Discussions

34^{th} International Workshop on Water Waves and Floating Bodies

Editor:Michael H. Meylan

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A Nonlinear Potential-Flow Model For Wave-Structure Interaction Using High-Order Finite Differences On Overlapping Grids

M. Amini-Afshar, H.B. Bingham, W.D. Henshaw, and R. Read

Discusser B. Beck

Question / Comment

Since you are using a fully non-linear free–surface boundary condition, what are you planning to do about wave breaking?

Reply

We are working on several breaking models which essentially attempt to define a surface pressure term which minimises the bulk effects of the breaking on the potential flow region. We have had some success with this method without a body, but it will be more challenging with bodies.

Wave interaction with a floating circular flexible porous membrane in a two-layer fluid

H. Behera, S.A. Selvan, and V.K. Gupta

Discusser M. Peter

Question / Comment

1) Does the imaginary part of your porous parameter possibly induce a phase shift of the wave so that the scattered wave cancels the incident wave on the leeward side of the membrane in the simulations presented?
2) What is the cause of the discontinuities in your plots of the heave force?

Reply

1) Yes there will be a phase change due to the presence of the imaginary part of the complex porous effect parameter.
2) The discontinuity in the plot for the impermeable membrane ($G = 0$) may be due to the resonance or a problem calculating the roots of the dispersion relation.

Mysterious wavefront uncovered

X. Chen, B. Zhao and R. Li

Discusser O. Kimmoun

Question / Comment

Practically when you generate waves, and in a wavetank, you add a ramp to smooth the wavefront. Could you take into account this kind of ramp, and what is the main effect of this ramp?

Reply

Yes, we intend to add a ramp at the beginning of the wavemaker motion. The introduction of the ramp will affect the transient wave behind the wavefront and front waves.

Poincare's velocity representation in time domain free surface flow

Choi Y.M., Malenica S, Clement, A.H., Bouscasse B., and Ferrant P.

Discusser H. Liang

Question / Comment

Very nice work. How do you select the scaling factor S in the Laguerre function? In the frequency domain $S = 2k_0$ is good, but how about in the time domain? In [1] there are lots of integrals about Laguerre functions.

[1] Liang H., and Chen X. (2017) A new multi-domain method based on an analytic control service for linear and second–order wave loads on floating bodies, *J Comp Phys*, 347m 506–532.

Reply

As the benchmark examples are time-harmonic cases, I can select $S = 2k_0$. For the irregular waves, it could be $S = 2k_p/k_p$.(k_p is the wavenumber of the peak period). For the narrowbanded sea state, it will work well, but the number of Laguerre modes should be increased as the spectrum becomes wider.

Oblique scattering by a thick rectangular barrier in deep water

B.C. Das, S. De, and B. N. Mandal

Discusser B. Molin

Question / Comment

It seems to me that Timokha has used a similar set of vertical functions accounting for the corner singularity in his paper with Faltinsen and Rognebakke (JFM 2007) (on moonpool).

Faltinsen OM, Rognebakke OF, Timokha AN. Two-dimensional resonant piston-like sloshing in a moonpool. *Journal of Fluid Mechanics*. 2007 Mar;575:359-97.

Reply

We have not seen this paper. We will look into the paper and incorporate it when we prepare our abstract in the form of a paper.

Oblique scattering by a thick rectangular barrier in deep water

B.C. Das, S. De, and B. N. Mandal

Discusser B. Teng

Question / Comment

To my understanding the function F (equations 4.2 and 4.3) is used to force the x-derivative of the velocity potential into a distribution with a singularity at the corner. I wonder if the distribution is okay when y is not near the corner, especially when N is large. Have you plotted the distribution of the x-derivative of the potential at the matching plane. Can this method remove the Gibbs phenomenon? I also suggest researching the second-order forces, as only the second order pressure is connected with the derivative of the potential directly.

Reply

Indeed the function (4.2 and 4.3) used to force the x-derivative of the velocity potential into a distribution with a singularity at the corner. The singularity at the corner arises due to the edge condition. Regarding the past one question, we may submit that in the numerical computation is not large (maximum value is 2). Thus the question whether the approximation 4.2 and 4.3 are okay when is large does not arise here. However, this is an important question mathematically, and we will try to find the answer later. We have not compared the x-derivative of the potential at the matching plane. We have also not thought about the occurrence of the Gibbs phenomenon. Regarding the research on second-order quantities, we submit that the problem considered here is based on the linearised theory of water waves. So doing further research on second-order quantities in a problem which is based on linear theory appears to be of mathematical interest.

Oblique scattering by a thick rectangular barrier in deep water

B.C. Das, S. De, and B. N. Mandal

Discusser M. Meylan

Question / Comment

When you get perfect transmission (i.e. $R = 0$) do you observe a large amplitude above the barrier?

Reply

The numerical results show that for some discrete values of the wavenumber R vanishes for the submerged think rectangular barrier (see figure 2). Thus there will be perfect transmission for these values of the wavenumber. However, for the partially immersed think barrier, this will not happen (see figure 1). We have not calculated the free–surface elevation for any barrier. However, we feel that since the problems considered under the assumption of linearised theory, the large amplitude of the free–surface will not occur.

Oblique scattering by a thick rectangular barrier in deep water

B.C. Das, S. De, and B. N. Mandal

Discusser M. Kashiwagi

Question / Comment

The singularity behaviour at the corner expressed by $(y/a - 1)^{-1/3}$ in the mode function$F(y)$ seems to be important in the fast convergence and accuracy. If we do not include the term $(y/a-1)^{-1/3}$ in the mode function how different will the result be?

Reply

This singularity behaviour is dictated by the physics of the problem (edge behaviour condition 2.6). This term has to be included as a factor in any approximation for the function. If this fact was not included in the mode function, then we feel that the integral involving the mode function will be divergent. This factor is very important.

Effect of a submerged plate on flexural-gravity wave blocking

S. Das, T. Sahoo, and M.H. Meylan

Discusser B. Y. Ni

Question / Comment

In the slide of the animation of the wave propagation why does the wave with $U = 0$ propagate faster and then with $U = 2$.

Reply

Here U represents the opposing current in the system. The higher magnitude of the opposing current resist the wave propagation, and this is the reason for which the wave with $U = 0$ travels faster than the wave with $U = 2$.

Effect of a submerged plate on flexural-gravity wave blocking

S. Das, T. Sahoo, and M.H. Meylan

Discusser H. Bingham

Question / Comment

Here you treat only a uniform current. Can you comment on how your results might be changed by currents with a vertical variation?

Reply

The authors recently published a paper on the effects of sheer current (linear beautiful velocity profile) on wave blocking. It is observed that the wave number corresponding to the blocking point (both primary and secondary blocking) and the point of inflexion (initiation of blocking mathematically a saddle point in the dispersion graph) is invariant under linear shear. However, the corresponding wave period is shortened with an increase in vorticity. Details can be obtained in the following paper

Flexural-gravity wave motion in the presence of shear current: Wave blocking and negative energy waves S Das, P Kar, T Sahoo, MH Meylan *Physics of Fluids* 30 (10), 106606

Numerical investigation of the performance of a pile-restrained WEC-type dual-floating breakwater system

H. Ding, J. Zang, C. Blenkinsopp, D. Ning, X. Zhao, Q. Chen, and J. Gao

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Discusser Unknown

Question / Comment

In this wave energy absorption problem it is known from the linear theory that the capture width can be maximised by realising first of the resonance of the heave motion and then by making the damping of the PTO system equal to that of the wave making by the floating body. Did you take account of this condition in your computations?

Reply

This research used preliminary tests to define the range of the maximum λ_{PTO} for CWR. Further research may consider the way you said to find the optimal λ_{PTO} to save the time of the preliminary computation.

However, due to this research will focus on the overall performance of two aspects of functions. Thus the group of tests will still need different λ_{PTO} to find out the optimal λ_{PTO} for a maximum bandwidth of the effective the frequency. In summary, the method to directly find out the optimal λ_{PTO} for the CWR are could improve the preliminary step for the research.

Numerical investigation of the performance of a pile-restrained WEC-type dual-floating breakwater system

H. Ding, J. Zang, C. Blenkinsopp, D. Ning, X. Zhao, Q. Chen, and J. Gao

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Discusser M. Hayatdavoodi

Question / Comment

1) Do you expect significantly different results if the computations are carried out in -D instead of 2D?

2) Given the smaller oscillation amplitude of the second body, can you comment on the advantages of the two body system?

Reply

There will be a 3D effect which will be considered in further research, especially for the consideration of the geometry of floating bodies. In this study, the 3D effect will be minor due to the symmetric wave conditions and long enough of the breakwater transverse width in practical situations.

2) The second body will support reflected waves to increase the heave motion of the first floating body, and that will increase the total CWR of the whole system.

An experimental model of wind-induced rafting of pancake ice floating on waves

A. Dolatshah, L. G. Bennetts, M. H. Meylan, J. P. Monty, and A. Toffoli

Discusser W. Qui

Question / Comment

What scale did you used to model the pancake ice, waves, and wind?

Reply

Generally, to consider scale factor in the experiment, we need to find an experiment in which dimensional similitude is considered, according to Froude or Reynolds similitude. However, in hydraulic physical modelling (our case) I guess Froude similitude is considered. Based on the similitude, the length scale of the physical model and the prototype should be equal. Therefore I need to consider wave and wind characteristics, flume basin water depth and ice floe dimensions. I started the wind speed from 0 to 10.5 m/s. I think this can be scaled in nature. Regarding the water depth, I think this is one of the most important factors which should be scaled carefully. Regarding the flow size as there is a wide range of ice floes in the MIZ. I think the current floe size in the experiment is fine.

An experimental model of wind-induced rafting of pancake ice floating on waves

A. Dolatshah, L. G. Bennetts, M. H. Meylan, J. P. Monty, and A. Toffoli

Discusser B. Ni

Question / Comment

1) How do you define rafting fitness I mean which section you select to measure the thickness of ice rafting?
2) For wind velocity 0 m/s namely without wind, how does the rafting distribute? In other words, how does ice rafting move with the wave? Is there a maximum at the wavecrest or trough etc.?

Reply

1) I considered a fixed section close to the grid, which blocks the ice cover. The section is 5 cm on the grid upstream.
2) The ice distributes on the water surface over the flume. As the flume is quite long, and there is enough space for all floes/ice cubes to spread over the flume, the ice cover thickness is equal to the dimension of one ice cube. Yes, there is a maximum rafting thickness at the crest and the minimum rafting thickness at the trough, but in total, the average value over the time series is almost equal to the ice cube dimension.

Severe Wave-Body Interactions: a Potential-Flow HPC Method and its Strong Domain-Decomposition Coupling with a Level-Set Navier-Stokes Solver

F.C.W. Hanssen, G. Colicchio, and M. Greco

Discusser M. Kashiwagi

Question / Comment

In the presentation you have shown the result of wave drift forces in which your results are based on the potential flow HPC method are smaller than 1.0 in the non–dimensional value in the sense of high frequencies. This implies that perfect reflection is not realised at higher frequencies, and the momentum conservation is not satisfied. What is the reason for that result?

Reply

We have done extensive studies on this, and the main conclusion is that there are important higher– order effects not fully accounted for by the second order theoretical model like Maruos formula. Indeed by evaluating the fluid momentum flux exactly in our simulation, we get consistent drift force with that obtained from the direct pressure integration. This implies that momentum is conserved, but it is not sufficient to apply a second order approximation when there are significant non-linearities present.

A Fictitious Body Continuation model for the vertical water entry of 2D asymmetric bodies with flow separation

R. Hascoet, N. Jacques, Y.M.Scolan, and A. Tassin

Discusser A. Iafrati

Question / Comment

Are you considering applying your model to decelerating cases? Maybe the velocity reduction could influence the separation point.

Reply

We have not carried out simulations for a decelerating body. But it would be something interesting to investigate.

A Fictitious Body Continuation model for the vertical water entry of 2D asymmetric bodies with flow separation

R. Hascoet, N. Jacques, Y.M.Scolan, and A. Tassin

Discusser B. Song

Question / Comment

Is it possible to choose different fictitious surfaces at the front edge (on the right side) of the airfoil body according to different inclination angles of the body (rather than a fixed value of 60 from the water entry of a flat plate)?

Reply

Yes, it would be. Here we wanted to show that these angles do not have to be fine-tuned to obtain satisfactory results for different inclination angles of the foil. But indeed it would be possible to fine-tune the values from one case to another to improve the agreement between FBC and CFD results.

On Piston and Sloshing Mode Resonances in Three-dimensional Moonpool of Vessels in Fixed and Free-floating Conditions

H. Huang, X. Xu, and X. Zhang

Discusser M. Meylan

Question / Comment

Do you think the very sharp peaks in the RAO's are likely to be observed in practice?

Reply

The sharp peaks may be overestimated due to the neglect of the viscous damping, especially by vortex shedding from the corner. However, the focus of the present study is on the resonance frequency instead of the amplitude.

Numerical simulation of hydroelastic waves along a semi-infinite ice floe

L. Huang, A. Dolatshah, P. Cardiff, L. Bennetts, A. Toffoli, Z. Tukovic and G. Thomas

Discusser Y. H. Choi

Question / Comment

During upper FSI algorithm, which quantity is utilised to examine to finalize the inner loop? And how many iterations are needed to finalise the loop?

Reply

1) The displacement between solid and fluid and interfaces
2)Averagely 40.

Cavitation/ventilation phenomena during the water impact with a horizontal velocity of double curvature shaped bodies

A. Iafrati and S. Grizzi

Discusser B. Ni

Question / Comment

Because the pressure of ventilation (pressure of atmosphere) is larger than that of cavitation (pressure of saturated vapour), the surface of the cavity may move forward into the cavity under this pressure difference, which is also known as a *re–entrant jet*. Have you ever noticed this phenomenon in your experiment?

Reply

Yes, indeed, ventilation starts as soon as the cavitation bubble reaches the trailing edge. We have recently computed the propagation velocity you are mentioning and have observed the maximum speed of about 100m/s in a frame of reference attached to the body.

A Linear Elasticity Model for Ice Shelf Vibrations

B. Kalyanaraman, M.H. Meylan, B. Lamichhane, and L.G. Bennetts

Discusser R. Porter

Question / Comment

Your results focus on a very long wave of period as large as 500s. Where do these waves come from

Reply

Bromirski et al. (2010) discuss the impact of transoceanic infra-gravity waves impacting on Antarctic Ice shelves, arising due to storm-induced wave interactions along the Pacific coast of North America. The wave has a much higher wavelength than swell waves and induces a strong response.

Bromirski PD, Sergienko OV, MacAyeal DR. Transoceanic infragravity waves impacting Antarctic ice shelves. Geophysical Research Letters. 2010 Jan 1;37(2).

Study on Added Resistance with Measured Unsteady Pressure Distribution on Ship-hull Surface

M. Kashiwagi, H. Iwashita, S. Miura, and M. Hinatsu

Discusser H. Bingham

Question / Comment

Comment: Thank you for this very impressive and very valuable work. I note that your experimental pressure probe discretisation is about the same as what you and I were using 30 years ago to make 3-D BEM calculations!
Question: I note that your added resistance measurements from pressure integration and direct forces do not quite agree, especially in the short weight regime. Can you comment on which method is more accurate?

Reply

In the short wavelength regime, the amount of scatter in the measured data tends to be large, but at this moment reliability is still better in the direct measurement by a dynamometer than the integration of the added pressure distribution. In the measurement of pressure using FBG pressure sensors, the effect of temperature variation seems still large, and the difference in temperature between air and water must be a small as possible; which will be improved in the near future.

Study on Sensitivity of Ship Added Resistance to Wave Slope

B.S. Kim, K.K. Yang, and Y. Kim

Discusser M. Kashiwagi

Question / Comment

Let me ask about uncertainty in the experiment of added resistance, where the non–dimensional value of $R_{AW} = R/\rho g A^2(B^2/L)$ is plotted against the wave steepness H/λ. I believe that Maruos theory is correct as the time-averaged second-order theory with respect to the incident–wave amplitude A. If this is the case, R_{AW} must be constant and for small values of H/λ and then may decrease as H/λ increases. In the range of small H/λ R is very small and $1/A^2$ would be very large and the value of A is not constant throughout the towing tank. Therefore the uncertainty analysis (especially depending on H/λ) should be carefully made.

Reply

It is true that for small wave amplitudes, Mauro's theory is correct. When looking at the added resistance for the short wavelength, we can confirm the uncertainty is larger as the wave amplitude A is reduced. The same would be true for the resonance frequencies; however, since the wave amplitude is larger compared to the short wavelength case, this uncertainty might not be a significant as the short wavelength case. Moreover, from the uncertainty analysis done by Park et al. (2015) shows that uncertainty in resonance frequency is not very large. However, I think the uncertainty bar should be shown for small wave amplitudes to support my results more.

Modelling of Wave-structure Interaction for Cylindrical Structures using a Spectral Element Multigrid Method

W. Laskowski, H.B. Bingham, and A.P. Engsig-Karup

Discusser R. Eatock Taylor

Question / Comment

With my colleague Prof. G.X. Wu, we suggested in 1995 (a paper in Ocean Engineering) that the FEM is in principle more efficient than the BEM for many hydrodynamic models, because in the former there are great advantages in that the system matrix is narrow banded - though there is, of course, a trade-off between the number of unknowns in the two types of models. It is not clear to me whether you can exploit this benefit of narrow bandedness in your method.

Reply

Our SEM solve has actually more dense Laplace operator than the 1st order FEM operators, when the density of the block diagonal matrix depends on the order of the polynomial (the higher the polynomial, the denser the Laplace operator is). However, we can increase the sparsity of the matrix via p-multigrids, where we decrease the polynomial order together with the number of unknowns. In short, we exploit the sparsity with localised, element-wise operations. If we add high-performance computing to this, we can achieve practical calculation time for large–scale simulations.

Modelling of Wave-structure Interaction for Cylindrical Structures using a Spectral Element Multigrid Method

W. Laskowski, H.B. Bingham, and A.P. Engsig-Karup

Discusser H. Liang

Question / Comment

Thank you for your work. What method do you use to generate the solitary waves?

Reply

We apply to Takaka'a solution as an initial condition for η and α on the free surface.

Effect of wave paddle motions on water waves

H. Liang, Y.Z. Law, H. Santo, and E.S. Chan

Discusser M. Kashiwagi

Question / Comment

How many wave paddles (how many segments in the wave maker) do you have? There are three different types in the wave maker: plunger type, piston type, and flap type. If we would use the plunger type, do you think the results are essentially the same as those in this paper?

Reply

There are 50 paddles on the right-hand side. The paddle width is 0.5m, and the gap between two adjacent paddles is 0.1m.

Displacement waves are due to the movement of wave paddles away from the mean position and are associated with nonlinear paddle boundary conditions. Therefore, I think displacement waves also exist for plunger type wavemakers if there are no corrections.

On the Four-wave Resonant Interactions in Finite Water Depth

S. Liu and X. Zhang

Discusser Y. Ma

Question / Comment

What were the boundary conditions used in the model?

Reply

We use periodic boundary conditions.

On the Four-wave Resonant Interactions in Finite Water Depth

S. Liu and X. Zhang

Discusser D. Barratt

Question / Comment

The distinction between exact and near resonance is difficult to make for numerical simulations or experiments. The requirement of the resonance condition $\omega_1 \pm \omega_2 \pm \omega_3 \pm \omega_4 \pm = 0$ cannot be strictly satisfied due to truncation errors in the simulations or mechanical limitation in experimental facilities. Thus the RHS of the frequency resonance condition will not exactly equal zero but rather a small finite number which is effectively a near–resonance interaction. How important do you think the distinction between exact and near resonance is for your experiments?

Reply

We distinguish between exact and near resonance based on the growth rate of the daughter wave. Linear growth of the amplitude of the daughter curve is consistent with exact resonance, and we have a compared to the gradient of the growth and found good agreement with the predictions of exact resonance.

On the Four-wave Resonant Interactions in Finite Water Depth

S. Liu and X. Zhang

Discusser O. Kimmoun

Question / Comment

What is your opinion the influence of a variable bathymetry on the evolution of the resonance interaction?

Reply

In the study, we investigate the resonance interactions in a flat bottom, and the effects of bathymetry are not included. We agree that the variable bathymetry may play an important role in the resonance interaction; it is our plan for future work.

A non-hydrostatic model for nonlinear water waves interacting with structures

Y. Ma, C. Ai, C. Yuan, and G. Dong

Discusser Y.M. Choi

Question / Comment

1) Subtraction of hydrostatic pressure is usually taken to apply the pressure boundary condition at the body surface. The same principle is applied In Open FOAM. I am wondering what is the difference between your governing equations and OpenFOAM?
2) Does the subtraction of the hydrostatic pressure help the immersed boundary method?

Reply

1) We assume the pressure is unchanged with respect to the vertical direction
2) Yes, it is more efficient.

A non-hydrostatic model for nonlinear water waves interacting with structures

Y. Ma, C. Ai, C. Yuan, and G. Dong

Discusser D. Rijnsdorp

Question / Comment

1) Which turbulence model did you use in the simulations of the thin plate (NH–model, Reef3D, OpenFOAM)?
2) In deciding on the vertical resolution for the simulation of waves interacting with the floating box, did you need five layers to capture the dispersion of the waves or did you need five layers to capture the wave structure interactions?

Reply

1) We did not open the turbulence model in simulating the submerged plate.
2) Yes, we used five layers. If we decrease the layers, the simulation would not be stable and would blow up.

Wave interaction with a shallowly submerged step

G. McCauley, H. Wolgamot, S. Draper, and J. Orszaghova

Discusser Y.M. Choi

Question / Comment

Wave probe inside the wavefront extract values from the VOF unless restricted from the VOF field. When the VOF field is very unstable, it fails to find an exact free surface position. It might be better to take the wave elevation using integration along with vertical direction

Reply

Thank you for the suggestion. I have in fact used the surface elevations calculated by integrating the α parameter over the depth. That these instabilities are still present indicates the highly unstable nature of the free service as predicted by CFD. In the future we plan to further validate the CFD model with experimental data.

Wave interaction with a shallowly submerged step

G. McCauley, H. Wolgamot, S. Draper, and J. Orszaghova

Discusser M. Hayatdavoodi

Question / Comment

Functions on the free surface (CFD results) seem unrealistic. We have observed in the past that refining the Courant number or mesh size results in a change of this behaviour. This may be a factor in your simulations that you may want to consider.

Reply

Thank you for the suggestion of my mesh convergence study indicates that further mesh refinement may not improve this problem. However, I have yet to consider convergence with Courant number. I will check this.

Wave interaction with a shallowly submerged step

G. McCauley, H. Wolgamot, S. Draper, and J. Orszaghova

Discusser M. Kashiwagi

Question / Comment

In the animations of the free surface elevation, I could see very short wavelength components which seem to be unrealistic. Could you make comments on the reasons for the short wavelength components?

Reply

Thank you for the comment. I agree that these high-frequency components are unrealistic. I consider this problem to be a result of the VOF method not accurately capturing air entrainment in the flow as it breaks over the step. It is clear from experiments that wave breaking occurs about the step even for small amplitude waves, but it is unclear how well the CFD model used in the current work can capture this wave breaking and subsequent bore propagation. Discussion with others at the workshop suggest these oscillations may be reduced by a reduction in the Courant number (CFL 0.05) as seen in other CFD studies.

Simplified models for waves due to steadily moving ships and submerged bodies

S.W. McCue, R. Pethiyagoda, and T.J. Moroney

Discusser B. Beck

Question / Comment

Could you please explain why your pressure distribution has negative pressure at the back and a high-pressure in the middle. The physical pressure distribution for the flow around a sphere is just the opposite with a stagnation pressure at the bow and stern and low pressure on the middle.

Reply

It is the velocity and pressure at the surface $z = 0$ that matters. Imagine we have a doublet and its image located at $(x, y, z) = (0, 0, \pm 1)$. The resulting velocity field at $z = 0$ has a maximum at $x = 0$ and a minimum at $x = \pm\sqrt{6}/2$ (in dimensionless variables). Now we want to replace the doublets with a pressure applied at $z = 0$. Since $1/2v^2 + p =$ constant we need a pressure along $z = 0$ that makes up for the $1/2v^2$ lost when we take the doublets away. That pressure will, therefore, have a maximum at $x = 0$ at and a minimum at $x = \pm\sqrt{6}/2$.

Simulation of Two-Body Interaction in Waves with the Immersed Boundary Method

W. Meng and W. Qiu

Discusser B. Beck

Question / Comment

How did you model the tank side wall and did the different wave from the side wall affect the motion/potential results?

Reply

The computations simulate the same test cases in the towing tank. In the simulation, the wall boundary conditions were applied to the side boundaries. As for the tank wall effect, there are potentially reflective waves by the walls, which would further affect motions of the two bodies. These are being investigated.

Simulation of Two-Body Interaction in Waves with the Immersed Boundary Method

W. Meng and W. Qiu

Discusser M. Kashiwagi

Question / Comment

By looking at the time history of the sway motion, I understand that the position (gap) of two bodies is changing in time. Do you think this fact is one of the reasons for the disagreement of the linear theory with measured results shown in your presentation? Even in the linear theory, the drift force can be computed which may be used in a quasi-static way to simulate the change in the position, resulting in hydrodynamic forces and motion response.

Reply

Responses in terms of body motions, wave elevations in the gap and drift forces depend on the actual gap. The change of gap, especially due to the sway motions, is expected to contribute to the discrepancies between the linear potential flow solutions and the experimental data. We have carried out some simulations based on the linear theory using a few instantaneous gaps at a couple of high wave frequencies. Initial results indicate that the solutions by the linear theory are in better agreement with the experimental data. We are extending the investigation to other wave frequencies.

Simulation of Two-Body Interaction in Waves with the Immersed Boundary Method

W. Meng and W. Qiu

Discusser K. Maki

Question / Comment

How do you update the level set function as the body moves? Also, is the level set function a distance function?

Reply

Floating bodies are modelled using triangular surfaces. The body services are updated each time step according to the 6D0F motions. The level set function, which is a distance function, is determined by finding the minimum distance from the cell vertices to a triangular body surface.

Experiments on a barge rolling next to a wall

I. A. Milne, O. Kimmoun, B. Molin, and J. M. R. Graham

Discusser X. Zhang

Question / Comment

What is the dependence of the results and damping on the wave steepness in your experiments.

Reply

We have shown results for the roll resonance period as a function of the wave steepness. Our RAOs indicate a weak dependence on steepness. This also suggests that mechanical friction effects are relatively small.

Nonlinear Stochastic Prediction of Extreme Deck Slamming on Offshore Platform in Irregular Waves

H.S. Nam and Y. Kim

Discusser R Hascoet

Question / Comment

In the example you have shown, you assumed a JONSWAP spectrum. Do you truncate the spectrum at high frequencies?

Reply

Yes, it is truncated at a level of 1% in terms of energy.

Numerical simulation of interface deformation and wave resistance caused by a given pressure load moving in an ice-breaking channel

B.Y. Ni and L. D. Zeng

Discusser L. Huang

Question / Comment

Why do you get lower resistance when there is ice compared with open water?

Reply

The formula of wave resistance is $R_w = \iint_\Omega p\partial\eta/\partial x dS$. Ω represents the domain just below the pressure, which is not the whole calculation domain. The resistance is just related to the wave from below the load. Therefore, the resistance when the ice appears may be lower than in open water.

On wave diffraction-radiation by bodies with porous thin plates¡

Ouled Housseine C.

Discusser H. Bingham

Question / Comment

In your comparisons between the panel method calculations and the analytic, solution, the agreement is in many cases, not perfect. Is this just a question of resolution in the panel method?

Reply

Yes, it is just a question of the panel discretisation. Is also due to a high singularity of the Green function second derivatives.

A graded resonator array for amplification of water waves

M. A. Peter, L. G. Bennetts, and R. V. Craster

Discusser M.H. Meylan

Question / Comment

Does the method work better when R-B waves dominate the solution?

Reply

No, the method works just as well otherwise. However, the force amplification is due to the field being dominated by the (local) Rayleigh–Bloch Waves.

Time-frequency analysis of wakes produced by turning ships

R. Pethiyagoda, T.J. Moroney, and S.W. McCue

Discusser M.Meylan

Question / Comment

What is the motivation/application of your study?

Reply

Applications can involve ship detection if we know what the signal for a given ship (footprint), we will be able to detect when the ship moves past the sensor. Another application is with coastal management. The spectrogram can give information for the energy of the wave passing, coupling this with the dissipation curve can give additional information such as the direction of propagation, which can inform a coastal erosion model.

An extension to the linear shallow water equation

R. Porter

Discusser H. Bingham

Question / Comment

Your extended equation looks very much like a Boussinesq equation. Where does it land in the spectrum of Boussinesq type models?

Reply

Yes, it is equivalent to the linearised version of Peregrines (1967 Longways on a beach") equations. Perhaps the novelty here is the realisation that the additional terms associated with vertical accelerations can be transformed back into a shallow water type equation.

An extension to the linear shallow water equation

R. Porter

Discusser M. Kashiwagi

Question / Comment

In your summary, you mentioned that the present theory is going to be used for studying the metamaterial, which may be associated with cloaking. In previous studies on the cloaking of water waves, anisotropic water depth in the form of a tensor has been used. If we will use the present theory for the study of cloaking, what do you think will be different from previous studies?

Reply

The answer comes in two parts. First, we have shown that normal bathymetry can act as a metamaterial, and so if one knows the prescription of anisotropy for a metamaterial bed, one may be able to design a water wave cloak without the use of a special microstructure bed. The second answer is that the work presented here has been extended to microstructure bed where we hope to provide more accurate prescriptions of the bathymetry than provided by the standard shallow water theory.

Modelling motion instabilities of a submerged wave energy converter

D. Rijnsdorp, J. Orszaghova, D. Skene, H. Wolgamot, and A. Rafiee

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Discusser H. Bingham

Question / Comment

It would be interesting to add non-linear Froude–Krilov forces to your Cummins model and see whether that helps or not.

Reply

It would certainly be possible to do this. However, we know (see McCauley et al. in the same workshop) that the flow on top of the WEC is modified in a highly non-linear way, and is very different from the incident wait field (wave breaking his present). Hence we consider it unlikely that non-linear Froude–Krilov forces will substantially improve the Cummins model. But it will be fairly simple to do so so that we may try it at some stage.

Modelling motion instabilities of a submerged wave energy converter

D. Rijnsdorp, J. Orszaghova, D. Skene, H. Wolgamot, and A. Rafiee

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Discusser Y. Li

Question / Comment

How did include viscous effect such vortex shedding? Where did you truncate the impulse function?

Reply

The model ran excluding any viscous effects on the flow and only included the viscous damping in yaw by a linear damping term and the yaw equation (as part of the rigid body solver). The linear form of the damping was inferred from the experimental measurements of decaying yaw motion. Exponentially decaying curve (with a rather small value of linear damping coefficient) could be satisfactorily fitted to the measurements. We also note that the fitted value of the linear damping coefficient is of the same order as that calculated from the laminar boundary layer of a yawing cylinder.

Study on water column impact without/with air cavity

B. Song and C. Zhang

Discusser R Hascoet

Question / Comment

How does the pressure peak produced by the air cavity compare with the pressure peaks due to the initial slamming event?

Reply

The pressure peak induced by the air cavity is much higher.

Wave-induced drift of a thin floating plate: A numerical experiment

S. Tavakoli, F. Nelli, L.G. Bennetts, and A. Toffoli

Discusser Y.M. Choi

Question / Comment

When we do a multiphase simulation, the kinematic energy is taken from water to air. Without the plate, how much energy is transferred to air what the multiphase simulation (VOF)?

Reply

All simulation for cases without the plate. The simulations were used as the benchmark. No significant energy exchange between water and air was observed. Note that the wave steepness varies between 0.06 to 0.15. Physically, this wave steepness does not cause an exchange of energy.

Wave-induced drift of a thin floating plate: A numerical experiment

S. Tavakoli, F. Nelli, L.G. Bennetts, and A. Toffoli

Discusser A Iafrati

Question / Comment

1) What kind of boundary conditions do you apply on the body surface?
2) Do you use any wall function to account for the friction on the boundary layer?

Reply

1) No-slip moving boundary condition was set on the surface of the thin plate.
2) No, we don't since the current simulation is an early stage of the research, we neglected wall functions. For sure we will consider this concept in our latest studies.

Wave-induced drift of a thin floating plate: A numerical experiment

S. Tavakoli, F. Nelli, L.G. Bennetts, and A. Toffoli

Discusser Unknown

Question / Comment

How did the heave and pitch motions compare between the drift and the no drift cases?

Reply

Drifting leads to larger motion at the considered waves period including $T = 0.8$s, 0.9s and 1s. Please note that these wave periods corresponded to $\lambda/L = 1$, 1.29 and 1.56 (λ is wavelength, L is plate length).
It has been observed that, when the wave steepness is increased (ka increases), normalised amplitudes of motions become lower for both drifting and non– drifting plate.

A fast method for optimization of large wave energy converter arrays

G. Tokic and D.K.P. Yue

Discusser R. Beck

Question / Comment

1) Does your method require axi–symmetric WEC?
2) Are there advantages to using non–axisymmetric WEC's?

Reply

1) The method is general and not limited to axisymmetric bodies only. If non–axisymmetric bodies are considered, the transfer matrices depend on the body orientation.
2) In general, isolated non–axisymmetric WEC's have the potential of extracting more wave energy than axisymmetric ones. If arranged in an array, they could be used to improve further and modify the array performance.

A fast method for optimization of large wave energy converter arrays

G. Tokic and D.K.P. Yue

Discusser M. Peter

Question / Comment

1) The is work closely related to your forward problem by McNatt et al.
2)Your optimisation algorithm is based on a gradient descent method. How do you ensure that you do not just find the closest local minimum?

Reply

1) McNatt et al. (2015) indeed use a similar approach in expressing the diffraction forces (i.e. introduce a diffraction force transfer matrix), but they still use the full–array added mass and damping coefficients, which requires them to be recalculated with every configuration.
2) Given the multimodality of the objective functions, a gradient-based optimisation method can indeed get trapped by a nearly local optimum. A way to ensure that the obtained optimum is not the immediate local optimum is to run first few optimisation iterations using an evolutionary (stochastic) optimisation algorithm that explores the entire space., and then start the fast gradient-based optimisation using the best candidate from the evolutionary optimisation as an initial point.

Predictions of Ship Turning Circle Maneuvers Using A Combined Computational Fluid Dynamics and Potential Flow Approach

P.F. White, B.G. Knight, K.J. Maki, D.J. Piro, and R.F. Beck

Discusser Y. Kim

Question / Comment

N–K formulation for the seakeeping problem may be one of the crucial problems in accuracy. Do you have any experience to apply D–B formulation for seakeeping coupled with the manoeuvering problem?

Reply

The test case presented here has not yet been evaluated using the alternative choice of flow linearisation, namely double body. The time–domain panel method used to generate the results does not include the capability, so as future work, the authors will make the comparison using the D–B linearisation.

Predictions of Ship Turning Circle Maneuvers Using A Combined Computational Fluid Dynamics and Potential Flow Approach

P.F. White, B.G. Knight, K.J. Maki, D.J. Piro, and R.F. Beck

Discusser M. Kashiwagi

Question / Comment

To understand the reasons for the difference in ship trajectories between experiments and computations you had better check the performance of each elementary component in the motion equation; For instance, rudder normal force, rudder ship–hull trajectory, the wave-induced second–order forces and yaw moment. Looking at the over-prediction of ship tuning trajectories, it seems that the rudder normal force and the added resistance may be smaller than those in the experiment. Do you have some comments on the reasons for this difference?

Reply

The authors agree on the value of investigating the individual component separately in as much as possible, given our computational framework. Though not thoroughly discussed at the workshop, due to time constraints, the authors have computational results indicating a poor prediction of rudder force, principally due to deficiencies in our method of introducing propeller induced velocities into the viscous manoeuvring flow. Creating this model is active research within our research lab.

A study of reactively controlled floating point absorber in wave tank experiments

Q. Xu, Y. Li, B. Ding, Z. Lin, and B. Cazzolato

Discusser B. Ding

Question / Comment

Did you add in viscous damping (drag force) to the potential flow model?

Reply

No, it was difficult to estimate viscous damping for the shape of the body but will do so in the future.

Gap resonance driven by linear, quadratic and cubic wave excitation

W. Zhao, P. H. Taylor, H.A. Wolgamot, and R. Eatock Taylor

Discusser B. Molin

Question / Comment

I wonder if the second order response in the gap is due to free surface nonlinearities in the gap or free surface nonlinearities outside the gap (presumably on the upwave side of the two boxes)?

Reply

Thanks for the question. We do not know the answer yet, but it is an interesting topic to explore will we conduct numerical simulations to answer this question as you suggested.
