Discussion

33^{rd} International Workshop on

Water Waves and Floating Bodies

4-7th April, 2018,

Guidel-Plages, France

Discussion Sheet

IWWWFB International Workshop on Water Waves and Floating Bodies

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Nonlocal model for deep water waves of a potential flow

Authors: Bestehorn M., Tyvand P.A.

Discusser: Didier Clamond

Question(s) / Comment(s):

If you simulate backward in time and substract the initial condition, what do you get?

Reply:

I did not try. I agree one should arrive at the initial state if the spatio-temporal evolution is regular. But what happens in a chatic regime? Remember the dynamics is nonlinear. So (infinitely) small deviations can cause large effects in the course of time.

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Paper: Nonlocal model for deep water waves of a potential flow

Authors: Bestehorn M., Tyvand P.A.

Discusser: Harry Bingham

Question(s) / Comment(s):

How did you introduce the obstacle into your scheme?

Reply:

Just puting the horizontal (and therewith also the vertical) velocity components to zero (like for a viscous fluid). Of course this may not be correct from the mathematical point of view, but it seems to work.

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The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Nonlocal model for deep water waves of a potential flow

Authors: Bestehorn M., Tyvand P.A.

Discusser: Y. Kim

Question(s) / Comment(s):

Could you explain the case of finite depth?
You used expansion for $e^{|k|z}$ term, and similar application can be made for finite depth.
What is the main difficulty for finite depth?

Reply:

For finite depth an expansion like $\frac{\cosh kz}{\cosh kd}$ can be performed. However, now there is a 2^{nd} small parameter (deep water case), namely λ/d with $\lambda = 2\pi/k$. The other one is the steepness $S = ka$, with amplitude a. For small depth, $\lambda \gg d$, however one can use shallow water eqs.

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The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Head-on collision between two hydroelastic solitary waves under a thin ice sheet floating on shallow water

Authors: M. M. Bhatti and D. Q. Lu

Discusser: Mashshi Kashiwagi

Question(s) / Comment(s):

I am confused with the last conclusion that the effect of flexible rigidity on the solitary wave os opposite to the effect of surface tension, because physically the flexural rigidity plays the same role as that of the surface tension. Could you explain how you could obtain the last conclusion.

Reply:

Yes, we totally agree with you that the flexural rigidity plays the same role as that of the surface tension. The last sentence in our slides (not in the proceedings) reads "The effects of the increasing surface tension parameter (τ) and the water depth H_0 are, on the contrary, enhance the above-mentioned variables." We should consider, separately, the effect of surface tension and the effect of water depth. We will revise this sentence accordlingly.

Finally we can reach the conclusion as follows: "As the flexural rigidity parameter (Γ) and/or surface tension parameter (τ) increases, the wave profile, maximum run-up amplitudes, the phase shift, and the wave speed decrease."

In the present study we are interested in the nonlinearity of Plotnikov and Toland's model. A full study on the effects of a linear Euler-Bernoulli Bean/plate can be found at M. M. Bhatti & D. Q. Lu, Head-on collision between two hydroelastic solitary waves in shallow water, Qualitative Theory of Dynamical Systems, Vol. 17, No. 1, pp. 103-C122, 2018. http://dx.doi.org/10.1007/s12346-017-0263-y

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Paper: Head-on collision between two hydroelastic solitary waves under a thin ice sheet floating on shallow water

Authors: M. M. Bhatti and D. Q. Lu

Discusser: A. Korobkin

Question(s) / Comment(s):

Which equations do you solve finally? How these equations depend on the stiffness of the ice sheet.

Reply:

With the aid of strained co-ordinates, we have perturbation equations for different orders. A detailed mathematical procedure can be found in our published paper M. M. Bhatti & D. Q. Lu, Head-on collision between two hydroelastic solitary waves in shallow water, Qualitative Theory of Dynamical Systems, Vol. 17, No. 1, pp. 103-122, 2018. http://dx.doi.org/10.1007/s12346-017-0263-y in which the linear Euler-Bernoulli beam model is used for the ice sheet.

In the 33rd IWWWFB, we used Plotnikov and Toland's model for a nonlinear beam model. Under the same strained co-ordinates, the stiffness of the ice sheet appears in the order of ϵ^3 for the Euler-Bernoulli beam model and for the Plotnikov and Toland's model.

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The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Hydrodynamics of side wall effects through image Green function based TEBEM

Authors: Chen J., Duan W., Zhao B.B.

Discusser: Y. Kim

Question(s) / Comment(s):

Thank you for nice presentation.

Per your presentation,

1. ITTC seakeeping procedure suggest proper size of ship and tank breadth to prevent blockage effect. So I don't worry much about in actual experiment.

2. Do you have any interpretation for scattered/change of added resistance, not in long waves? Blockage effect is more important in long waves, isn't it?

Reply:

Thank you for your questions:

1)ITTC seakeeping procedure is for normal speed test of general ship.But for minimum power test, the speed of ship is at 2 to 4 knots, so the general wave tank can have side wall reflection effects on the results, but it is not clear for different tank width. So this is the purpose of the research.

2)The tank wall effects is corresponding to the critical wave length which is equal to double tank width divided by integer. So the longest wave is corresponding to double tank width.

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Paper: Hydrodynamics of side wall effects through image Green function based TEBEM

Authors: Chen J., Duan W., Zhao B.B.

Discusser: J.A. Pinkster

Question(s) / Comment(s):

1. How does TEBEM related to middle field method?
2. Does TEBEM mean that middle field not necessary to improve prediction of mean wave drift force in near field waves?

Reply:

Thank you for your question:

1) TEBEM method is a set of method for solving potential and tangential velocity on boundary panels. And it can directly give first order and second order pressure information, especially for no smooth boundary, where the general Hess-Smith source distribution panel method can not give correct results for the tangential velocity.

2) Middle field method is a method for obtain the second order forces based on the general panel method. It can improve the drift forces prediction very well, but for the tangential velocity on boundary with sharp changes, It can not give the correct results of pressure, especially for second order pressure or current/forward speed cases.

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Paper: Hydrodynamics of side wall effects through image Green function based TEBEM

Authors: Chen J., Duan W., Zhao B.B.

Discusser: Alain H. Clment

Question(s) / Comment(s):

First let me tell you that I am very happy to see that experimental results I obtained during my PhD in the universities are still useful for someone, forty years later...

Question: you use the iGF Green function, which account for the infinite series of image sources as you use here in infinite water depth. If you want to extend the method to finite water depth, and the series of images with respect to the free surface and the sea bottom will ?. Do you know an ? of the iGF to finite water depth which would account for the two combined infinite series of image sources?

Reply:

Thank you for your comments and questions: Yes, your PhD thesis work on drift forces of box-shape floating body is very useful for our research. Our work based on IGF is for infinite water depth case. For the finite water depth case, the IGF algorithm has been given in the paper of Chen(1994)

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The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: A primary analysis of wavefronts

Authors: Chen X.B., Li R.P. & Zhao B.B.

Discusser: A. Korobkin

Question(s) / Comment(s):

you can control the transient zone by controlling the motion of the wavemaker at the initial stage, is it right?

Reply:

It is one of objectives of the present study. In fact, the wavefront contains rich information about wavemaker including the effect of its initial motions. Thus we could be able to change the transient zone (duration) by modifying wavemaker motions at the initial stage, in principle.

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The 33rd International Workshop on Water Waves and Floating Bodies

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Paper: Numerical study of the hydrodynamic performance of a pile-restrained WEC-type floating breakwater

Authors: Qiang Chen, Jun Zang, Xuanlie Zhao, Dezhi Ning

Discusser: Mashashi Kashiwagi

Question(s) / Comment(s):

If only the heave mode is allowed, you had better consider an asymmetric body to increase the efficiency of wave energy absorption, because we know from the potential-flow theory that only half of the incident wave energy (only the symmetric component) can be absorbed with symmetric mode of motion and symmetric body.

Reply:

Thank you very much for this comment. We will look into that.

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Authors: Qiang Chen, Jun Zang, Xuanlie Zhao, Dezhi Ning

Discusser: Zhiming Yuan

Question(s) / Comment(s):

To assess the wave transmission coefficient, two wave gauges are used in the test. Is transmission coefficient sensitive to the location of the WG?

Reply:

Thank you for this question. There are small differences between the results from the two wave gauges. However, we have handled the numerical data using the same wave gauges as those used in the physical experiments. So, the results are consistent for comparison. Nevertheless, I agree with you that the location of the WG used may affect the results, for which we will need more detailed tests.

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Authors: Qiang Chen, Jun Zang, Xuanlie Zhao, Dezhi Ning

Discusser: Vuko Vukčević

Question(s) / Comment(s):

In the cut cell method, do you experience oscillations of the pressure field when the body moves through a background mesh?

Reply:

I do experience small oscillations in pressure field, but (as fas as I understand) they are related to the flow field.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Preliminary study on coupling of viscous and potential flow using domain decomposition and relaxation zones

Authors: Choi Y.M., Malenica , Bouscasse B., Sopheak S., Monroy C., Gentaz L., Ferrant P.

Discusser: Paul Sclavounos

Question(s) / Comment(s):

Have you considered introducing a damping layer in the free surface condition which absorbs energy both in your viscous and potential flow solvers? we have found this treatment of the radiation condition to work very well with Rankine panel methods without the need to discretize the outer fluid domain.

Reply:

We are thinking to include damping zone in the viscous solver for the comparison between different outlet. Different with addition damping layer used for the Rankine panel method, we will put an increased viscosity to the outlet, it will give us more comprehensive understanding on the outlet condition used in CFD solver now a days. Thank you for your comment!

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The 33rd International Workshop on Water Waves and Floating Bodies

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Paper: Robust computation of steady water waves of arbitrary length

Authors: Clamond D.

Discusser: John Grue

Question(s) / Comment(s):

There is much observational and experimental documentation that periodic/non-periodic finite depth waves, of finite amplitude, are strongly height limited by instability and breaking. See Grue, Kolaas, Jensen, Eur. J. Mech. B/Fluids (2014) where also several references are given. Can your method be extended to investigate these bifurcations and instabilities?

Reply:

One motivation was to provide accurate steady states to analyse stability. Otherwise, inaccurate states may lead to incorrect stability analysis. So far, the method is not for unsteady flows. This is a programme for future works.

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The 33rd International Workshop on Water Waves and Floating Bodies

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Paper: Flexural gravity wave blocking in a two-layer fluid

Authors: Santu Das, Trilochan Sahoo and Michael H. Meylan

Discusser: I. V. Sturova

Question(s) / Comment(s):

What practical application is possible for submerged body which oscillates and moves with forward speed?

Reply:

There is no moving body in our problem. We are interested in how waves propagate without any body or obstacle. However, it will be a promising area to apply this theory to such problems.

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Paper: Flexural gravity wave blocking in a two-layer fluid

Authors: Santu Das, Trilochan Sahoo and Michael H. Meylan

Discusser: D. Evans

Question(s) / Comment(s):

Where is there ice cover and ocean stratification where your theory can be applied? In Antarctica? It was a very impressive piece of work.

Reply:

First of all, we would like to thank for the appreciation. Yes, ice cover with ocean stratification can be observed in Antarctica (Sigman et al. (2004)) and it will be a perfect place for experimental validation of the result obtained theoretically. Furthermore, this theory is equally applicable to other very large floating structures such as long floating platforms in tropical regions where salinity and temperature difference stratify water (Yuan et al. (2007)).

Reference:

Sigman, D. M., Jaccard, S. L., & Haug, G. H. (2004). Polar ocean stratification in a cold climate. Nature,428(6978), 59.

Yuan, Y., Li, J., & Cheng, Y. (2007). Validity ranges of interfacial wave theories in a two-layer fluid system.Acta Mechanica Sinica,23(6), 597-607.

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The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Experimental and numerical investigation of sloshing in anti-roll tank using effective gravity angle

Authors: Ercolanelli J., Le Boulluec M., Scolan Y.-M., Babarit A., Magaldi P.

Discusser: Y. Kim

Question(s) / Comment(s):

It is a very interesting study, particularly for EGA.

Two questions are made as follows:

1) For the EGA of pure roll, how can we include the effect of motion arm?

2) In the coupling with ship motion, phase between ART and ship motion is critical. How can you include phase effect to EGA?

Reply:

1)For a pure roll motion (R_y) at the center of fluid, the EGA equals the roll amplitude. When the center of rotation is different of the center of fluid, an extra term is added to take into account the effect of level arm R. Then, the EGA equals: $EGA(t) = R_y(t)(1 + Rw^2/g)$ (w is the angular frequency and g acceleration of gravity)

2)The effect of ART is included with a liquid force term in the rigid body equation, in the same way as the hydrodynamic excitation force. This term is depending on EGA.

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The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Extraordinary transmission past cylinders in channels

Authors: Evans D.V., Porter R., Chaplin J.R.

Discusser: John Grue

Question(s) / Comment(s):

First a comment, Thomas Ebbesen, the first author of the paper in nano-science, which you cite, is my countryman, and an award winner of the Kavli prize in nano science, in 2014.

Second, if youround off the sharp corners at the gaps, the effect will be a small change in the wave phase. The complete transmission will still occur. Method wise you cannot then use the Schwartz-Christoffel mapping. Instead you can patch the fluxes and pressures at the gaps. See Grue, JFM 1992.

Reply:

Thank you for your comments. Ebbesen certainly started something!

I look forward to reading your JFM article of 1992. A good example of the workshop at its best.

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The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Efficient Methodology of Roll Load Prediction on 2D bodies in Nonlinear Flows

Authors: Ratnakar Gadi, R.H.M Huijmans, Ido Akkerman, and Riaan Vant Veer

Discusser: Rodney Eatock Taylor

Question(s) / Comment(s):

I think it is misleading to suggest that having to solve for auxiliary potentials to obtain reliable pressures is computationally expensive.

It Just increases the number of right hand sides in the formulation; the solver is not significantly compromised.

Reply:

This is indeed the case in the pure diffraction and radiation cases presented. In these cases there is no motion, or prescribed motion.

However, in the full nonlinear setting where both diffraction and radiation occurs the matrix changes due to changes in the geometry (normals of the body). This can be accounted for by an additional boundary condition that relates the velocity potential and its temporal gradient on the body. This requires some manipulation to the matrix. Therefor the DPI appears to be more computationally expensive in the fully nonlinear context.

Although FIT (Fluid Impulse Theory) is a valid force extraction routine the requirement that the momentum in the entire domain needs to be simulated correctly (approximately conserved) seems a severe drawback. One possible way of using FIT would be to use it as an indicator for the adequacy of the underlying discretisation. That is perform DPI and FIT force extraction and use the closeness of these results as a measure for the adequateness of the discretisation (mesh).

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The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Wave energy park interaction in short-crested waves

Authors: Malin Göteman, Marianna Giassi, Cameron McNatt

Discusser: Robert Read

Question(s) / Comment(s):

In relation to your multiple scattering method, have you considered that your choice of cutoff distance always provides full convergence, or is this distance limited by the computational requirement of solving the linear system?

Reply:

In what I presented here, an unlimited cutoff was used, so the results were exact within the assumptions of linear potential flow theory. But yes, convergence has been studied and was presented at the 2015 workshop in Bristol. A park with 100 WECs can still be studied with full hydrodynamic interactions (= infinite cutoff) with our method, and used as a benchmark when comparing faster simulations with a finite interaction distance cutoff. (The faster simulations are required when a very large number of cases should be computed, for example when using the genetic algorithm.) In a realistic park, devices will typically be deployed in smaller clusters sharing a substation, and these clusters provide a natural choice for the cutoff distance.

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Paper: Wave energy park interaction in short-crested waves

Authors: Malin Göteman, Marianna Giassi, Cameron McNatt

Discusser: Jun Zang

Question(s) / Comment(s):

1. If you don't use the resonance to optimize your WEC devices, then what is your strategy for optimizing your devices?
2. As we know, array layout may make huge difference to the performance of the wave energy park, have you done such experiments?

Reply:

1. The park (defined by its layout, individual WEC dimensions, etc) will be suboptimal for many sea states, but optimal when considering the total performance (energy over costs) at a site for, say, one year of operation. Even though the WECs are not operating at resonance, we see a large difference in the performance depending on the park parameters.
2. We have performed initial wave park experiments in wave tank, and will follow up with more experiments this year in June.

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Paper: Wave energy park interaction in short-crested waves

Authors: Malin Göteman, Marianna Giassi, Cameron McNatt

Discusser: David Evans

Question(s) / Comment(s):

Are you building in to your results constraints on each devices to ensure the end stops are not damaged in deep waves?

Reply:

With the current method, we assume infinite stroke length and solve the equations of motion in the frequency domain.

But we also have other numerical methods where we solve the equations of motion in the time domain and also account for limited stroke length. That is of course required when considering load impact on the structure or control methods, but is too computationally extensive to study large parks, which is the scope of the current work.

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Paper: Wave energy park interaction in short-crested waves

Authors: Malin Göteman, Marianna Giassi, Cameron McNatt

Discusser: M.A. Peter

Question(s) / Comment(s):

There has been a recent paper (Montiel, Squire & Bennets, 2016, JFM 790), which presents an efficient clustering method resolving all multiple scatterings (but very similar to your method otherwise) and computing directional spreading in the context of ocean-wave scattering by ice floes.

It might be worth looking at this work.

Reply:

Thank you for this comment.

In our method, we don't have to make any assumptions on park layout or length scales, as is typically the case for other clustering methods.

But I will definitely have a look at the work to see the results regarding directional spreading.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Analysis of the generation phase of the upstream waves caused by a ship moving across a depth change

Authors: Grue J.

Discusser: Korobkin A.A.

Question(s) / Comment(s):

The waves generated by a ship or anything else moving in shallow water over an elevated part of the bottom can be explained by using the analogy with a body moving at constant speed in 2D acoustic media through a region of reduced sound speed. The body starts in the region where the body speed is subsonic (subcritical for shallow water equations). There the waves generated by the body are small and they propagate from the body. Once the body enters the region of reduced sound speed, its speed becomes supercritical (supersonic). Then the disturbances cannot propagate from the body and they are accumulated at the nose of the body. These disturbances (shock wave in acoustic) grow in time if the body moves in the region of reduced sound speed for long time. Next the body exits from this region and enters again the region of high sound speed, where the body speed becomes again subsonic. If so, the relatively large wave detaches from the body nose and propagates from the body at the speed of the sound. In such a way, a wave larger than normal for the region is generated.

Reply:

The situation here is different: The depth change in combination with the moving ship is the direct cause. The flow at the ship's bow, pressed (mostly) under the ship, collides with the new, reduced depth. An upward velocity at the water surface is the result. This occurs similarly at the bow and aft (opposite sign). The mechanism is symmetrical for positive / negative depth change, for subcritical, supercritical and critical ranges, where in the latter the effect of nonlinearity becomes important.

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The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Hybrid modeling of wave structure interaction with overlapping viscousinviscid domains

Authors: Harris J.C., OReilly C. M., Mivehchi A., Kuznetsov K., Janssen C. F., Grilli S. T., Dahl J. M.

Discusser: Paul Sclavounos

Question(s) / Comment(s):

How do you estimate the induced drag for transom stern ships due to the shed vorticity. We have found using SWAN that the total viscous drag (friction ITTC57 + vortex induced drag) is very close to ITTC57 flat plate $*$ 2.5 (form factor), it would be worthwhile to validate this with CFD.

Reply:

This would be interesting to study with CFD. For the preliminray JHSS simulations presented, a transom free-surface patch was used in AEGIR, but the transom was not submerged to avoid the transom flow problem. Therefore the ITTC flat plate frictional resistance without a form factor would give a close agreement, and the viscous pressure drag should be nearly zero for this early validation.

In the final hybrid with submerged transom the perturbation solution will capture the form factor and friction drag in Elbe. So ideally, our hybrid method should agree well with an equivalent CFD simulation without the need for any corrections, while provides a relative speedup.

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Authors: Harris J.C., OReilly C. M., Mivehchi A., Kuznetsov K., Janssen C. F., Grilli S. T., Dahl J. M.

Discusser: Y. Kim

Question(s) / Comment(s):

You mentioned "Boundary Element Method" for Euler equation for far-field flow. Could you explain more details for this?

(BEM has been adopted for potential flow.)

Reply:

We start by using a fully nonlinear potential flow time domain BEM for the entire computation domain (which therefore includes nonlinear effects of the body – e.g. diffraction). We therefore derive the coupled equations in the way we do because this inviscid velocity from the potential flow solution should obey the Euler equations.

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The 33rd International Workshop on Water Waves and Floating Bodies

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Paper: Wave Diffraction by Multiple Vertical Cylinders: The Nonlinear Shallow Water Wave Equations

Authors: Masoud Hayatdavoodi, Douglas R. Neill and R. Cengiz Ertekin

Discusser: M. A. Peter

Question(s) / Comment(s):

There is a vast literature on linear wave diffraction by multiple cylinders assembled in a row. In particular, exceptionally high loads are found at the center cylinder even for a low number of cylinders in the row. This phenomenon has been connected to the excitation of wave bound to the line array (Rayleigh-Bloch waves). It would be interesting to see how this phenomenon relates to the nonlinear cases you consider.

Reply:

There is a rich literature on the subject of interaction of water waves with vertical cylinder(s). Most of the studies, however, are concerned with the linear wave diffraction, focusing on various wave components, phenomena and wave behavior that are best explained within the linear theory context. Here, we use nonlinear, shallow-water wave theories to study the problem of wave (solitary and cnoidal waves) interaction with multiple, in-line cylinders. In this work, our main goal is to develop nonlinear models based on the Boussinesq and the Green-Naghdi equations, and linearized version of these equations, to solve this problem, and to study the nonlinear effects of multiple cylinders on the wave diffraction. We have shown some comparisons with laboratory experiments and linear theory results; however, cnoidal waves differ from sinusoidal waves and hence comparisons with the linear theory is not always possible. Further studies are required to closely compare the nonlinear theory results with various wave components and phenomena seen when using the linear theory; this can be done in the future. Thank you for the suggestion.

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Paper: Wave Diffraction by Multiple Vertical Cylinders: The Nonlinear Shallow Water Wave Equations

Authors: Masoud Hayatdavoodi, Douglas R. Neill and R. Cengiz Ertekin

Discusser: Xiao Bo Chen

Question(s) / Comment(s):

As you mentionned, pressure calculation is an issue in classical G-N theory and you have compared the results of G-N with those from Boussinesq's theory. However, the pressures compared are the total pressure including hydrostatic one. Could you show the difference of hydrodynamic pressure between the two theories? If any, what are the reasons?

Reply:

We make an assumption about the distribution of the (total) pressure over the water column for the GN equations. The total pressure is used in determining the force on the cylinder(s). Comparison of the assumed GN pressure distribution with the Boussinesq's equations results show very close agreement; we also calculate the error of this assumption and show that this is negligible. Of course we could also show the hydrodynamic force by substracting $\rho g(h+\eta)$ from the total force. Given the close agreement between the surface elevation (η) of the GN and Boussinesq equations. However we do not expect significantly larger differences between the hydrodynamic forces than that shown for the total pressure. As suggested, we can show this quantitatively. Thank you for the comment.

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The 33rd International Workshop on Water Waves and Floating Bodies

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Paper: On natural modes in two-dimensional asymmetric and symmetric moonpools in finite water depth

Authors: Huang H., Zhang X.

Discusser: Xiao Bo Chen

Question(s) / Comment(s):

My comment concerns the difference between the natural frequency and that at which the response is maximum (often called resonant frequency). The natural frequency is that at which there is a balance between the inertial force and restoring force in the system. When the damping is zero, the natural frequency should be that at which the response is maxi (singular). If damping is not zero and exciting force varies near the natural frequency, the frequency of maxi response could be shifted from the natural frequency.

Reply:

Thank you very much for your comments. The natural frequencies we defined here are basically resonance frequencies where responses are maximum. The moonpool resonance problem is a little bit different with that the dynamic system.

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Authors: Huang H., Zhang X.

Discusser: Bin Teng

Question(s) / Comment(s):

$\phi = 0$ (or $p = 0$) conditions are put at the outer ends of the boxes, and the natural frequencies you got are a little bit higher than Ning et al's. Have you tried to put the boundary conditions at other places, such as at the centerline of the boxes, to improve the accuracy?

Reply:

Thank you very much for your comments and suggestions. As ϕ decays as the distance to center of moonpool increases, we should place the boundary condition ($\phi = 0$) as far as possible. For simplification of the problem, we just define $\phi = 0$ at the outer vertical wall of rectangle cylinders. In the end, a very simple formulation can be achieved.

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Authors: Huang H., Zhang X.

Discusser: David Evans

Question(s) / Comment(s):

The blocks will have a mild cube-root singularity at the edges which will be difficult to model using trigonometric eigenfunction expansion. Do you have problems with convergence because of this effect?

Reply:

Thank you very much for your comments. There is weak singularity at the low edge of the box. But the matching is done by integration of the eigenfunction along the wall. So the singularity can be avoided. Further we focus on the global hydrodynamic behavior. The convergence of our results with respect to the truncation orders are very good.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Backward waves through array of rectangular columns

Authors: Iida T., Kashiwagi M.

Discusser: M. A. Peter

Question(s) / Comment(s):

Your method for tuning the parameters assumes O^o incident angle, which is why your structure does not show nice results for larger incident angle.

Do you expect your kind of structure (rectangular columns) to show negative refraction for larger incident angles if tuned by a more sophisticated method?

Reply:

As you mentioned, the equivalent theory is valid for zero and small angles. Unfortunately, it is in fact hard to blush up this scheme because we utilize rectangular columns. Rectangular columns have corners and thus the nature of the refraction has huge dependency of the oblique angles. Therefore, it might be better to use circular cylinders for achieving more sophisticated negative index materials. Nevertheless, we believe equivalent circuit analysis is meaningful because it gives us the refractive index in multi-bodies fields with explicit form.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: An innovative EFD for studying ship seakeeping

Authors: Iwashita H., Kashiwagi M.

Discusser: Xinshu Zhang

Question(s) / Comment(s):

My first question is on the value of wave steepness in your experiments.

The second one is : Do you plan to put sensors above the still waterline? As ship travel with forward speed, there will be steady bow wave, which may cause hydrodynamic pressure on the area close to the bow area.

Reply:

The wave steepness H/Λ in the experimnent was within the linear theory regime; that is in the range of 1/60 to 1/100.

We have already fixed 12 pressure sensors above the still water line, after detecting the profile of steady wave generated by the steady translation at constant speed ($Fn = 0.18$), at positions which are between the still water line and the steady wave profile.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Water impact near the edge of a floating ice sheet

Authors: T.I. Khabakhpasheva, Yang Chen, A.A. Korobkin, K. Maki.

Discusser: S.A.Ellingsen

Question(s) / Comment(s):

Are the effects of viscous drug and dissipations fully accounted for, and do they much influence the dynamics of the problem (e.g. the moving part of the sheet)?

Reply:

The CFD solution is of the Navier-Stokes equations with a laminar viscous stress term (there is no Reynolds stress or sub-grid-scale stress term). For this problem, the numerical grid in space and time is sufficient to resolve all of the scales of the flow so the viscous drag and dissipation is fully accounted for up to the numerical accuracy of the solution.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Water impact near the edge of a foating ice sheet

Authors: T.I. Khabakhpasheva, Yang Chen, A.A. Korobkin, K. Maki.

Discusser: Mike Meylan

Question(s) / Comment(s):

Can the elasticity of ice be included in your formulation?

Reply:

We are working just now on this problem with elastic floating ice floe. A current difficulty for us is how to calculate the added mass matrix at each time instant.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Water impact near the edge of a floating ice sheet

Authors: T.I. Khabakhpasheva, Yang Chen, A.A. Korobkin, K. Maki.

Discusser: Bob beck

Question(s) / Comment(s):

How will the results change dueto 3-D effects?

Reply:

The 2-d analysis is an important starting point to understand the role of ice on slamming loads. For example, classification societies use 2-d analysis to estimate slamming loads on ships in open water. Our 2-d analysis for slamming near ice directly indicates the influence of ice on the force and pressure, relative to the open water scenario. Also, our results in 2d map the relationship between ice proximity and change in loading. This result indicates the region in which ice should be accounted for, or, the region in which ice may be neglected. The 2-d results will overestimate this region in which ice should be accounted for compared to the 3d case, and hence the results can be considered a conservative estimate for the region in which the ice influences the force.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Water impact near the edge of a floating ice sheet

Authors: T.I. Khabakhpasheva, Yang Chen, A.A. Korobkin, K. Maki.

Discusser: Yonghwan Kim

Question(s) / Comment(s):

I somewhat doubt if the Wagner solution solves the physical problem that you described. The Wager solution that you showed is that for $d\Phi/dn = 0$ onphysical domain in the ice sheet (free surface, $z = 0$). However, your Wagner solution is for $d\Phi/dn = 0$ on the elevation of intersection point between body and free surface elevation ($z = \nu$).

Reply:

In the Wagner model, the boundary conditions are linearised and imposed on the initial water level, which is $z = 0$ in your notations. This is the level at which the rigid ice plate is placed. The linearization at the pile-up height is typical for the Generalized Wagner Model, which gives good agreement with CFD and experimental results for moderate deadrise angles. In our present problem, the deadrise angle of the body is small and standard Wagner approach can be used.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Dispersive shock water waves. Experiments and numerical comparisons

Authors: Kimmoun O., Hsu H.C., Chabchoub A.

Discusser: Didier Clamond

Question(s) / Comment(s):

What is the difference between an ondular bore and a dispersive shock?

Reply:

There is no differences. Undular bore is the most known example of dispersive shock water waves.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Dispersive shock water waves. Experiments and numerical comparisons

Authors: Kimmoun O., Hsu H.C., Chabchoub A.

Discusser: John Grue

Question(s) / Comment(s):

My question relates to the results you show in figure 3 (right) in the abstract. your measurements and viscous calculations show excellent agreement at position $x = 128.8m$ from the wavemaker.

My question relates specifically to the effect of viscosity on the BF-instability. Segur, Henderson and co-workers have shown mathematically, and confirmed experimentally, that viscosity kills the BF-instability.

What is your experience on this conflict seen from your work in very long tanks ?

Reply:

In the paper of Segur *et al.*, the results show that with linear dissipation the growth rate of the sidebands is linear and not exponential as expected by the NLS equations. What we have shown in the papers

Kimmoun, O., Hsu, H., Kibler, B., Chabchoub, A. (2017), "Nonconservative higher-order hydrodynamic modulation instability". Phys Rev E 96 :022219

and

Kimmoun, O., Hsu, H. C., Branger, H., Li, M. S., Chen, Y. Y., Kharif, C., Onorato M., Kelleher, E. J. R., Kibler, B. & Chabchoub, A., 2016, "Modulation Instability and Phase-Shifted Fermi-Pasta-Ulam Recurrence". Nature scientic report, 10, 28516

is that with dissipation a breather which is less narrow band than the solution chosen by Segur et al. (regular waves with two sidebands) is submitted to instabilities that lead to bifurcation of the envelope of the wave. The major result was that with these bifurcations the wave amplitude can be much higher than the focus non bifurcate breather.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Interaction of hydroelastic waves in ice cover with vertical walls.

Authors: A.A. Korobkin, S. Malenica , T. Khabakhpasheva.

Discusser: Masashi Kashiwagi

Question(s) / Comment(s):

One important difference between hydroelastic wave and water waves is the existence of a critical wavenumber (frequency) where the phase velocity takes a minimum value and the group velocity becomes larger than the phase velocity for the wavenumbers higher than that critical wavenumber. Is there a special phenomenon corresponding to that critical value in the frequency in obtained results.

Reply:

The question is interesting. We should pay attention to the critical wavenumbers in our analysis. So far, we did not find special phenomena corresponding to those critical values. Also we cannot see how it may affect the analytical results for wave interaction with structures but we will keep eyes open on this possible phenomenon.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Formation of waves riding on the forced free-surface flow

Authors: Kostikov V.K., Makarenko N.I.

Discusser: David Evans

Question(s) / Comment(s):

In 1963 Ogilvie, in a paper in the Journal of Fluid Mechanics proved, on linear water wave theory, that a submerged horizontal cylinder, making small circular rotations in a wave tank, created waves in one direction only. Experiments confirm this. Can you confirm this in the early stages of such a motion?

Reply:

As we consider an arbitrary motion of the cylinder we can try to catch this effect. Anyways we were about to start studying periodical motion of the underwater body. You gave me a good example of such motion.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Wave-making problem by a vertical cylinder: Neumann-Kelvin theory versus Neumann-Michell theory

Authors: Hui Liang, Xiaobo Chen, Xingya Feng

Discusser: Masashi Kashiwagi

Question(s) / Comment(s):

Even in the Neumann-Michell theory, the final expression for the velocity potential consists of the double integral on the body surface and a line-integral term. Can we expect to transform further this line-integral term into a certain double integral on the body surface, or can we simply ignore the contribution from this line-integral term in the computation?

Reply:

Thank you for your question. In the original work on the Neumann-Michell theory by Noblesse *et al* (2013), the local-flow component of the line integral is ignored. In the present work, this term is retained and then there is a line integral term with respect to the Rankine source term in the final expression. For a slender body, like a ship, this term is not important and can be simply dropped. For a blunt body, however, the importance of this term is unknown, and it requires further study.

Discussion Sheet

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The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Transient wave runup on cylinders due to wavefronts

Authors: R.P. Li and W.Y. Duan

Discusser: YuXiang MA

Question(s) / Comment(s):

What is the difference the run-up between the transient wave-fronts and a regular wave? What is the difference between the train wave-front and a transient wave run-up?

Reply:

Waves generated by harmonic motions of wavemaker have a transient zone (or duration) before becoming steady state. In the usual time-domain simulation, the steady-state waves are taken as the incoming waves. While waves with transient wave-fronts contain much more information and have different features (ref paper by Chen XB p17 of this workshop). The run-up stands for the wave elevation around the cylinder including diffraction effect. The run-up in transient waves with wavefront could be higher than that in steady-state waves as shown in the figures where we have given the weather side and lee side of the wave run-up on the cylinder.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Transient wave runup on cylinders due to wavefronts

Authors: R.P. Li and W.Y. Duan

Discusser: YoungMyungCHOI

Question(s) / Comment(s):

I am curious regarding on the computation of your elementary function. Because there have been many algorithms to calculate time domain Green function. (tabulation, direct integral, solving the ODE). Recently, Bingham(2016) compares the computation speed of mentioned algorithms and he concluded the tabulated one is most fast. Do you have any brilliant idea to evaluate your elementary function? (Like ODE).

Reply:

Thank you for your comments. Yes, much efforts have been made by many scholars on the algorithms of evaluating the time domain Green function efficiently and accurately. Here, in our new multi-domain method, we like to introduce the elementary solution, different from point solution. It can be referred to CHEN and LIANGWavy properties and analytical modeling of free-surface flows in the development of the multi-domain method2017.

For the elementary solution, there is no need to compute the time domain Green function itself, but the integration multiplied by the Fourier-Laguerre basis function on the cylinder surface. From the analytical formula and the numerical results, it can be seen that the elementary solution behaves better than the point solution. For the numerical algorithm, we adopt the idea of the steepest descent method. While we do not need to find the exact integrating path, and an approximate path (fairly steepest descent path) in the complex plane will do.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Numerical simulation of breaking waves using adaptive mesh approach

Authors: Liu C., Hu C.

Discusser: Masoud Hayatdavoodi

Question(s) / Comment(s):

The results and animations of drop and jet tests, given your experience of running these and similar cases, could you comment on your expectation of the computational cost for the future cases that you have planned, i.e. wave-floating body interaction? This is particularly of interest for practical cases of e.g. offshore floating wind turbines.

Reply:

To simulate a practical case of offshore floating wind turbine system in waves at an acceptable computation cost is the goal of our CFD development. A highly parallel Cartesian grid code with AMR and high order IBM is considered as a promising approach to reach our goal.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Numerical simulation of wave propagation over submerged reef

Authors: Jinxuan Li, Jun Zang, Shuxue Li, Wei Jia, Qiang Chen

Discusser: D.Z. Ning

Question(s) / Comment(s):

1. How do you deal with the reflected wave at the input boundary in the case of larger slope?
2. How to determine the length of damping zone in the model?

Reply:

1. The relaxation zone is set for avoiding the wave reflection.
2. The length of the relaxation zone is one wave length. From our experience, the length is enough for wave absorption.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Numerical simulation of wave propagation over submerged reef

Authors: Jinxuan Li, Jun Zang, Shuxue Li, Wei Jia, Qiang Chen

Discusser: Michel Benoit

Question(s) / Comment(s):

1. Can you give me an order of magnitude of the CPU time for this type of simulation?

2. In the formula you propose to estimate wave set-up the bottom slope does not appear, which is a bit surprise. Can you comment on this?

Reply:

1. The numerical tests are performed with 0.8 million grids. The duration of the simulation is 45s real time The total CPU time for this simulation is around 12 48h on a 2.4 GHz*8 processors. Generally, larger breaking wave needs smaller time step and longer simulation time. For example, for the case T=2,H=20cm, the total CPU time is 48h, for the case T=2,H=6cm, the total CPU time is 12h

2. From our simulation results, it can be found the slope has no effects on the wave setup on the reef flat. So the wave slope was not considered in the empirical formula.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Application of the Hydroelastic Theory of Ships to the Motion of Ice Shelves

Authors: M. H. Meylan, L. G. Bennetts, M. Ilyas, B. Lamichhane and M. A. Peter

Discusser: A Korobkin

Question(s) / Comment(s):

The bending stresses in the elastic plate can be useful to decide where the plate could be broken with calving floes. The plate edge, where the plate is clamped to the vertical wall, in your sketch, is particularly interesting in the of the stresses there. Did you calculate the stresses in the plate?

Reply:

No, we have not looked into this. A real ice sheet grows very thick away from the edge, and we would need to include this thickness before computing this. I agree that in our current model there would be a strong concentration of stress at the edge where it is clamped.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: A second-order theory for wave energy converters with curved geometry

Authors: Michele S., Renzi E., Sammarco P.

Discusser: Bob Beck

Question(s) / Comment(s):

Your figure 1b shows ± results relative to a flat plate for different frequencies. How would your results change in a real seaway where waves of many different frequencies are present?

Reply:

As pointed out by Sclavounos (1992), nonlinear interactions between random sea waves and a vertical wall generate third order effects comparable to the second-order forcing terms. This would be helpful for the corresponding exciting force and the diffraction solution in which the moving gate is held stationary in incoming waves. When in nonlinear regimes, analyses of radiation effects combined with random waves and moving curved boundaries require non-straightforward techniques. This question represent a challenging subject and will be addressed in the near future.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: A second-order theory for wave energy converters with curved geometry

Authors: Michele S., Renzi E., Sammarco P.

Discusser: Rodney Eatock Taylor

Question(s) / Comment(s):

Have you considered gate surface variations which have exponential or hyperbolic cosine dependence on depth?

Reply:

We thank prof. Eatock Taylor for this comment, however, recent results for a gate having exponential dependence on depth revealed no significant improvements in terms of power extraction or efficiency. We believe that the analysis of strong interactions and/or resonance between the gate profile and the vertical eigenmodes require fast and slow vertical coordinates as in the case of the Bragg scattering phenomenon. In this case we should expect strong reflection at the gate boundaries and a corresponding increasing in the exciting force for a particular range of incident wave frequencies.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: A second-order theory for wave energy converters with curved geometry

Authors: Michele S., Renzi E., Sammarco P.

Discusser: Rod Rainey

Question(s) / Comment(s):

If I might venture to suggest an improvement to this impressive piece of work, I believe the numbers in the worked example could be chosen to be of more practical relevance. The big changes in power seen in Figure 1 are at 1.5-2 rad/s, where there is not much power in the waves, compared with lower frequencies.

Reply:

We thank Rod Rainey for this precious comment. Reasonable geometries/device mechanical characteristics that maximize power extraction for lower frequencies will be taken into account in future works.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: On sloshing modes in square or nearly square moonpools

Authors: Molin B.

Discusser: David Evans

Question(s) / Comment(s):

If you use vertical boundaries at the inner edges and corresponding eigenfunction, you could reduce the number of the regions by one using symmetry. Also what is the validity of using $\phi = 0$ on the outer boundary?

Reply:

You are correct on the first point. The size of the problem can also be reduced by parity considerations. The boundary condition $\phi = 0$ has proved to provide valuable results in the gap case (e.g. see Newman& Sclavounos BOSS88). It is also regularly used in hydraulics (e.g. see Mulcahy, Trans ASME, Vol 47, 1980).

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: On sloshing modes in square or nearly square moonpools

Authors: Molin B.

Discusser: Hugh Wolgamot

Question(s) / Comment(s):

The effect seen for the 'second sloshing mode' in Figure 2 of the abstract, where the curves do not cross, strongly resembles a phenomenon seen in other contexts and sometimes known as veering (see e.g. Mace & Marconi, 2012).

Whether crossing or veering of eigenvalue curves occurs depends on the coupling between the eigenmodes. So is it prossible that the reason the 'first sloshing mode' curves cross while the 'second sloshing mode' curves veer is that the longitudinal and transverse modes are uncoupled in the first case ans coupled (weakly) in the second?

Mace B.R. & Marconi E., 2012, The Journal of the Acoustical Society of America, 131, 1015.

Reply:

Thank you for pointing out this reference.

I have the intuition that "veering" occurs for the modes which are even both in x and y. This remains to be checked (or proved).

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Hydrodynamic investigation of a dual-chamber OWC Wave Energy Converter

Authors: De-Zhi Ning, Rong-Quan Wang, Ying Gou

Discusser: M. Kashiwagi

Question(s) / Comment(s):

How to determine the damping coefficient on the free surface boundary condition? What is the relationship between u?

Reply:

The hydrodynamic efficiency is determined with the averaged surface elevation at the chamber center and air pressure in the chamber in experiments shown by the presentation, which is different from those in the abstract, just the crests of surface elevation and air pressures used. It is an improvment comaprison with the method in the abstract.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Hydrodynamic investigation of a dual-chamber OWC Wave Energy Converter

Authors: De-Zhi Ning, Rong-Quan Wang, Ying Gou

Discusser: Zhiming Yuan

Question(s) / Comment(s):

Some of the figures shown in the presentation (e.g. Air pressure and hydrodynamic efficiency) looked different from those in the proceedings! Were there some mistakes in the computations?

Reply:

There are two damping coefficients on the free surface boundary conditions. One is used at the left end of the flume to absorp the reflected wave from the OWC device, which can be determined explicitly according to the length from the starting point of damping layer. The other is used on the chamber free surface to approximate the viscous effect due to vortex or flow seperation from the front wall, which can be determined using the method of error and trial by comparison with the experiments. The auhtors' previous work (Applied Energy, 2016, 168:636-648) can be refered.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Boundary-integral relations in the theory of ship motions in regular waves

Authors: Noblesse F.

Discusser: Masashi Kashiwagi

Question(s) / Comment(s):

Basically I agree with possibility of cancellation of singularities between the line-integral term and the hull-surface integral. (In fact, its solution is known as the least-singular solution.)

However, I understand that $G\phi_x$ term is eliminated in your transformation. If the term of $G\phi_x$ is kept (especially for the unsteady problem with forward speed), how will be the result?

Is it true that the same kind of transformation is possible to transform the line-integral term into an expression on the hull surface?

Reply:

There is considerable numerical evidence, as well as some theoretical arguments, that strongly suggest that the classical boundary integral formulation, with the term $G\phi_x$ in the waterline integral is a problem that is ill posed and cannot be solved. The transformation used to express the term ϕG_x as a hull-surface integral could in principle also be applied to the term $G\phi_x$ but that transformation seems unlikely to be useful.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Boundary-integral relations in the theory of ship motions in regular waves

Authors: Noblesse F.

Discusser: Harry Bingham

Question(s) / Comment(s):

Have you considered applying this idea to the time-domain formulation with the free-surface Green function?

Reply:

I have not, but the spreading of the waterline integral over the upper part of the ship hull surface could be done in the same way. The alternative boundary integral representation can also be extended to unsteady motions.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Rainbow trapping of water waves

Authors: Peter M.A., Bennetts L.G., Craster R.V.

Discusser: Malin Göteman

Question(s) / Comment(s):

In realistic ocean waves with irregular and short-crested waves, how would the method generalize? (To be of practical use for wave energy applications...)

Reply:

The method is based on linear theory. However, it would be very interesting indeed to see what happens for a multidirectional irregular incident wave spectrum, which we can test fairly easily with our method.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Rainbow trapping of water waves

Authors: Peter M.A., Bennetts L.G., Craster R.V.

Discusser: Paul Sclavounos

Question(s) / Comment(s):

I would suggest that you apply your method in random seas with the objective of collecting your energy at a central substation with an objective function that maximizes the mean power and that also minimizes its variance. this would lead to an optimal minimum power rating of the Power take off mechanism.

Reply:

Thank you very much for this comment.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Plate arrays as a water wave metamaterial

Authors: R. Porter

Discusser: Paul Sclavounos

Question(s) / Comment(s):

Have you considered applying your theory in the design of the optimal angle of plate baffles that dissipate energy in tuned liquid dampers via vortex shedding ?

Reply:

We are looking at damping energy, but not specifically for TLDs. Since the plate arrays are closely-spaced it makes sense to add a source of physical damping of the field in the plate array and this is currently being considered as a broadbanded stop-filter for an acoustic waveguide.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Plate arrays as a water wave metamaterial

Authors: R. Porter

Discusser: Simen Ellingsen

Question(s) / Comment(s):

Its interesting that also the exact solution shows total transmission at -delta for all frequencies. I could be wrong but I seem to remember from my days doing electromagnetics that the Kramers-Kronig relations imply that any physical linear response (e.g. scattering) can only show negative refraction within a finite range of frequencies. Are there any assumptions made which means this does not apply. E.g. that interplate scale remain sub-wavelength ?

Reply:

So, there are no more assumptions made than those I have already stated. The Kramers-Kronig relations relate the real and imaginary parts of a complex function and are often used to relate quantities such as forces on bodies. Im not aware of their implication in the way you describe but I will see if I can find a connection.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Plate arrays as a water wave metamaterial

Authors: R. Porter

Discusser: Peder Tyvand

Question(s) / Comment(s):

Oblique plane shallow-water waves can be totally transmitted across a step ($x = 0$) where the water depth changes from h_1 ($x < 0$) to h_2 ($x > 0$). Total transmission for these hydrostatic non-dispersive waves takes place at a certain angle of incidence somewhat below the threshold angle of total reflection. Through this angle of total transmission, the phase shift of the reflected wave switches from 0^o to 180^o. With dispersion, there is no total transmission, as the phase shift of reflection changes gradually with the angle of incidence. This is because dispersion legally allows any phase shift angle of reflection, in contrast to the fact that 0^o and 180^o (equivalent to a sign change) are the two only legal phase shift angles for plane non-dispersive waves. Do these classical insights have relevance to your work?

Reply:

Not directly. The effect of the homogenisation in the plate array to the underlying equation is the same mathematically as changing the depth of the water, but that change is dependent on the incident wave angle. So there is a connection in this sense.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: The behaviour of short waves in the presence of large long waves

Authors: Rainey R.C.T.

Discusser: Paul Sclavounos

Question(s) / Comment(s):

The loads on the tower of a bottom mounted wind turbine with diameter $D = 6m$ in a spectrum with $H_s = 8m$ are very well predicted by linear+second-order contributions from our Fluid Impulse Theory (FIT) for slender cylinders presented at the 31^{st} IWWWFB. Concerning the truncation of the spectrum at high frequencies we found in our systematic studies that a truncation over 1.5-$2rd/s$ in our model is sufficient to prevent the blow-up and still generate very accurate level crossing rates when compared to experiments carried out in Trondheim. The reason a cut-off at 1.5-$2rd/s$ is sufficient is that the dominant contribution to the wave load extremes comes not from the linear but the sum-frequency effects in our quadratic FIT model. The sum-frequency terms arise from wave frequency pairs that lie below the cut-off and with the selected truncation the summation of the sum-frequency QTF is stable and convergent as the frequency resolution of the spectrum increases.

Reply:

Thank you for that. At the 2012 Workshop John Chaplin and I analysed model experiments on a $3.5m$ diameter vertical cylinder in long sequences of irregular waves of H_s between $9.7m$ and $14.2m$. We found good agreement with a simple Morison model with linear irregular waves, but with a more severe truncation of the spectrum. But the cylinder was stiff - there was no significant dynamic response. The problem I am highlighting today is when the dynamic response is important, for fatigue if not for extreme loads. There was no significant dynamic response of your wind turbine tower, if I understand you correctly.

Reply : from Paul Sclavounos

Following up we did not explicitly consider the flexural response and fatigue of the wind turbine tower which has a natural frequency around $2.5rd/s$. We have measurements of the flexural response and we plan to look into them.

More generally our quadratic FIT slender cylinder wave load model for a rigid cylinder leads to analytical sum- and difference-frequency QTFs which are additive to the linear transfer function. When we compared our load simulations to experiments we found that viscous effects were not important for a cylinder with diameter $D = 6m$. Using the Kac-Siegert eigenvalue analysis and the results in a paper by Kleiven, Winterstein and Uve (KWU) on TLP tether loads we compute the skewness and kurtosis of the nonlinear wave load on the tower including all second-order effects. The KWU paper derives explicit expressions for these nonlinear moments and show how they are used for the calculation of extreme load level crossing rates and for fatigue analysis. We plan to present the details of this frequency domain analysis and a comparison with direct time domain simulations in a forthcoming paper.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: The behaviour of short waves in the presence of large long waves

Authors: Rainey R.C.T.

Discusser: Paul Taylor

Question(s) / Comment(s):

The additional harmonics you highlight are caused by the inaccurate initial conditions for the long wave. If you used more accurate ones, they would disappear.

Reply:

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: The behaviour of short waves in the presence of large long waves

Authors: Rainey R.C.T.

Discusser: Guillaume Ducrozet

Question(s) / Comment(s):

I fully agree with Paul Taylor that what you observe for highest harmonics is the result of the initialization process. For an even simpler configuration (that you can test with your code), *i.e.* just one regular wave, a similar feature is observed when using linear initial conditions in a nonlinear solver. We have experienced this in our program HOS-ocean, which is similar to yours, and is described in Vol. 34 (2012) of the European Journal of Mechanics -B/Fluids, pp 19-34 and Vol. 203 (2016) of Computer Physics Communications pp 245-254.

To overcome this problem, you may:

- use a fully (highly) nonlinear initial solution: for regular waves we are using stream-function theory
- use relaxation schemes (in time) on the non-linear terms of the free surface boundary conditions at the beginning of the simulation. This has been described by Dommermuth in Vol. 32 (2000) of Wave Motion pp 307-317

The latter is actually what we are using when simple non-linear initial conditions are not available (for instance for irregular sea states). Recently, we actually started to study the problem of short-wave/long-wave interactions and use linear initial conditions with such relaxation schemes and obtained good results.

Reply:

I very much appreciate these references to other work in this field, that I was unaware of - this is one of the things that this workshop is famous for! Also the very interesting suggestion that my higher harmonics are caused by my inaccurate starting condition for the long wave. This had not occurred to me and is plausible physically, by analogy with the way a wavemaker programmed with only linear irregular waves, will generate a second-order "set down", plus a free-running wave of the same period but different speed, to cancel the "set down" at the wavemaker. The oscillations I see in the amplitude of my higher harmonics, see my figure 5, could be locked higher harmonics, and free-running waves of the same wavenumber, beating with each other because they have different speeds.

But the order of magnitude is wrong. John Chaplin has kindly run his 50^{th} order stream function program (described in Vol 3 (1980) of Coastal Engineering pp 179-205) for my case of a 10m high wave of 12.8s period, and reports that the 5^{th}-8^{th} harmonics have velocity potentials whose time-derivatives in m2s-2 (my Dphi) are respectively 0.00014, 0.00011, 0.00026 and 0.000094. This is three orders of magnitude less than the amplitudes I am seeing in my Figure 4. This opens up the following possibilities:

- It is a numerical error produced by my code. This is certainly possible, but I have not found any examples in the literature of equivalent codes producing no such harmonics with an accurate initial condition for a regular wave.
- It is the result of my adding the short wave
- It is an instability of the long wave. Steep regular waves are of course known to be unstable. We have suppressed the Benjamin-Feir instability with our periodic boundary conditions; maybe this is not enough.

Reply: from Guillaume Ducrozet

This is in my opinion difficult to have a definite answer with your current initial condition. At the beginning of your simulation, you artificially create free waves in place of all bound waves (harmonics of each primary wave + their mutual interactions). You consequently end-up with a very complex set of free waves that may interact among themselves and with the long wave. This may lead to instabilities or other features that seems complicated to analyze with the present data. I really suggest you to try the relaxation scheme if you want to conclude about the observed features.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Time- and frequency-domain comparisons of the wavepiston wave energy converter

Authors: Read R., Bingham H.B.

Discusser: Masoud Hayatdavoodi

Question(s) / Comment(s):

Have you considered the friction force between the plate and the shaft when solving the equation of motion? Also, have you determined the vertical force on the plate? The vertical force would potentially contribute to the friction force (and hence it is time and spatial dependent).

Reply:

The effects of any frictional loading between the plate carriage and the supporting beam have not been included in the analysis. If the wheels of the carriage are functioning correctly, these forces should be negligible in comparison to the plate and power take off loads. If problems become apparent in practice, they could be characterized experimentally and included directly on the right-hand side of the time-domain equation of the motion.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

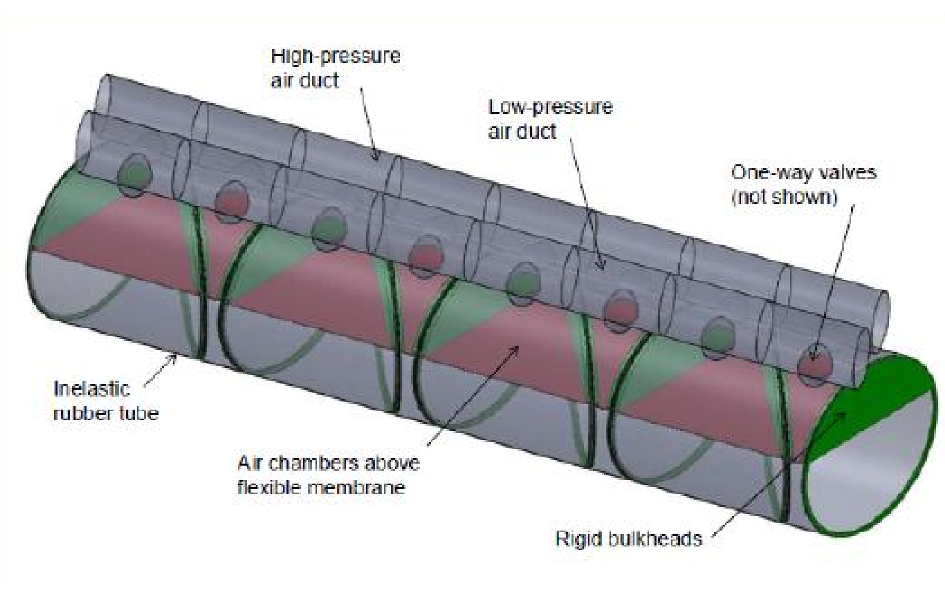
Paper: Time- and frequency-domain comparisons of the wavepiston wave energy converter

Authors: Read R., Bingham H.B.

Discusser:

Question(s) / Comment(s):

The importance of this paper, in my opinion, is that if wave energy has a future, it is in WECs of this configuration - many small devices in a line, perpendicular to the wave crests, pumping into a common hydraulic (or pneumatic) hose. My own preference is for a pneumatic hose rather than an hydraulic one, because the hose flow losses are lower, and the air acts as an accumulator, to smooth the power. One such device was illustrated in my paper with John Chaplin at the 2013 Workshop, another is illustrated below (see picture below), taken from my 2012 talk on the INI website, cited in that Workshop paper. The up-to-date link to my analysis of it on the INI website is http://www.newton.ac.uk/files/seminar/20121217160016301-153457.pdf. My analysis follows the same scheme as that being described today by the present authors, of linearizing the highly non-linear process of pumping into a hose through a non-return valve. It is a drastic approximation, but I see no alternative.



Reply:

We thank the questioner for his suggestions and for the references provided. With regard to the final point, it is not necessary to linearise the pumping process if the modelling is performed in the time domain. If it provides accurate results, a frequency-domain analysis is more computationally expedient, but in our case linearising in the frequency domain leads to significant errors at mid-range frequencies. A time-domain analysis is therefore to be preferred here.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Time- and frequency-domain comparisons of the wavepiston wave energy converter

Authors: Read R., Bingham H.B.

Discusser: Malin Göteman

Question(s) / Comment(s):

When you compute the absorption in irregular waves, how do you compute the optimal damping? Are you assuming a passive control?

Reply:

For each irregular wave condition we identify the optimal PTO damping coefficient and hydraulic cylinder pressure associated with a regular wave with a period and height equal to the peak period and significant wave height respectively of the irregular wave state (let us call this the regular H_s-T_p wave). This PTO damping coefficient is identified using a constrained minimisation function that maximises the absorbed power while constraining the response to an acceptable range. Thereafter, for the full range of wave frequencies, and using the estimated optimal cylinder pressure calculated previously, the PTO damping coefficient and the response are calculated for one steepness, namely that of the regular H_s-T_p wave described above. The power and CWR are then calculated as a function of frequency for this single value of the wave steepness. The product of the CWR, power spectrum, and group velocity is then integrated with respect to frequency in the normal manner to obtain the average absorbed power in that sea state. In this process, the assumptions regarding control are that the onshore turbine generator system can convert the absorbed energy to electricity with 100 % efficiency whilst maintaining the optimal cylinder pressure for that particular wave state.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Modelling nonlinear wave-body interaction with the Harmonic Polynomial Cell method combined with the Immersed Boundary Method on a fixed grid

Authors: Robaux F., Benoit M.

Discusser: M.A. Siddiqui

Question(s) / Comment(s):

For freely standing wave case, convergence of the 5^{th} order is demonstrated whereas in the Harmonic Polynomial Cell Method, polynomials up to 4^{th} order are used, this discrepancy should be checked!

Reply:

Indeed this discrepancy should be checked and is not explained and understood for now. Nevertheless the order found is shown to be better than the expected one and this is the reason this problem was not investigated yet.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Modelling nonlinear wave-body interaction with the Harmonic Polynomial Cell method combined with the Immersed Boundary Method on a fixed grid

Authors: Robaux F., Benoit M.

Discusser: Alessandro Iafrati

Question(s) / Comment(s):

In the simulation with the cylinder I would expect breaking which you cannot describe of course. May you comment about how you intend to address this question in the future?

Reply:

For the case of the cylinder at low depth – reproducing the experimental case of Chaplin 1984 – waves are not expected to break for the investigated wave heights. Of course the method presented here does describe breaking if it should happens. However, the main objective of the work is to add viscous coupling to the presented model. The aim is that this coupling be able to solve breaking by solving the NS equations on the complementary variables.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Wave energy conversion using machine learning forecasts and model predictive control

Authors: Sclavounos P.D. , Ma Y.

Discusser: Harry Bingham

Question(s) / Comment(s):

You apply two constraints to your control (for heave): a max. response amplitude, and a max. force on the PTO. How do you ensure that these do not confict with each other? i.e. I can imagine situations where a very large damping force may be required to limit the motion.

Reply:

When the force and motion constraints are in conflict the controller would select the more conservative of the two. We think that pitching devices not piercing the free surface and for which the kinematic constraint is less severe offer advantages. For example when a large pitch response occurs viscous damping from flow separation acts as a significant damper, similar to bilge keels, in seastate environments where a large peak in power needs to be curtailed in order not to overload the power takeoff mechanism. In such cases the need for additional damping from the PTO is reduced.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Wave energy conversion using machine learning forecasts and model predictive control

Authors: Sclavounos P.D. , Ma Y.

Discusser: Alain H. Clément

Question(s) / Comment(s):

Have you tried to determine the optimal value of the horizon time T_h? To your opinion, is it related more to the natural period of the device, or to the typical period of the incident waves?

Reply:

We have experimented with the forecast window and found that it ranges from a few to five seconds. A more systematic set of tests would be necessary depending on the severity of the seastate and the parameters and constraints associated with the power takeoff mechanism.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Validation of damaged ship hydrodynamics by a Domain Decomposition Approach using the Harmonic Polynomial Cell method and OpenFOAM

Authors: Mohd Atif Siddiqui, Marilena Greco, Giuseppina Colicchio, Odd M. Faltinsen

Discusser: Y. Kim

Question(s) / Comment(s):

Your results for added mass and damping coefficients seem smoothly varying fro frequency (Fig. 4). Is there any singular behavior near/at resonance case? (i.e. resonance with sloshing)

Reply:

Dear Professor Kim, thank you for the question. In our case since the forces for calculating added mass and damping coefficients are taken from NS solver (OpenFOAM). The solver is nonlinear in nature and also includes viscous damping, therefore we do not observe a singular behaviour at sloshing resonance.

Singular behavior at sloshing resonance is a case usually observed for linear potential flow solutions without viscous damping as also mentioned in Sloshing (Faltinsen and Timokha).

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: An experimental setup for wave-body forces in shear currents

Authors: Smeltzer B.K., Æsøy E., Li Y., Ellingsen S.Å.

Discusser: Robert Read

Question(s) / Comment(s):

Given the significantly reduced scale of your experimental setup, to what extent will future measurements of the forces on a model ship and the generated wake be adversely affected by surface tension?

Reply:

The main aim of immediate future work is to investigate the impact of shear currents on ship wakes and wave resistance forces at a fundamental level. Though some waves at the scale of our lab are affected by surface tension, their dispersion is still altered by a sub-surface shear current. It is acknowledged that quantitative results are likely not valid when scaled up to realistic vessel dimensions, though our results can give us confidence in our modeling capabilities, which may be applied at full scale.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Numerical simulation of wave impact with air cavity effects

Authors: Song B., Zhang C.

Discusser: Xiantao Zhang

Question(s) / Comment(s):

In your presentation, you gave the comparison of the wave profile calculated using your multi-scale method with CFD results. And the agreement is good. Have you compared the impact force on the wall influenced by the entrapped air cavity with CFD or experimental results?

Reply:

Currently no comparison with CFD or experimental results for the impact force on the wall is made.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Experiments on the water entry and/or exit of a cone

Authors: Tassin A., Breton T., Jacques N.

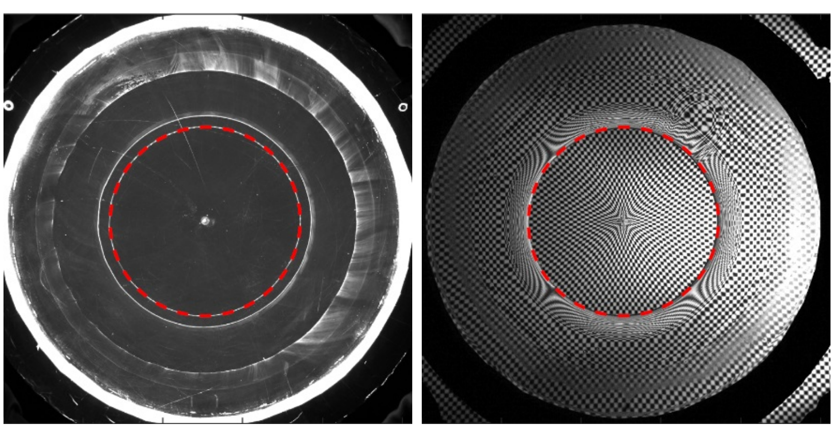
Discusser: A. Korobkin

Question(s) / Comment(s):

In your videos (top view), there several circular lines. One of them is identified as the contact line in exit stage. What is about other circles?

Reply:

In the experiments, a transparent mock-up is used and LED arrays are fixed on the edges of the mock-up. With this setup, the contact line appears as a luminous line in the videos. In fact, the contact line corresponds to the inner luminous line. This point was demonstrated from experiments in which a draught board was placed at the bottom of the water tank (the comparison shows the correspondence between the illuminated contour and the perimeter of the surface over which the draught board is "undistorted") and from experiments in which top and side views was recorded simultaneously (see Tassin et al., Experiments in Fluids 58(8), 2017). We think that the other circular lines are due to parasitic reflections of the lighting device on the free surface. This is probably due to the fact that the sides of the mock-up were not polished well enough.



Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Experiments on the water entry and/or exit of a cone

Authors: Tassin A., Breton T., Jacques N.

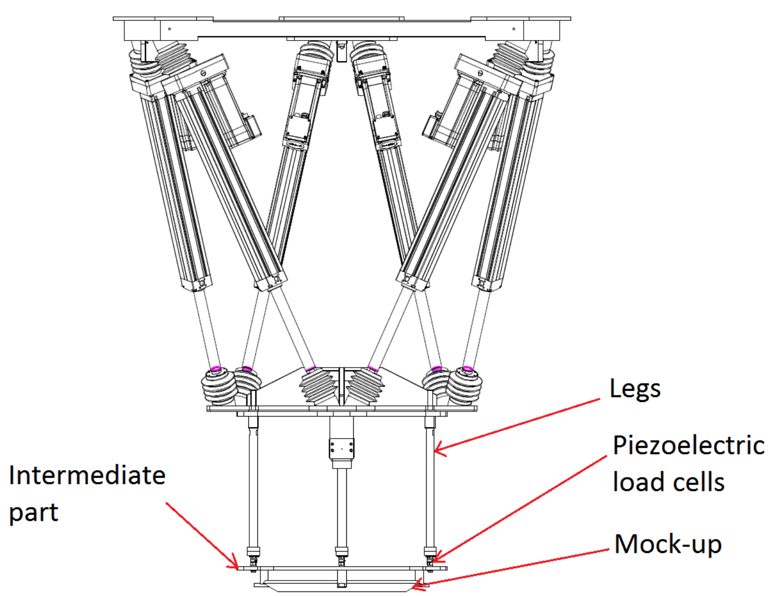
Discusser: Alessandro Iafrati

Question(s) / Comment(s):

Can you comment about the way you are measuring the loads?

Reply:

The hydrodynamic force is measured by 3 piezoelectric load cells which are located between the "legs" and an intermediate massive part (see Figure below). Due to the mass of this intermediate part, it was difficult to extract the force component due to the hydrodynamic force. We changed the location of these sensors (under this part) for the up-coming new experiments in order to improve the hydrodynamic force measurement.



Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Wave transmission through vertical thin barriers with gaps in channels by a hyper singular BEM

Authors: Teng B., Huang J., Zhao Y.F., Gou Y.

Discusser: David Evans

Question(s) / Comment(s):

This was a very interesting extension of our paper (Evans and Porter, IWWWFB 2015) to a wide variety of parameters. I wonder if the ET effect occurs if one of the barriers is pointing down and a second barrier pointing upwards each with small gaps?

Reply:

This is a very good suggestion. We will do this calculation and try to find some regulations.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Experimental study of the fast exit of a plane lifting from a water surface

Authors: P. Vega-Martnez,J. Rodriguez-Rodriguez, T. Khabakhpasheva, A.Korobkin.

Discusser: John Grue

Question(s) / Comment(s):

Can some of these highly temporal, local, strong accelerations, be estimated by integral quantities such as the pressure impulse?

Reply:

The accelerations of the rigid and elastic modes of the circular elastic disc are related to the external force by linear equations obtained by using ideas similar to the pressure-impulse approach. These equations include such integral quantities as added masses of both rigid and elastic modes.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Experimental study of the fast exit of a plane lifting from a water surface

Authors: P. Vega-Martnez,J. Rodriguez-Rodriguez, T. Khabakhpasheva, A.Korobkin.

Discusser: Alan Tassin

Question(s) / Comment(s):

The experimental results in terms of the radius of the wetted surface stop just after the radius is 10% lower than the initial radius (radius of the circular plate), are the results for longer time?

Reply:

We have experimental results for the radius of the contact line 20% smaller than the initialradius of the contact area. The radius of the contact region and the displacement of the plate were recorded by high-speed cameras. Here we presented synchronized results for short time only, because unfortunately we have no results for force and acceleration after 6 ms. We recorded data during the experiments from different devices: accelerometer, load cell and high-speed cameras. The high-speed camera collected data for longer times than the oscilloscope, which acquiredthe acceleration and force. Therefore, weworked mainly with the results during the time that we have all the information: accelerations, force and contact radius.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Reconstruction of an extreme wave profile with analytical methods

Authors: Thomas Vyzikas, Marc Prevosto, Christophe Maisondieu, Alan Tassin and Deborah Greaves

Discusser: Paul H. Taylor

Question(s) / Comment(s):

A very interesting paper, but one which focusses on ID wave groups on quite deep water- which is most affected by 3rd order wave-wave effects (such as BF instabilities). Here, the use of iterations is required to obtain clear focusing. In contrast, on shallower water and in directionally spread seas, the local 3rd order wave-wave interactions are much weaker or disappear completely. So, purely linear focusing + local bound harmonics ought to work better and for more nonlinear waves (but the bound harmonics will be larger in shallow water). In order to go beyond 2nd order theory for the bound harmonics for finite depth and directionally spread wave groups, new theory is required.

Reply:

Thank you for the interesting remarks. Indeed, an iterative methodology was used to correct the dispersive properties of the wave components of the group, namely the amplitudes and phases, that have been altered due to 3rd order nonlinear wave-wave interactions. According to the theory, 3rd order interactions refer to Benjamin-Feir (BF) instabilities or to four-wave resonant or near-resonant interactions for long-term evolution. For directional seas, resonant interactions occur among 3 waves to produce a new 4th free wave. However, since exact resonance among four waves cannot occur when the waves have the same direction, for the present conditions, we refer to these interactions as near-resonant. BF instabilities appear for narrow-banded long-crested spectra in deep water and for relatively short time scales of wave evolution. Four-wave interactions, on the other hand, can appear in any water depth and spectral distribution. The present conditions refer to a broad-banded spectrum with components propagating in practically any water depth regime (shallow, intermediate, deep). The propagation is unidirectional and the time scales are short. The spectral analysis does not show any indications of the BF instability effects, such as energy transfer to side bands. Thus, considering also the physical conditions, the best candidate to explain the free-wave spectral evolution is near-resonant four-wave interactions. For shallower water, indeed, the bound interactions are expected to be larger. However, 3rd order interactions do not disappear and the need for a correction methodology is evident. In the past, we examined a wave group with a similar spectral peak, propagating in water depth of 0.5m instead of 1m, in the present study [1]. The results demonstrate that the physical mechanism is similar between the two cases. Thus, purely linear focusing and bound waves are not adequate to capture a steep focused wave profile in shallow water. In fact, Katsardi and Swan (2011) [2], showed that in intermediate-shallow water the focusing mechanism ceases, when a correction methodology is not employed. Nevertheless, the authors personal opinion is that in [2] the wave group starts from a very dispersed condition and resembles more a regular wave group with different dynamics of its propagation. For directional waves, it was shown by Johannessen and Swan [3] that 2nd order theory is adequate to describe the bound wave structure of even steep waves. Thus, for directional waves, if the local free-wave spectrum is known, 2nd order theory should give a realistic solution of extreme wave profiles. For unidirectional waves, as our results demonstrate, up to 5th order harmonics can be identified for nearly breaking groups and certainly, another theory beyond 2nd order is required. The best option for the moment is the Creamer transform, which finite water depth version we plan to explore in the near future. Thomas Vyzikas, 13 Apr. 18

[1] Vyzikas, T., Stagonas, D., Buldakov, E., Greaves, D., 2014. On the simulation of focused waves with OpenFOAM& waves2Foam. In: Coastlab14: 5th Int Conf on the Application of Physical Modelling to Port and Coastal Protection. Varna, Bulgaria, vol. 2, pp. 237-282.

[2] Katsardi, V., Swan, C., 2011. The evolution of large non-breaking waves in intermediate and shallow water. I. Numerical calculations of uni-directional seas. Proc. R. Soc. Lond. A 467 (2127), 778-805.

[3]Johannessen, T.B., Swan, C., 2003. On the nonlinear dynamics of wave groups produced by the focusing of surface-water waves. Proc. R. Soc. Lond. A 459 (2032), 1021-1052.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Reconstruction of an extreme wave profile with analytical methods

Authors: Thomas Vyzikas, Marc Prevosto, Christophe Maisondieu, Alan Tassin and Deborah Greaves

Discusser: Michel Benoit

Question(s) / Comment(s):

I understand you are using (3) nonlinear wave models to propagate the wave trains. These models include the formation of bound wave in the course of propagation. So why do you need to add bound waves afterwards at the focusing location?

Reply:

The scope of the work is to examine a nonlinear wave profile (produced by bound harmonics) if the evolved (due to near-resonant interactions) is known. Thus, we examine the validity of the analytical methods to predict very steep waves.

At present, there is no analytical way to estimate the evolved free-wave spectrum. Therefore, we use the extracted free-wave spectrum from the nonlinear models. Then, the bound waves are added and the analytically produced surface profile is compared with the models prediction.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: A harmonic polynomial method based on Cartesian grids with local refinement for complex wave-body interactions

Authors: Jingbo Wang and Odd M. Faltinsen

Discusser: Yuxiang MA

Question(s) / Comment(s):

How to resolve the energy dissipation in the potential solver?

Reply:

Thank you for your question. After the breaking wave re-enters the water surface, viscous effects matter. It results in the energy dissipation. At the present stage, this phenomenon is not included in the numerical model.

Discussion Sheet

IWWWFB
International Workshop on Water Waves and Floating Bodies

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: A harmonic polynomial method based on Cartesian grids with local refinement for complex wave-body interactions

Authors: Jingbo Wang and Odd M. Faltinsen

Discusser: Harry Bingham

Question(s) / Comment(s):

What iterative schemes are you using to solve the linear system of equations and how many iterations are typically required to reach a residual of for example 10^{-7}?

Reply:

Thank you for your question. For small scale problems (for example, unknowns $< 2\ 10^5$), we use GMRES with incomplete LU pre-condition. For large scale problems in 3D, an accelerated Jacobi method has been developed, which is suitable for parallel computing on GPU. Based on my experience, the required iteration number is a few hundreds for the fully nonlinear problems. It is about 20-50 for linearized problems. It is because the solution from last time step is a well-guessed solution for the present time step.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: A combined CFD/Potential flow simulation method for prediction of hydrodynamic maneuvering forces

Authors: White P.F., Beck R.F., Maki K.J., Piro D.J.

Discusser: Y. Kim

Question(s) / Comment(s):

1) In your numerical test for sway, yaw, how did you treat the vortex shedding effect in the potential flow solver?

2) In actual ship turning, there is heeling of the ship. Do you plan to solve the double body at every time of the ship turning/maneuvering (heel is a function of time)?

Reply:

1) At this stage of development, the unsteady radiated ship waves are assumed to be decoupled from any viscous effect. The simulation environment is being designed, however, with consideration of the velocity decomposition work previously presented at IWWWFB.

2) We recognize that heel can be important for many maneuvers. At this stage heel is not included in our calculations. We do have plans to first include heel in the double-body CFD computation to account for heel effects on the viscous force.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: A combined CFD/Potential flow simulation method for prediction of hydrodynamic maneuvering forces

Authors: White P.F., Beck R.F., Maki K.J., Piro D.J.

Discusser: Masashi Kashiwagi

Question(s) / Comment(s):

For the study on the maneuvering motion in waves, one of the most important points is how we can estimate accurately the wave-induced steady forces in the x- and y-axes and the steady yaw moment about the z-axis. In your study, how are you going to compute those wave-induced steady forces?

Reply:

We intend to calculate the mean second order wave drift forces and moment from the first-order potential using methods in Aegir (for details see Joncquez *et al*, J. Ship Res. 2012).

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Unsteady waves generated by two ships with different speeds

Authors: Yuan Z.-M., Yeung R.W.

Discusser: Simen Ellingsen

Question(s) / Comment(s):

For meeting ships, the ships must be close enough together to be within each others' Kelvin wedge simultaneously for there to be mutual interactions between the ships, otherwise the problem is equivalent to a single ship running into some waves (that happen to come from another ship). How close must the ships then be for you to see the onset of these multiple scattering effects?

Reply:

The interaction is very obvious when the distance is small. As the distance between two ships increases, the interaction becomes small. However, it exists. For large distance, the ship experiences smaller interactive forces, but in a larger time scale. Theoretically these interaction effects always exist in encountering process, no matter how far away between each other. But this is not the case for overlaking case.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: The role of overtopping duration in greenwater loading

Authors: Xiantao Zhang, Hugh Wolgamot, Scott Draper, Wenhua Zhao and Liang Cheng

Discusser: Harry Bingham

Question(s) / Comment(s):

You have been able to nicely classify the momentum flux due to the overtopping event. Do you expect there to be any other aspects which would be important, for example, the vertical slamming load?

Reply:

For greenwater problem, the initial plunging events exist for the plunging plus dam break (PDB) and hammer fist (HF) event. However, both the time and space scale related to this initial plunging phase is small and thus the impact on the deck is not significant. Once the on-deck water flow become shallow, the pressure on the deck is hydrostatic and its force on the deck is insignificant for a small water depth. Thus the impact force on the superstructure on the deck will be the dominant one, which is considered in the present study. However, it should be mentioned that once the motion of the box is considered, slamming at the bow region may sometimes occur. In this condition, slamming force should be evaluated.

Discussion Sheet

The 33rd International Workshop on Water Waves and Floating Bodies

April 4-7, 2018, Hosted by ENSTA Bretagne, Brest

Paper: Steady solution of internal solitary wave and linear shear current interaction

Authors: B.B. Zhao, Z. Wang, W.Y. Duan, R.C. Ertekin, W.Q. Yang

Discusser: D.Z. Ning

Question(s) / Comment(s):

You compare your results with those by Choi. What method is used by Choi? Is uniform current or linear shear current considered in Chois work?

Reply:

Based on the Eulers equations, Choi used an asymptotic method to derive the nonlinear evolution equations. Then, the Boussinesq assumption is used to obtain the steady solution. The linear shear current is considered in Choi's work.