

Appel A Projets I : formulaire de candidature

(date limite le 30/04/2020 – le dossier doit être envoyé à romain.teychene@univ-amu.fr)

Nom du correspondant : ABID Malek (abid@irphe.univ-mrs.fr)

Nom du projet : **MODelliNg and forecaSting of exTreme wave Events in the coastal aRea (MONSTER)**

Résumé du projet (5 lignes en anglais) :

The study of extreme waves is a challenging problem for safety considerations and as an open problem in nonlinear physics. In fact, due to global warming there is an increase of occurrence of exceptionally extreme sea waves and extreme wave impacts with destructive effects. In coastal area, extreme sea waves present a real danger for population and affect human activities (industry, tourism, shipping, fishing, etc.) causing fatalities and injuries and important damages on ships. From a physical point of view there is no consensus on the generation mechanisms of known rogue wave events. Furthermore, until now, there is no study within the framework of fully nonlinear governing equations that has considered the dynamics of ocean extreme waves in the presence of vertically sheared currents in water of arbitrary depth. The aim of the present work is to address this problem in the framework of mathematical modelisation, numerical simulations and experimental studies.

Volet(s) complémentaires demandé(s) : Collaboration internationale Pédagogie

Montant de la subvention demandée : 24363 Euros (+3550 Euros, volet complémentaire, CV joint à la fin du document) ; **les partenaires taiwanais ont leurs propres financements.**

Abbreviations:

THL: Tainan Hydraulics Laboratory (Tainan, Taiwan)

DM (NTU): Department of Mathematics (Taipei, National Taiwan University)

NSYSU: National Sun Yat-sen University (Kaohsiung, Taiwan)

DMEE: Department of Marine and Environmental Engineering (NSYSU, Kaohsiung, Taiwan)

Contenu scientifique (3 pages maxi)

Contexte scientifique

Présenter ici comment le sujet proposé s'inscrit dans le domaine scientifique pertinent.

Présenter l'état de l'art. Présenter la manière dont le sujet s'inscrit dans l'activité de l'équipe.

The study of extreme waves (called freak waves or rogue waves, "vagues scélébrates") is a challenging problem for safety considerations and as an open problem in nonlinear physics.

Due to global warming there is an increase of occurrence of exceptionally extreme sea waves and extreme wave impacts with destructive effects. In coastal area, extreme sea waves present a real danger for population and affect human activities (industry, tourism, shipping, fishing, etc.) causing fatalities and injuries and important damages on ships.

Rogue waves are giant waves whose height, H_r , is larger than twice the significant height (this is an empirical definition currently used in oceanography), H_s , which is the average wave height among one third of the highest waves in a time series (generally 20mn). The abnormality index, $AI=H_r/H_s$, is the parameter defining whether the wave is rogue or not. These huge waves which are generally due to severe weather conditions (storms, typhoons and cyclones) are often observed in the coastal zone of the overseas countries of France and, to a lesser extent, the metropolitan coasts of France are under

the threat of these extreme waves, too. Rogue waves are produced by a number of physical mechanisms that are described in the book of Kharif et al (2009). So far, **there is no consensus on the generation mechanisms of known rogue wave events**. Consequently, the prediction of rogue waves is a challenging problem. Until now, the most used indicator of rogue waves is the Benjamin-Feir Index (BFI) introduced by Janssen (2003). This parameter which controls the importance of four-wave interactions is the ratio of the wave steepness to the spectral bandwidth and is a convenient indicator for prediction of rogue waves due to the modulational instability. Probability of rogue wave occurrence increases with the BFI. Note that the Benjamin-Feir instability weakens with depth and vanishes in shallow water for 1D propagation (see also Tkachenko et al. 2020 for the proof in the case of large amplitude long dispersive waves). Hence the relevance of the BFI in coastal zone and shallow water becomes questionable and **the search of an alternative indicator of rogue waves in coastal area is required. In our project, we will mainly concentrate on the role of vorticity in the rogue wave formation and breaking.**

Programme

Présenter le programme de travail projeté.

T1: Weakly nonlinear models in shallow water and finite depth in the presence of a vertical shear current (C. Kharif, M. Abid)

First we will consider weakly nonlinear models in the presence of constant vorticity in shallow water and finite depth. For shallow water the concerned models are the Korteweg-de Vries (KdV) equation and Whitham equation whereas for finite depth the nonlinear Schrödinger (NLS) equation will be used. The effect of vorticity on the mechanism of rogue wave formation due to the spatial-temporal focusing (or dispersive focusing) will be studied within the framework the vor-KdV and vor-Whitham equations derived by Kharif & Abid (2018). Attention will be paid to the effect of the vorticity on the lifetime and amplification of rogue waves. In addition, a statistical approach of the problem will be developed by considering the generation of rogue wave from random wave fields. In the case of constant finite depth, the nonlinear Schrödinger equation (NLS) in the presence of constant vorticity, vor-NLS equation derived by Thomas et al (2012) will be used. Numerical simulations using random wave as initial conditions, obtained from the JONSWAP power spectrum (or TAM spectrum for finite depth) will be performed. From these simulations the cumulative probability density functions of the wave heights will be derived. The outputs of this task will be used in task T2 as particular initial conditions.

T2: Fully nonlinear models, breaking Rogue Waves (S. Gavriluk, C. Kharif, M. Abid)

The IUSTI team has recently derived a 2D-propagation model for shear shallow water flows. The system is hyperbolic, with two contact characteristics, two characteristics responsible for surface waves, and two characteristics for shear waves. The main difficulty in numerical solving of such a system is that it is not in conservative form. However, a finite volume method based on the solution of the Riemann problem has been recently developed by the IUSTI team for such a non-conservative formulation. The 2D-propagation numerical model was tested on exact solutions as well as for flows down an inclined plane and its final version is now available (Gavriluk et al, 2018).

We are planning, in particular, to use this system for the study of multi-dimensional hydraulic jumps. The second step would be the extension of this multi-dimensional system to account for dispersive effects. A 1D-propagation model was already derived by Gavriluk et al. (2016). A two-layer long-wave approximation of the homogeneous Euler equations for a free-surface flow evolving over mild slopes is derived. The turbulent upper layer is described by depth-averaged equations for the layer thickness, average fluid velocity and fluid turbulent energy. The lower layer is almost potential and can be described by Serre-Su-Gardner-Green-Naghdi equations. A simple model for vertical turbulent mixing is proposed governing the interaction between these layers. The non-stationary model was then numerically solved and compared with experimental data for the following two problems. The first one is the experimental study of Favre (1935) who considered the problem of undular bores. For a Froude number between 1 and approximately 1.3, the formation of an undular bore is observed, numerically. For a Froude number between 1.3 and 1.4, the transition from an undular bore to a breaking (monotone) bore occurs. The shoaling and breaking of a solitary wave propagating in a long channel (300 m) of mild slope (1/60) was then studied numerically. A good agreement with experimental data of Hsiao et al.

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(2008) for the wave profile evolution was found. We are planning to use such a 2D extension to the study of the wave shoaling and breaking over 2D topography.

Within the framework of 2D propagation, a 2D model will be derived and numerically solved for the problem of a periodic wave train shoaling and breaking on a sloping beach. The initial conditions will be given by the outputs of Task T1. A new high order numerical method developed by DM (NTU) will be applied to dispersive shallow water flows. The model aims to provide an estimation for the maximum amplitude of the rogue waves and the mechanism of their breaking.

T3: Experiments on breaking undular bores (H. Hsu, Y. Y. Chen, S. Gavriluk, C. Kharif, M. Abid)

This task is devoted to experiments on undular bores. It will be conducted by Taiwanese colleagues who have their own funds. The initial conditions for experiments will be given by the outputs of Task T1. The transition from undular bores to monotonic bores will be predicted, using models developed in task T2, and compared to the experiments conducted at the THL, DMEE. In particular, the theoretical prediction of upstream conditions to have the "white cap" occurrence exactly at the first, or at the second wave crest will be compared with the experiments conducted in THL, DMEE. The possibility of generating linear shear currents using current conditioner, as described in Steer et al. (2020), will be explored.

T4: Experiments on non breaking water waves in the coastal zone (H. Branger, C. Kharif, M. Abid, S. Gavriluk)

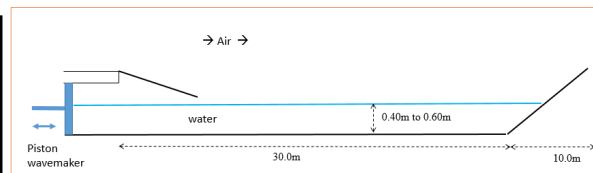
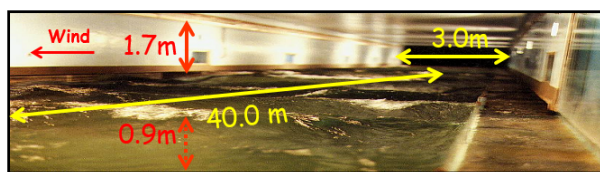
Neither field observation nor numerical modelling can offer the same versatility as that provided by physical experimentation. The objectives are: (i) To provide the structure of the underlying current generated by the wind (ii) To validate numerical/conceptual developments resulting from previous tasks (iii) To explore the indicator of rogue waves in the coastal area. The Pytheas-IRPHE-MIO Large air-sea interaction Facility, located in Marseille-Luminy will be used. Jonswap spectrum and TAM spectrum will be used to generate extreme waves (<https://www.youtube.com/watch?v=6f-y0THQWPs>, <https://www.youtube.com/watch?v=ZvFSEESUIRg>).

The wave field evolution will be measured with a set of wave gauges. Wind speed and turbulence will be measured with different anemometers (sonic, hotwire and hot-film). The water current profile will be estimated using hot-film anemometers and acoustic Vectrino current meters. The wind wave facility will be slightly modified to simulate near shore coastal area with intermediate water depth and shallow waters configuration (cf. picture below). This new set up would be dedicated to the study of the influence of water depth on rogue wave occurrence and dynamics. Depending upon input wind and wave conditions, some extreme waves may break during their propagation.

Scheduled experiments in the facility could be as follow:

- 1) Waves generated only by wind (3 different wind speeds): measure of the shear surface current generated by the wind and the water elevation at different fetches, for different water depth configurations.
- 2) Extreme waves generated in the facility by spatio-temporal focalization of waves a) without wind ; b) with wind, for different water depth configurations. The goal is to evaluate the influence of the intermediate and shallow depths on the development of rogue waves in a coastal environment. The initial wave field will be "quite" realistic, with a Jonswap spectrum shape.

The task T4 will benefit from the results of Task 3 on the exploration of the possibility of generating linear shear currents using current conditioner, as described in Steer et al. (2020).



Pytheas-IRPHE-MIO Large air-sea interaction Facility: actual dimensions (left). Proposed modifications to generate extreme waves and to measure velocity profiles under the free surface using hot film anemometry and sonic current meter.

Retombées attendues

Présenter les résultats attendus. Présenter les suites possibles du projet en termes de collaboration académique, de collaboration industrielle, de dépôts de projets (ANR, Europe, ...)

The main scientific target of the present project is twofold: (i) to get a better understanding of the dynamics of extreme sea waves in finite depth and shallow water in the presence of vertically sheared currents on uniform depths and uneven sea bottom in 1D and 2D propagation (ii) to provide a robust rogue wave indicator specific to shallow water which will be implemented in operational system for detection of rogue waves at Météo-France and the Central Weather Bureau (Taiwan). Theoretical, numerical and experimental means will be used to these ends.

This proposal involves four interconnected tasks. In task T1, non-breaking rogue waves are investigated theoretically and numerically in the presence or absence of vorticity. The validity of the models in the presence of vorticity will be checked against the results of the experiments conducted at The Pytheas-IRPHE-MIO Large air-sea interaction Facility provided by task T4. The objective of task T2 is to develop and implement a 2D propagation two-layer numerical model for long surface gravity waves on shear flow over topography which is capable to take into account dispersion and wave breaking. Numerical results of the mathematical model will be compared with those of experiments conducted at THL, DMEE described in task T3. The initial conditions will be given by the outputs of Task T1. The task T4 is devoted to non-breaking rogue waves in the coastal zone. These experiments will be conducted to check and improve the results of the models used and developed in tasks T1 and T2. The task T4 will benefit from the results of Task 3 on the exploration of the possibility of generating linear shear currents using current conditioner, as described in Steer et al. (2020).

The outcomes of the project will be published in international refereed journals and presented in international conferences, workshops and summer schools.

Références

- Chesnokov A., El G., Gavriluyk S., Pavlov M.** 2017, Stability of shear shallow water flows with free surface, *SIAM J. Appl. Math.*, **77**(3), 1068–1087.
- Favre H.**, 1935, Etude théorique et expérimentale des ondes de translation dans des canaux découverts, *Dunod*, Paris.
- Gavriluyk S., Liapidevskii V., Chesnokov A.**, 2016 Spilling breakers in shallow water : applications to Favre waves and to the shoaling and the breaking of the solitary wave, *J. Fluid Mech.*, **808**, 441-468.
- Gavriluyk S., Liapidevskii V. & Chesnokov A.**, 2018 Interaction of a subsurface bubble layer with long internal waves. *Eur. J. Mech./B Fluids*, **73**, 157-169.
- Gavriluyk S., Ivanova K., Favrie, N.** 2018, Multi-dimensional shear shallow water flows: problems and solutions, *J. Comput. Physics*, v. **366**, p.252-280.
- Gavriluyk S., Nkonga B., Shyue, K.-M., Truskinovsky L.** 2020 Stationary shock-like transition fronts in dispersive systems, *Nonlinearity* (under revision).
- Janssen P.A.E.M.**, 2003, Nonlinear four-wave interactions and freak waves. *J. Phys. Oceanogr.*, **33**, 863-884.
- Kharif C. & Abid M.**, 2018 Nonlinear water waves in shallow water in the presence of constant vorticity: A Whitham approach. *European Journal of Mechanics / B Fluids*, **72**, 12–22
- Kharif C., Pelinovsky E. N. & Slunyaev A.**, 2009, *Rogue Waves in the ocean* (216p. **89** illus.). Springer (ISBN: 978- 3-540-88418-7).
- Steer J. N., Borthwick A. G. L., Stagonas D., Buldakiov E. & van den Bremer T. S.**, 2020, Experimental study of dispersion and modulational instability of surface gravity waves on constant vorticity currents, *J. Fluid Mech*, **884**, A40(1-28).

Thomas R, Kharif C & Manna M., 2012, A nonlinear Schrödinger equation for water waves on finite depth with constant vorticity. Phys. Fluids, 24, 127102.

Tkachenko, S., Gavriluk, S. Shyue K.-M., 2020 Hyperbolicity of the modulation equations for the Serre-Green-Naghdi model, Water Waves, <https://doi.org/10.1007/s42286-020-00035-9>

Equipe scientifique

Préciser les personnes impliquées dans le projet. Indiquer aussi les éventuels intervenants extérieurs à l'institut. Pour chaque personne :

Nom : ABID Malek Laboratoire : IRPHE

Statut : (C/EC ou IR/IE/... ou Postdoc ou Doctorant ou stagiaire ou ...) EC

Complémentarité de l'équipe : *Décrire brièvement le rôle de chaque personne dans le projet de recherche* Tasks : **T1**, T3, T4, (i) modelisation and numerical simulations of gravity waves on linear shear currents. (ii) Contribution to the computation of initial conditions for tasks T2, T3. (iii) Generation of rogue wave from random wave fields.

Nom : KHARIF Christian Laboratoire : IRPHE

Statut : (C/EC ou IR/IE/... ou Postdoc ou Doctorant ou stagiaire ou ...) EC, émérite

Complémentarité de l'équipe : *Décrire brièvement le rôle de chaque personne dans le projet de recherche* Tasks : **T1**, T3, T4, (i) modelisation and numerical simulations of gravity waves on linear shear currents. (ii) Contribution to the computation of initial conditions for tasks T2, T3. (iii) Generation of rogue wave from random wave fields.

Nom : BRANGER Hubert Laboratoire : IRPHE

Statut : (C/EC ou IR/IE/... ou Postdoc ou Doctorant ou stagiaire ou ...) C,

Complémentarité de l'équipe : *Décrire brièvement le rôle de chaque personne dans le projet de recherche* Tasks : **T4**, T1, T2, T3 (i) provide the structure of the underlying current generated by the wind (ii) validate numerical/conceptual developments resulting from tasks T1, T2 (iii) explore the indicator of rogue waves in the coastal area.

Nom : GAVRILYUK Sergey Laboratoire : IUSTI

Statut : (C/EC ou IR/IE/... ou Postdoc ou Doctorant ou stagiaire ou ...) EC, Professor at AMU

Complémentarité de l'équipe : *Décrire brièvement le rôle de chaque personne dans le projet de recherche* Tasks : **T2**, T3, T4, Deriving multi-D models for breaking waves.

Nom : HSU Hungchu Laboratoire : DMEE, THL **(Having his own fund)**

Statut : (C/EC ou IR/IE/... ou Postdoc ou Doctorant ou stagiaire ou ...) EC,

Complémentarité de l'équipe : *Décrire brièvement le rôle de chaque personne dans le projet de recherche* Tasks : **T3**, T1, T2, T4 (i) Experiments on breaking undular bores (ii) Explores the possibility of generating linear shear currents using current conditioner, as described in Steer et al. (2020)

Nom : CHEN Yang-Yih Laboratoire : DMEE, THL **(Having his own fund)**

Statut : (C/EC ou IR/IE/... ou Postdoc ou Doctorant ou stagiaire ou ...) EC,

Complémentarité de l'équipe : *Décrire brièvement le rôle de chaque personne dans le projet de recherche* Tasks : **T3**, T1, T2, T4 (i) Experiments on breaking undular bores (ii) Explores the possibility of generating linear shear currents using current conditioner, as described in Steer et al. (2020)

Nom : SHYUE Keh-Ming Laboratoire : DM (Having his own fund)

Statut : Professor at the National Taiwan University

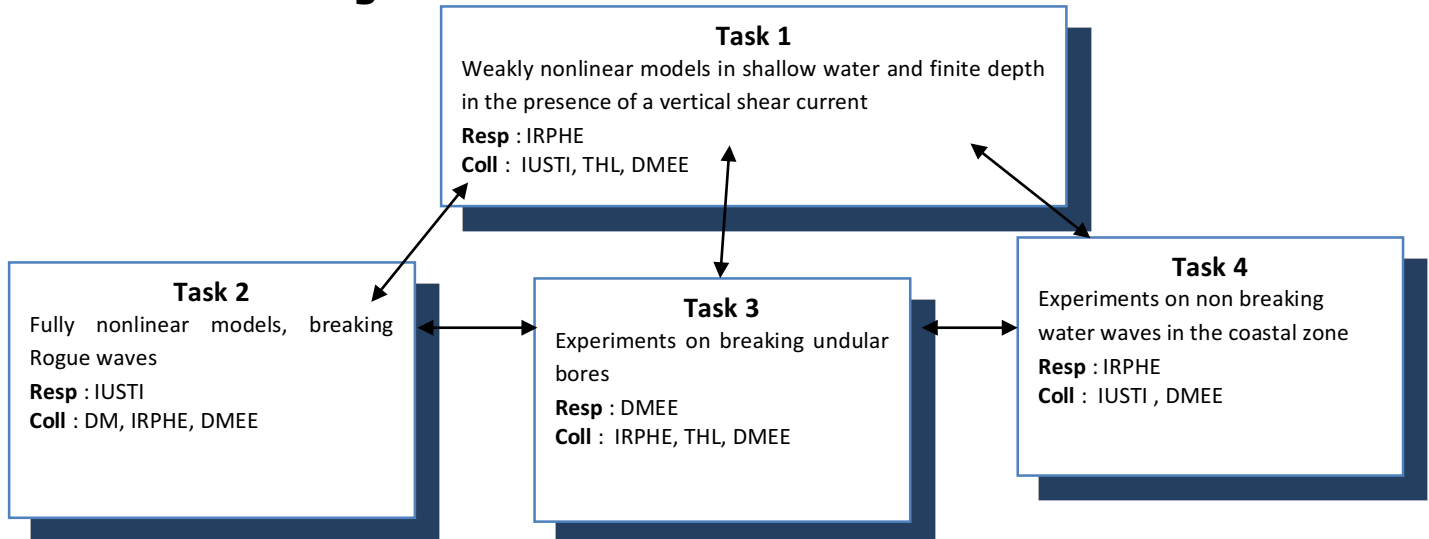
Complémentarité de l'équipe : Specialist in numerical methods for hyperbolic and dispersive systems of equations. The collaboration already exists, two common papers are already published (see the reference list). Tasks : **T2**, T4 (ii).

Nom : CHESNOKOV Alexander Laboratoire : Lavrentyev Institute of Hydrodynamics, Novosibirsk, Russia (**funding 3550 euros is asked, see Appendix `Volet complémentaire`, CV à la fin du document**)

Statut : Professor at the Novosibirsk state University

Complémentarité de l'équipe : Specialist in modelling and numerical methods for hyperbolic and dispersive systems of equations. The collaboration already exists, three common papers are already published (see the reference list). Tasks : **T2**, T4 (ii).

Task Organisation



Tasks	Quadrimester 1		Quadrimester 2		Quadrimester 3		Quadrimester 4	
	2	4	6	8	10	12	14	16
T1 Weakly nonlinear models in shallow water and finite depth in the presence of a vertical shear current	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
T2 Fully nonlinear models, breaking Rogue Waves	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
T3 Experiments on breaking undular bores			xxx		xxx		xxx	

T4				xxx	xxx	xxx	xxx	
Experiments on non breaking water waves in the coastal zone								

Demande financière

Préciser ici le détail des dépenses envisagées :

Montant de la subvention demandée : 24363 Euros (+3550 Euros, volet complémentaire)

Détail de la demande :

Fonctionnement :

Malek Abid : 5865 Euros

Dont missions : Une conférence et/ou un voyage à Taiwan (2500 Euros), pour 2021

Dont gratifications de stage :

Equipement : joindre des devis (ou préciser le prix catalogue) pour tout équipement d'un montant d'achat supérieur à 800 euros HT) Mac-Book Pro 2665 Euros HT, prix catalogue, à utiliser avant décembre 2020; Consommables : 700 Euros, pour 2021

Christian Kharif : 4999 Euros

Dont missions : Conférences, (2500 Euros), pour 2021

Dont gratifications de stage : 1000 Euros, pour 2021

Equipement : joindre des devis (ou préciser le prix catalogue) pour tout équipement d'un montant d'achat supérieur à 800 euros HT) Dell Inspiron 15 7000, 1499 Euro HT, prix catalogue à utiliser en 2021

Hubert Branger : 10000 Euros

Location/Utilisation de la soufflerie Pytheas : 8 semaines 8 000 euros

Equipements divers : montants et supports de sondes, cartes acquisition national instrument ou carte électroniques teensy, Bobines de fil imprimante 3D pour support spécifiques de sondes, câbles, etc.: 2000 euros

Equipement : joindre des devis (ou préciser le prix catalogue) pour tout équipement d'un montant d'achat supérieur à 800 euros HT)

Sergey Gavriluk : 3500 Euros

Dont missions : une conférence et une mission à Taiwan (2500 Euros), pour 2021

Dont gratifications de stage : 1000 Euros

Equipement : joindre des devis (ou préciser le prix catalogue) pour tout équipement d'un montant d'achat supérieur à 800 euros HT)

Autres sources de financement pour ce projet :

Détailler ici toute autre source de financement dans le cadre de ce projet. Préciser si le financement complémentaire est acquis, soumis, en attente de soumission. Le texte de description devra aussi préciser dans quelle mesure le projet est réalisable sans les financements complémentaires.

Planning des dépenses : Impossible de prédire des missions en 2020 dans l'état actuel.

Indiquer ici en particulier les dépenses qui seront effectuées avant décembre 2020.

Volet complémentaire collaboration internationale

Ce volet complémentaire vise à financer l'accueil d'un scientifique étranger avec un statut de professeur invité dans le cadre du projet proposé. Le montant de la subvention peut atteindre 6000 euros.

Il est ici précisé que des demandes de financement de séjour d'un chercheur étranger hors du cadre de cet appel à projet peuvent-être déposées « au fil de l'eau ». Pour cela nous vous invitons à prendre contact avec Romain Teychené (romain.teychene@univ-amu.fr)

Nom : CHESNOKOV Alexander

Etablissement d'origine : Lavrentyev Institute of Hydrodynamics

Contribution au projet : Spécialiste in modelling and numerical methods for hyperbolic and dispersive systems of equations. The collaboration already exists, three common papers are already published (see the reference list). Tasks : **T2**, T4 (ii) Numerical solving the problem of a periodic wave train shoaling and breaking on a sloping beach. He was invited in the past by Labex MEC. He already tested preliminary 1D models for breaking waves.

Expertise : Joindre un CV (voir la fin du document)

Liste de publications pertinentes :

1. Teshukov, V., Russo, G., Chesnokov, A. Analytical and numerical solutions of the shallow water equations, *Math. Models and Methods in Appl. Sci.* 2004, v.14, N. 10, 1451-1459.
2. Chesnokov A., Khe A., Is Landau damping possible in a shear flow? *Studies in Applied Mathematics*, 2013, v. 131, N4, 343-358.
3. Chesnokov, A., El, G., Gavriluyuk, S., Pavlov, M. Stability of shear shallow water flows with free surface, *SIAM J. Appl. Math.*, 2017, 77(3), 1068–1087.
4. Gavriluyuk S., Liapidevskii V., Chesnokov A., 2016 Spilling breakers in shallow water : applications to Favre waves and to the shoaling and the breaking of the solitary wave, *J. Fluid Mech.*, 808, 441-468.
5. Gavriluyuk S., Liapidevskii V. & Chesnokov A., 2018 Interaction of a subsurface bubble layer with long internal waves. *Eur. J. Mech./B Fluids*, 73, 157-169.

Activité prévue lors du séjour : a seminar will be given

Action de formation envisagée lors du séjour :

A two hours course on the stability of shear flows for Master and PhD students can be given

Détail des dépenses envisagées : approximately 3550 euros :

*les frais de repas 35 € / jours x30+ hébergement 1500 euros+ frais de voyage 1000 euros=***3 550 euros**.

Pour les modalités d'accueil (formalité/hébergement), ou pour des informations sur les frais liés à l'accueil, les demandeurs sont invités à se rapprocher de ROMAIN TEYCHENE (romain.teychene@univ-amu.fr) qui pourra apporter une aide administrative.

Volet complémentaire actions de formation

Le renforcement du lien formation recherche est un objectif prioritaire de l'IMI. Nous encourageons l'utilisation de résultats de recherche dans des actions de formation. Nous invitons donc les porteurs à proposer une action orientée vers les étudiants développée à partir de leur projet de recherche. Le montant éligible pour cet appel est 6000 euros.

Nom du porteur :

Nature de l'action envisagée :

Toute action de formation est éligible. Par exemple : montage d'un TP (indiquer alors comment il s'insère dans les formations) ; projet informatique ou expérimental ; expérience de démonstration ; séquence d'enseignement ...

Indiquer obligatoirement le nombre d'heures devant étudiant et le nombre d'étudiants bénéficiant de l'action. Indiquer aussi si cette action est susceptible d'être proposée plusieurs années.

Formation(s) concernée(s) et responsable(s) de formation(s) :

Il est fortement conseillé de prendre contact avec le responsable de formation pour échanger sur l'insertion de l'action dans la formation. Lors de l'évaluation du projet, l'avis du responsable de formation sera demandé par le CS de l'IMI.

Détail de la demande financière :

Sont éligibles des demandes d'équipement, de fonctionnement, et des HCC ou vacations (taux horaire brut 41.41€).

Justification des heures demandées :

Si la demande financière inclut des heures complémentaires, détailler ici leur utilisation. Le nombre d'heures est limité à 32 h par projets. Il convient également d'indiquer (de manière provisoire) le nom des personnes bénéficiant de ces HCC ou vacations.

CURRICULUM VITAE

Personal Data

Last name Chesnokov
First name Alexander
Born January 09, 1973
Place of birth: Irkutsk, Russia
Nationality Russia
Family status Married, son



Contact Information

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Career

2014 – Present	Head of Laboratory, Novosibirsk State University
2012 – Present	Professor, Novosibirsk State University
2012 – Present	Leading Researcher, Lavrentyev Institute of Hydrodynamics
2003 – 2012	Senior Researcher, Lavrentyev Institute of Hydrodynamics
2008 – 2012	Associate Professor, Novosibirsk State University
2000 – 2003	Researcher, Lavrentyev Institute of Hydrodynamics
2000 – 2008	Assistant, Novosibirsk State University

Academic Degree

- 2010 D.Sc. in Physics and Mathematics (Generalized characteristics, symmetries and exact solutions of the long-wave integro-differential equations, Lavrentyev Institute of Hydrodynamics, Novosibirsk, Russia)
- 1999 Ph.D. in Physics and Mathematics (Exact solutions and characteristics of the long-wave equations (PhD thesis supervisor – Prof. Vladimir M. Teshukov), Lavrentyev Institute of Hydrodynamics, Novosibirsk, Russia)

Education

- 1996 M.Sc. in Mechanics and Applied Mathematics, Novosibirsk State University, Novosibirsk, Russia
- 1994 B.Sc. in Mechanics and Applied Mathematics, Novosibirsk State University, Novosibirsk, Russia

Research Fields

- Fluid Mechanics, Applied Mathematics, Nonlinear Waves

Key words: nonlinear waves, shallow water equations, hyperbolic models, differential and integro-differential equations, group analysis, exact solutions, shear flows, hydrodynamic stability, Hele–Shaw flow, numerical methods.

List of Publications

Referred papers

1. Gavriilyuk S. L., Liapidevskii V. Yu., Chesnokov A. A. *Interaction of a subsurface bubble layer with long internal waves* // Europ. J. Mech. B/Fluids. (accepted) (**IF=1.969**)
2. Chesnokov A. A., El. G. A., Gavriilyuk S. L., Pavlov M. V. *Stability of shear shallow water flows with free surface* // SIAM J. Appl. Math. **2017**. V. 77. P. 1068–1087. (**IF=1.793**)
3. Chesnokov A. A., Liapidevskii V. Yu., Stepanova I. V. *Roll waves structure in two-layer Hele–Shaw flows* // Wave Motion. **2017**. V. 73. P. 1–10. (**IF=1.575**)
4. Chesnokov A. A., Liapidevskii V. Yu. *Viscosity-stratified flow in a Hele–Shaw cell* // Int. J. Nonlin. Mech. **2017**. V. 89. P. 168–176. (**IF=2.074**)
5. Gavriilyuk S. L., Liapidevskii V. Yu., Chesnokov A. A. *Spilling breakers in shallow water: applications to Favre waves and to the shoaling and breaking of solitary waves* // J. Fluid Mech. **2016**. V. 808. P. 441–468. (**IF=2.821**)
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11. Chesnokov A. A., Kovtunenkov P. V. *Weak discontinuities in solutions of long-wave equations for viscous flow* // Stud. Appl. Math. **2014**. V. 132, Iss. 1. P. 50–64. (**IF=2.015**)
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13. Chesnokov A. A., Pavlov M. V. *Reductions of kinetic equations to finite component systems* // Acta Appl Math. **2012**. V. 122, N 1. P. 367–380. (**IF=0.702**)
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15. Khe A. K., Chesnokov A. A. *Propagation of nonlinear perturbations in a quasineutral collisionless plasma* // J. Appl. Mech. Tech. Phys. **2011**. V. 52, N 5. P. 677–688. (**IF=0.396**)
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17. Chesnokov A. A. *Symmetries and exact solutions of the rotating shallow water equations* // Europ. J. Appl. Math. **2009**. V. 20, Iss. 5. P. 461–477. (**IF=0.761**)
18. Liapidevskii V. Yu., Chesnokov A. A. *Sub- and supercritical horizontal-shear flows in an open channel of variable cross-section* // Fluid Dynamics. **2009**. V. 44, N 6. P. 903–916. (**IF=0.509**)

19. Chesnokov A. A., Liapidevskii V. Yu. *Wave motion of an ideal fluid in a narrow open channel* // J. Appl. Mech. Tech. Phys. **2009**. V. 50, N 2. P. 220–228. (IF=0.396)
20. Chesnokov A. A. *Symmetries and exact solutions of the shallow water equations for a two-dimensional shear flow* // J. Appl. Mech. Tech. Phys. **2008**. V. 49, N 5. P. 737–748. (IF=0.396)
21. Chesnokov A. A. *Interaction of shear flows of an ideal incompressible fluid in a channel* // J. Appl. Mech. Tech. Phys. **2006**. V. 47, N 6. P. 800–811. (IF=0.396)
22. Russo G., Teshukov V., Chesnokov A. *Special class of solutions of the kinetic equation of a bubbly fluid* // J. Appl. Mech. Tech. Phys. **2005**. V. 46, N 2. P. 176–184. (IF=0.396)
23. Chesnokov A. A. *On the propagation of long-wave perturbations in a two-layer free-boundary rotational fluid* // J. Appl. Mech. Tech. Phys. **2004**. V. 45, N 2. P. 230–238. (IF=0.396)
24. Teshukov V., Russo G., Chesnokov A. *Analytical and numerical solutions of the shallow water equations for 2D rotational flows* // Math. Models and Methods Appl. Sci. **2004**. V. 14, N 10. P. 1451–1479. (IF=2.860)
25. Chesnokov A. A. *Characteristic properties and exact solutions of the kinetic equation of bubbly fluid* // J. Appl. Mech. Tech. Phys. **2003**. V. 44, N 3. P. 336–343. (IF=0.396)
26. Chesnokov A. A. *Vortex motions of liquid in an elongated elastic tube* // J. Appl. Mech. Tech. Phys. **2001**. V. 42, N 4. P. 628–637. (IF=0.396)
27. Chesnokov A. A. *Exact Solutions of the one-dimensional Russo – Smereka kinetic equation* // J. Appl. Mech. Tech. Phys. **2000**. V. 41, N 4. P. 593–603. (IF=0.396)
28. Chesnokov A.A. *Long Waves in a Two-Layer Vortex Fluid under a Lid* // J. Appl. Mech. Tech. Phys. **1999**. V. 40, N 3. P. 420–431. (IF=0.396)
29. Chesnokov A. A. *Vortex motions of liquid in a narrow channel* // J. Appl. Mech. Tech. Phys. **1998**. V. 39, N 4. P. 513–524. (IF=0.396)
30. Chesnokov A. A. *Exact solutions of the equations of vortex shallow water* // J. Appl. Mech. Tech. Phys. **1997**. V. 38, N 5. P. 692–703. (IF=0.396)

Books and chapters of books

- Chesnokov A. A., Liapidevskii V. Yu. *Shallow water equations for shear flows* // Notes on Numerical Fluid Mechanics and Multidisciplinary Design. Springer-Verlag Berlin Heidelberg, **2011**. V. 115. P. 165–179.
- Golovin S. V., Chesnokov A. A. *Group analysis of differential equations* // Novosibirsk State University. Novosibirsk, **2008**. 113 pp. (in Russian)

Guidance of students and graduate students (Novosibirsk State University)

Bachelor

- Borodina S. V. (2017), Ryzhkovich A. A. (2017), Golovach T. V. (2014), Medova Yu. A. (2013), Knyazeva E. Yu. (2011), Kovtunenکو P. V. (2011), Latyshev S. V. (2009), Ovcharenko A. A. (2008)

Master

- Knyazeva E. Yu. (2017), Golovach T. V. (2016), Medova Yu. A. (2015), Kovtunenکو P. V. (2013)

PhD

- Kovtunenکو P. V. (September 2017, Lavrentyev Institute of Hydrodynamics)

Teaching activity (Novosibirsk State University, Department of Mechanics and Mathematics)

- Fluid mechanics
- Mathematical analysis
- Group analysis of differential equations
- Wave models of hydrodynamics

Projects & Grants

- 2015–2017 “Nonlinear wave processes in complex hydrodynamics systems”, Russian Science Foundation
- 2014–2017 “Nonlinear processes in hydrodynamic systems”, Novosibirsk State University
- 2014 “Stability analysis of shear flows of a non-homogeneous fluid in a Hele–Shaw cell”, Russian Foundation of Basic Research
- 2008 “A model of a slightly compressible fluid flow in a finite reservoir, drained by a single horizontal well”, Schlumberger Technology Corporation
- 2006–2007 Project of SB RAS “Hydraulic jump in a homogeneous and stratified fluid: a theoretical analysis, numerical simulation and experiment”
- 2005–2006 Grant of the President of Russian Federation for young scientists “Propagation of nonlinear long-wave perturbations on shear flow”
- 2000–2001 INTAS Grant YSF 1-80 Newly Qualified Postdoctoral Fellowships; Co-executive of INTAS project “Conservation laws of mechanics of continua: waves and fronts” (Coordinator – Prof. Giovanni Russo)

International Conferences (2012–2017)

- International summer school “Dispersive hydrodynamics and oceanography: from experiments to theory”, Les Houches, France, August 27 – September 01, 2017
- International Conference Physics and Mathematics of Nonlinear Phenomena (PMNP2017: 50 years of IST), Gallipoli, Italy, June 17–24, 2017
- Russian–French workshop “Mathematical Hydrodynamics”, Novosibirsk, Russia, August 22–27, 2016
- International Conference Nonlinear Waves: Theory and Applications, Beijing, China, June 25–28, 2016
- International Conference Lavrentyev readings on mathematics, mechanics and physics, Novosibirsk, Russia, September 7–11, 2015
- International Conference Equadiff 2015, Lyon, France, July 6–10, 2015
- Workshop on dispersive shocks: tidal waves, rogue waves and superfluids, Marseille (CIRM, Luminy), France, January 7–11, 2013
- 15th International Conference Hyperbolic Problems: Theory, Numerics and Applications, Padova, Italy, June 25–29, 2012
- General Assembly 2012 of the European Geosciences Union, Vienna, Austria, April 22–27, 2012

Conference organization

- Russian–French workshop “*Mathematical Hydrodynamics*”, Novosibirsk, Russia, August 22–27, 2016
- International conference “*Nonlinear Waves: Theory and Applications*”, Novosibirsk, Russia, February 29 – March 2, 2016
- 53th International Scientific Student Conference “*Student and Scientific and Technological Progress*”, Novosibirsk, Russia, 12–17 April, 2015
- 52th International Scientific Student Conference “*Student and Scientific and Technological Progress*”, Novosibirsk, Russia, 11–18 April, 2014
- Russian–French workshop “*Mathematical Hydrodynamics*”, Lake Baikal, Irkutsk, Russia, September 8–13, 2011
- International conference “*Nonlinear Waves: Theory and Applications*”, Novosibirsk, Russia, March 2–4, 2011

Probations and visits

- Aix-Marseille University (France), collaboration with Prof. Sergey Gavriluk, 2017 (one month)
- Loughborough University (UK), collaboration with Dr. Gennady El, 2016 (two weeks)
- IMERA foundation of Aix-Marseille University (France), Team project with Dr. Gennady El and Dr. Maxim Pavlov, 2016 (one month)
- Aix-Marseille University (France), collaboration with Prof. Sergey Gavriluk, 2015 (one month)
- University of Catania (Italy), Mathematics and Computer Science Department, 2002 (two months); 2003 (one month). Supervisor – Prof. Giovanni Russo.

Awards

- 2017 Letter of thanks from the mayor of Novosibirsk.
- 2006 Letter of thanks from Siberian Division of Russian Academy of Sciences.
- 2004 Certificate of the first degree given by Novosibirsk Region Administration for scientific accomplishment in the nomination “Physics and Mathematics studies”.
- 1998 The winner of All-Russian competition of student’s scientific papers (Medal of the Ministry of General and Professional Education).