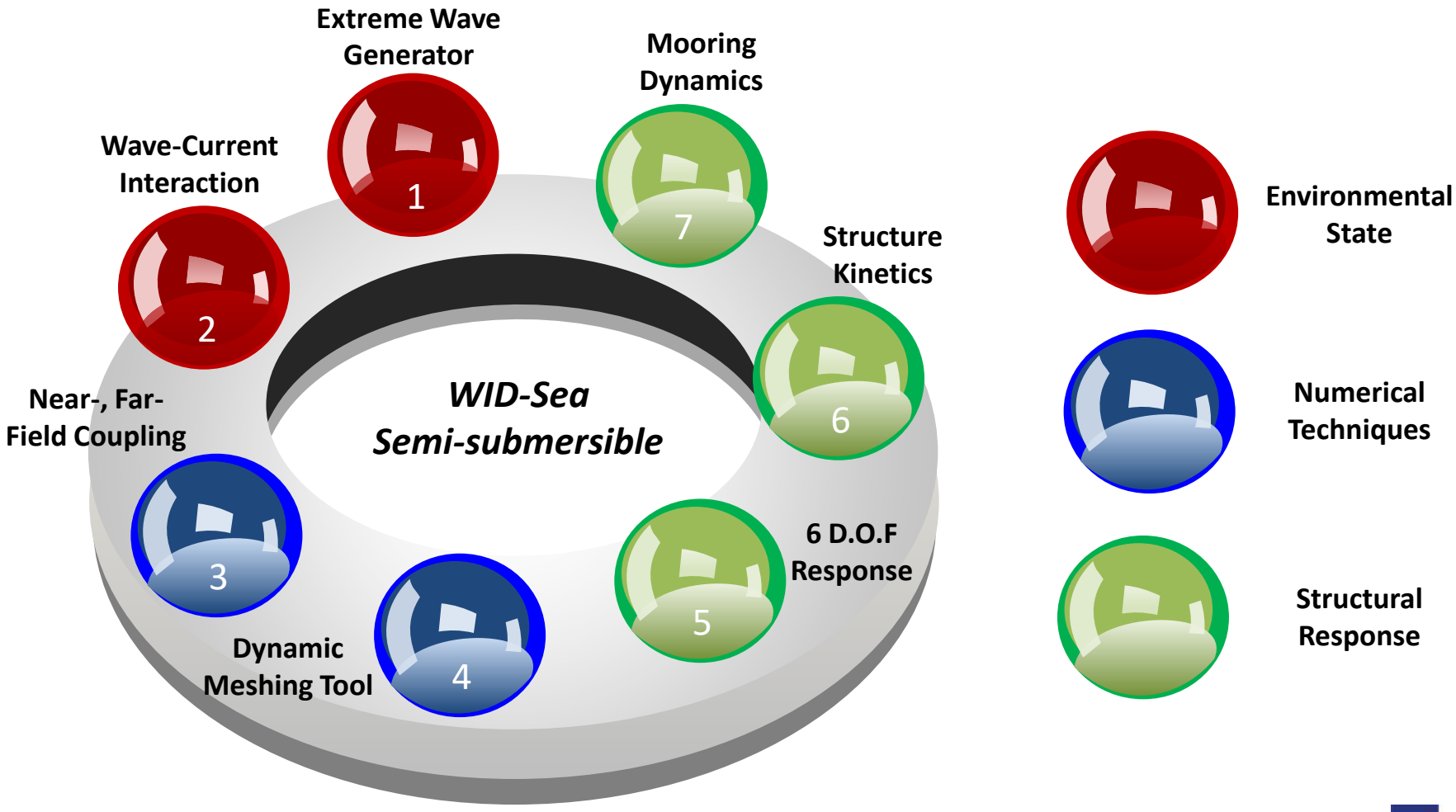
Project Objective

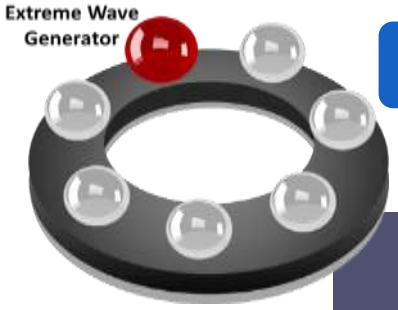
Develop an Advanced Simulation Tool for Wave Impact on Floating Platform



Project Scope

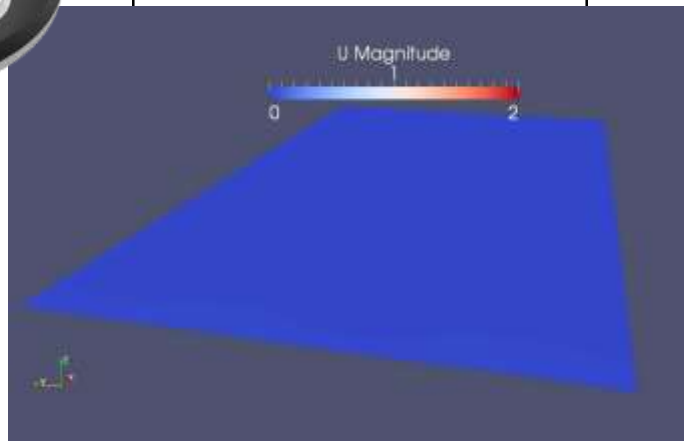


Key Development 1: 3D New Wave Modeling

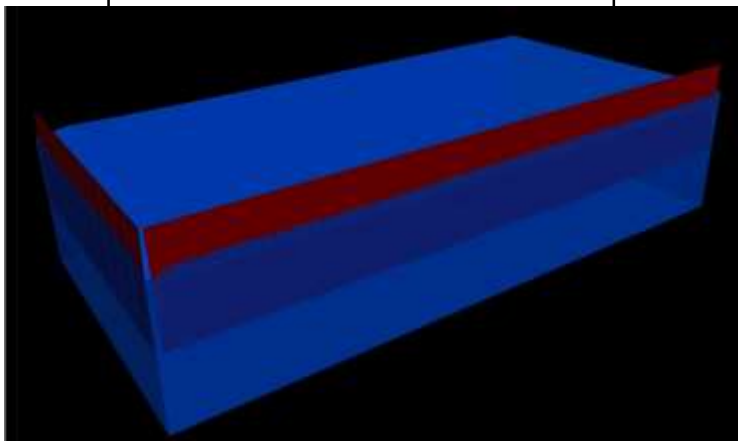


Complex Wave Generator (3-D, random, spreading, focused waves)

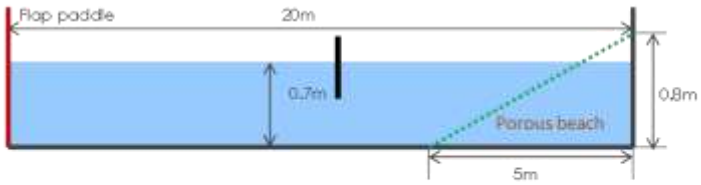
Wave dynamics in open sea



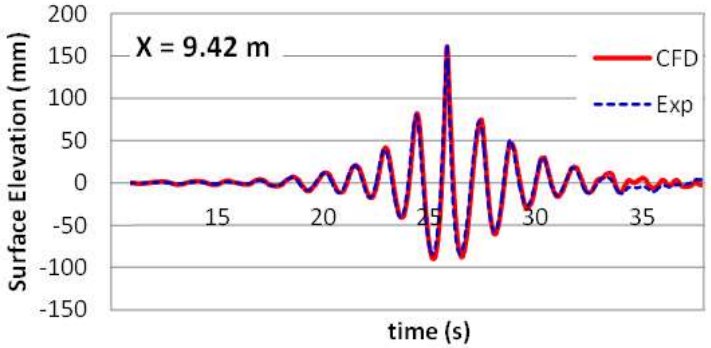
Wave generation in wave basin



Model validation

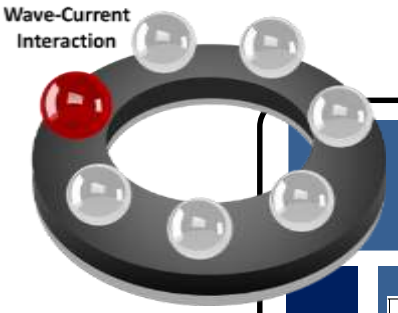


Wave generation using paddle movement signal from experiment



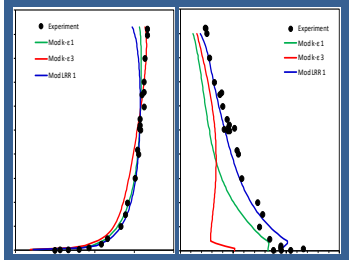
ISOPE 2014.

Key Development 2: Wave-Current Interaction



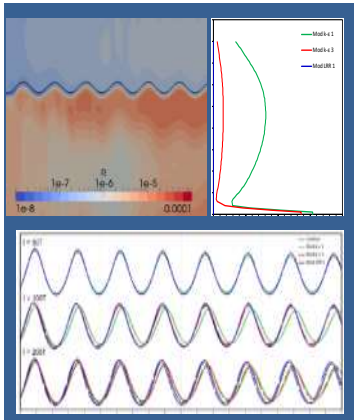
Interface-switch for Turbulence Model

Current



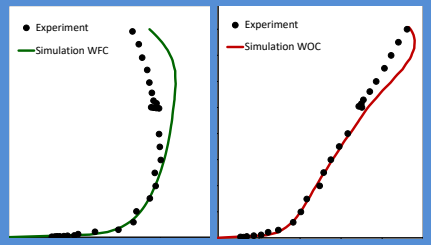
Predict correctly:
- Mean current.
- TKE profile.

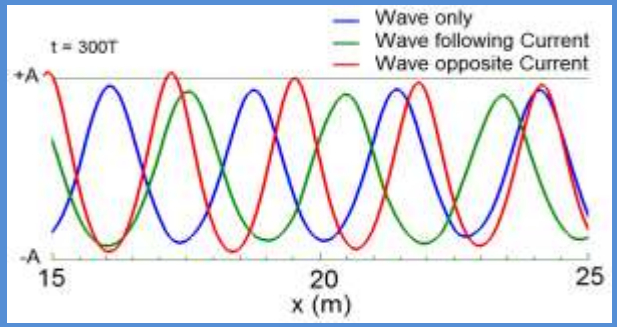
Wave



Successfully model surface wave:
- TKE decreases towards interface.
- Minor decrease of amplitude after t > 200T.

Wave-Current Interaction

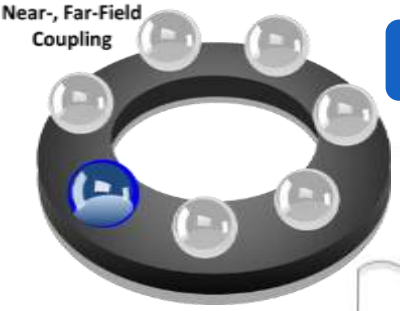




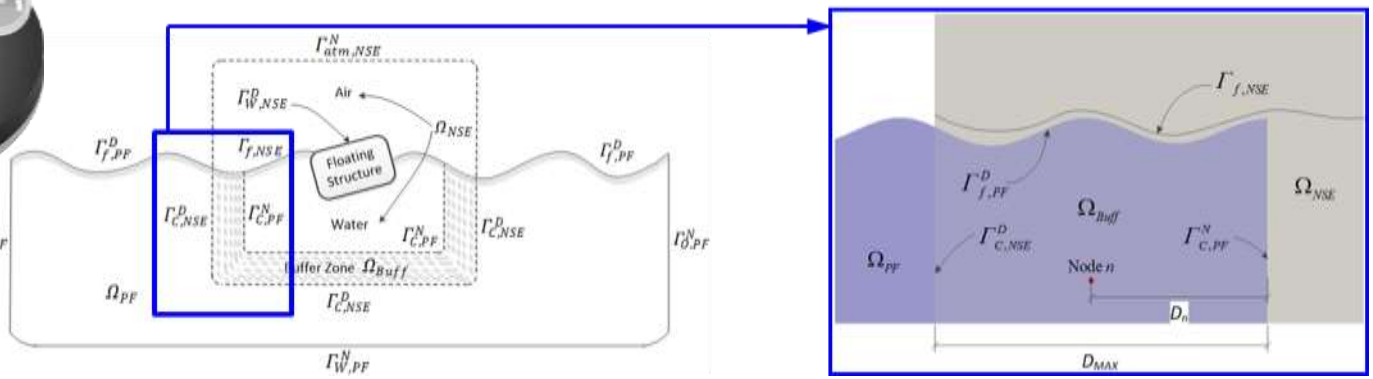
Capture wave-current interaction effects:
- Change in mean current due to surface wave.
- Change in surface wave form due to turbulent current.

ISOPE 2016.

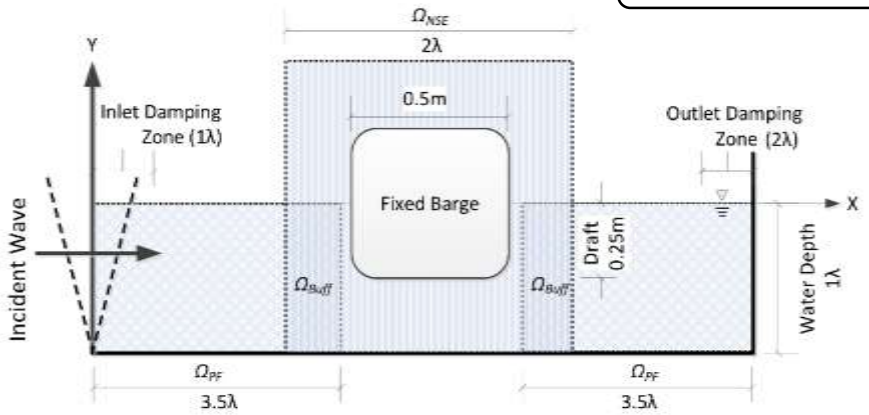
Key Development 3: Viscous Potential Flow Coupling



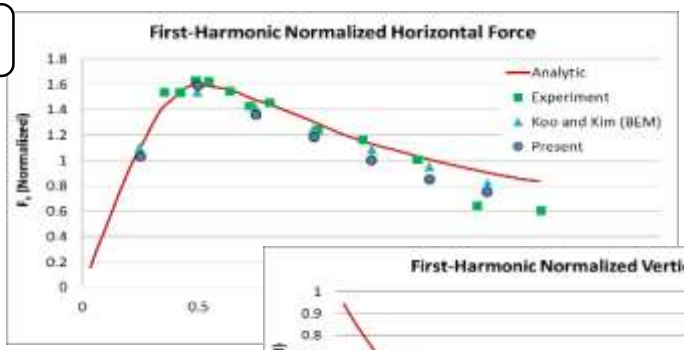
Coupling Method

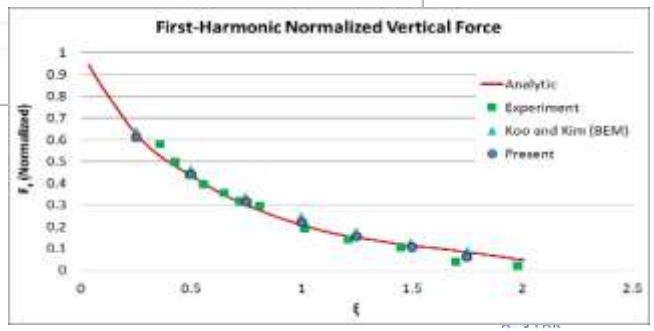


Model Validation



Loading on Barge

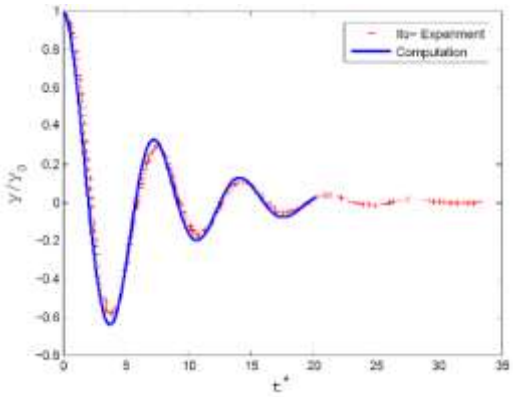


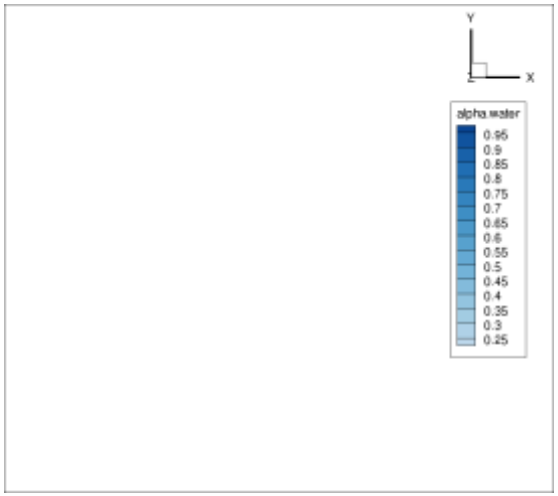


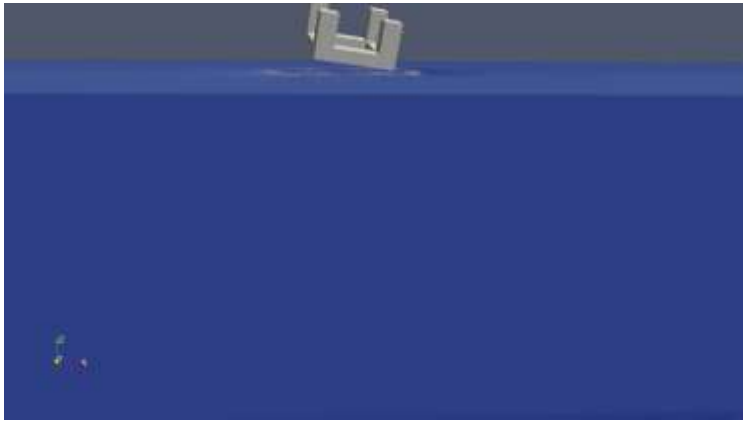
Int. J. Comp. Meth. and Exp. Meas. 2016.

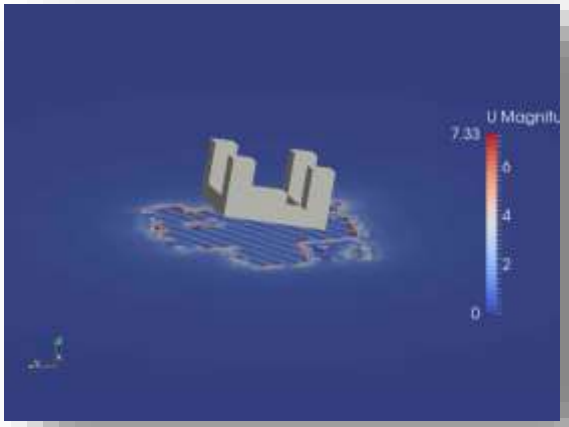
Key Development 4: Overset Meshing

Drop Test Validation





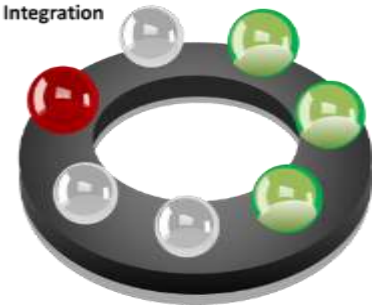


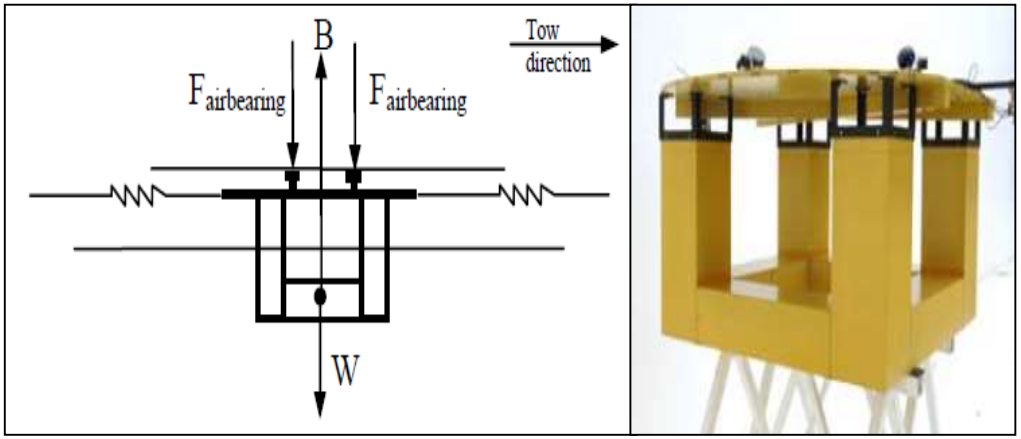


Technology Disclosure:
OPERA: Overset Mesh Parallel Engine for Engineering Applications
(IHPC-TD-FD-2015-003, ETPL Ref: IHPC/Z/09187)

J. Appl. Comput. Sci. Math. 2015 & OMAE 2015

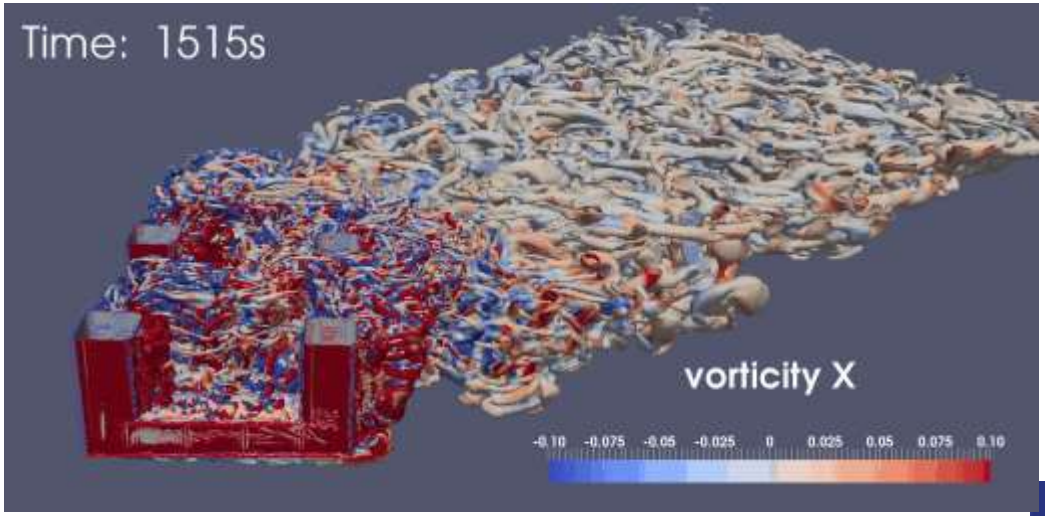
Integration for Application 1: Vortex-Induced Motion



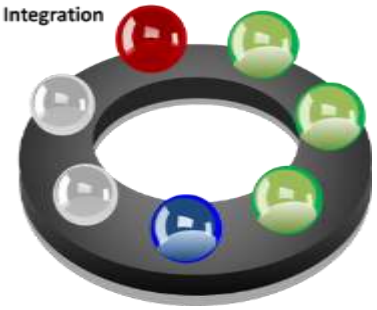


Integration of Modules:

1. Wave-Current Interaction
2. 6 D.O.F Response
3. Structure Kinetics
4. Mooring Dynamics

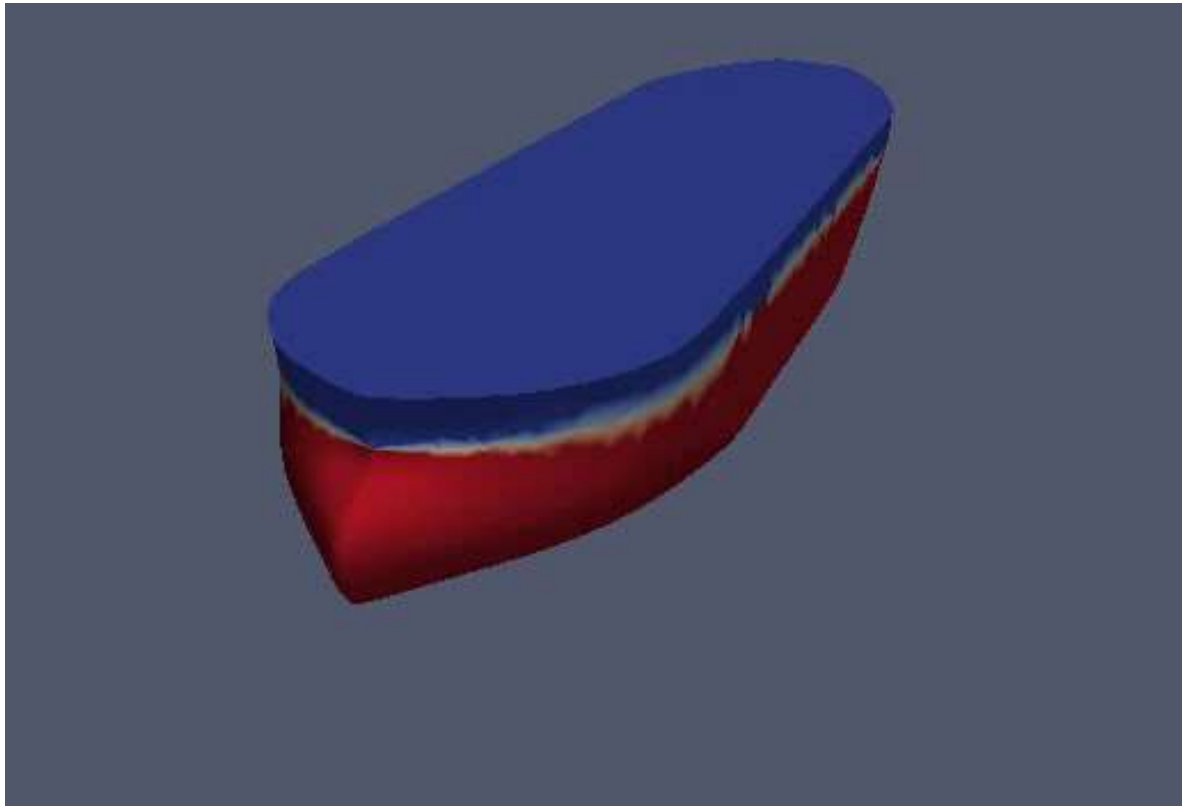


Integration for Application 2: KLVCC Tanker Study



Integration of Modules:

1. Extreme Wave Generator
2. Dynamic Meshing Tool
3. 6 D.O.F Response
4. Structure Kinetics
5. Mooring Dynamics



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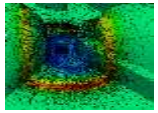


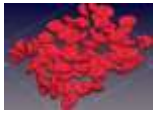

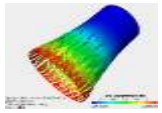
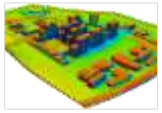

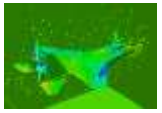

THANK YOU!