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Preface

To cite this article: 2021 *J. Phys.: Conf. Ser.* **1809** 011001

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Preface

These proceedings are the output of **VII Perm Hydrodynamical Forum (PHD-Forum 2020)**. The conference was held by Perm State University and Institute of Continuous Media Mechanics UB RAS in Perm, Russia **on October 22-24, 2020**.

The conference was dedicated to the memory of the leaders of the Perm Hydrodynamic Scientific School - the Leading Scientific School of the Russian Federation, Professors G.Z. Gershuni, E.M. Zhukhovitsky, and D.V. Lyubimov. It was devoted to the analysis of the advanced problems in Hydrodynamics and discussion of ways to solve them, the exchange of the scientific achievements and practical experience, the establishment of new and strengthening the existing scientific communications, the creation of the necessary conditions to stimulate and support young scientists, the dissemination and popularization of scientific knowledge and innovative technologies.

The work program of the Conference included the discussions on the current state and advanced problems of Mechanics and Physics of Continuous Media in the following directions:

- 1 - Large scale vortex structures in turbulent flows
- 2 - Heat and mass transfer in the atmosphere and ocean
- 3 - Generation of magnetic fields by the turbulent flow of electrically conductive fluid
- 4 - Dissipative structures on the interphase boundaries. Hydrodynamics of systems with interfaces
- 5 - Hydrodynamic stability and transition to chaos
- 6 - Unsteady flows in complex fluids and multiphase media
- 7 - Acoustic and wave processes in inhomogeneous media
- 8 - Applied aeroacoustics and aerospace engineering
- 9 - Eco-hydrodynamic modeling of water bodies and aquatic ecosystems

Within the framework of the Conference, the 5-rd International workshop "Mechanics and Ecological Problems" was held, which has already become traditional for the Conference. On this platform, a discussion of the problems of transport of pollutants in large water bodies and the solution of problems of sustainable water use took place, it included four invited lectures given by representatives of Switzerland, France, Italy, and Russia.

The conference brought together more than 100 researchers, doctoral students and professionals, who shared the results of their scientific research, innovative ideas, and practical experience. All papers were presented in oral form. For the best convenience of participants and due to COVID-19 Pandemic, the organizing committee introduced an opportunity for virtual participation for all participants.

We sincerely thank the invited speakers, E.V. Ermanyuk, Novosibirsk, Russia (Wave attractors: geophysical applications), A. Nepomnyaschy, Haifa, Israel (Parametric excitations and control of interfacial instabilities), E.N. Pelinovsky, Nizhny Novgorod, Russia (Korteweg-de Vries hierarchy in mechanics of continuum media; Analysis of coronavirus dynamics using logistic models), O.A. Kabov, Novosibirsk, Russia (High heat dissipation liquid, evaporative cooling of microelectronics), I.I. Ryzhkov, Krasnoyarsk, Russia (Controlling the transport of ions in nanoporous membranes using an electric field: theory and experiment), D. Fornasiero, Mawson Lakes, Australia (Kinetics of particle-bubble interaction in flotation), L.O. Filippov, Nancy, France (Investigation of the effect of process water salinity on the fine particle flotation), S.N. Lane, Lausanne, Switzerland (The role of particle interactions in determining how sediment moves through river junctions), C. Gualtieri, Naples, Italy (Mega-rivers under the global change: some field observations from Amazon, Orinoco and Yangtze), B. Roux, Marseille, France (Sedimentary dynamics of muddy sediments in a narrow and shallow channel confluenting a wide reservoir in a windy area), T.P. Lyubimova, Perm, Russia (Influence of hydrodynamic regimes on mixing of waters of confluent rivers), for the excellent lectures.



This Special Issue includes 37 papers presented at the Forum. Here we present a brief description of their directions. The large series of papers presented in this issue is devoted to experimental and theoretical studies of hydrodynamic aspects of the processes taking place in multicomponent, including chemically reacting, liquid media. In particular, the features of the development of double-diffusive instability in systems with a concentration-dependent diffusion of components [1], as well as under conditions of moving [2] or vibrating [3] liquid media are considered. The paper [4] demonstrates a method for measuring the concentration dependence of diffusion in a single-component solution based on the use of modern digital interferometry. The papers [5-7] are devoted to the experimental and theoretical study of the conditions for the development of hydrodynamic instability in chemically reacting liquid media on the example of frontal reactions. The features of the development of reaction-diffusion-convection processes are considered both for the case of a diffusion interface [6] characteristic of mixing reacting systems and in the presence of an interfacial surface [5,7].

The theoretical investigation of diffusive processes in a wide range of fluid mechanics problems was presented at the Forum and is discussed in a Special Issue, such as convection of two-component fluid, namely solutal convection into isothermal porous media with solute immobilization [8, 9] and thermo-solutal convection in pure liquid [10,11]. The authors of [8] are focused on solute front propagation in porous media with taking into account solute immobilization and buoyancy force. The paper [9] is devoted to the generalization of the classical Horton-Rogers-Lapwood problem to the case of solutal convection with immobilization and clogging of porous media. The main point of paper [10] is the reversing of convective moving direction due to changing of solute concentration profile. The paper [11] deals with the investigation of the gravity level effect on the onset and nonlinear convective regimes of binary fluid with the Soret effect in a rectangular cavity. The propagation of waves of admixture concentration into the liquid crystals is studied in the paper [12]. The investigation of diffusive and hydrodynamic mechanisms of solute immobilization into porous media by the random walk modeling is presented in [13].

The instability of hydrodynamic systems under external magnetic fields is studied [14-16]. The results of calculations of the stirring rate of the liquid metal in an electron vortex flow in a hemispherical volume are presented in [14]. It is shown that the effect of an external magnetic field can both accelerate and slow mixing. In [15] the stability of a horizontal magnetic fluid layer on a liquid substrate under the alternating magnetic field orthogonal to the surface is experimentally investigated. The combined effect of electric field and vibrations on the instability of infinitely deep dielectric fluid layer with the free surface was studied in [16] using the approximation of small viscosity. It was shown that depending on the vibration intensity there are three or two resonance zones existed instead of one first resonance zone. Another interesting effect of vibrations is demonstrated in [17] where experiments and numerical simulations of Faraday waves at the liquid-vapor interface of fluids near its critical point is reported. It is shown that the dispersion relation significantly deviates from the classical theoretical dependence. The vibration effect on crystal growth is discussed in [18]. It is worth noting the work [19] where an interesting numerical approach based on the selective frequency damping method is applied for simulation of instability in bent flow.

For the description of many effects, the nonlinear dynamics is very important. A convective system with surface phase shows the complex interplay between the thermal and concentration capillary forces, which leads to the non-uniform motion of surfactant film [20]. Convection of the humid air is determined by first-order phase transitions between the liquid water and vapor [21]. A nonlinear model of tissue metabolism permits the development of new effective diagnostics methods [22]. The continuum media approach and nonlinear methods are also well applicable for condensed matter systems and magnetism phenomena analysis [23].

Within the framework of the scientific direction "Oscillatory dynamics of heterogeneous hydrodynamic systems under the influence of complicating factors" presented at the conference

and in a Special Issue, two topics could be defined. The first topic concerns the influence of vibrations on hydrodynamic systems, including the systems with an interface, in slotted channels and porous media: in [24], the influence of oscillations on mass transfer in porous media and inhomogeneous in cross-section channels is considered experimentally; the vibrational dynamics of the interface of immiscible liquids in slotted channels of various geometries are considered in [25, 26]. The second topic deals with the oscillatory dynamics of fluids in rotating systems: the oscillatory and averaged flows of fluid in a non-uniformly rotating cylinder with inclined ends are considered in [27]; the influence of rotation on the averaged thermal convection excited by oscillations of liquid was experimentally investigated in-plane layer [28] and axisymmetric cylindrical gap [29]; the stability of the interface of liquids with a large viscosity contrast in a nonuniformly rotating cavity was considered in [30].

The papers [31-33] are devoted to the effect of ultrasonic radiation on liquids [31], as well as on rigid surfaces and gas bubbles drifting in liquids. In recent years the study of these phenomena became especially important due to the increasing use of ultrasonic treatment in the flotation processes. In [32], it is shown that one of the reasons for the selective attachment of bubbles on a rigid surface exposed to ultrasound is a change in the surface roughness with a change in the concentration of a surfactant on its surface, this effect was observed on a plate made of amorphous quartz. In [33], the peculiarities of the selective attachment of bubbles on surfaces with different wettabilities in solutions of NaCl and KCl salts during degassing are studied.

Three papers of this issue are devoted to turbulent heat and mass transfer. An example of a flow arising in a gravity field in a stratified turbulent medium and caused by inhomogeneity of turbulent transport coefficients is analytically considered in [34]. Specifically, the author examines a downward flow that occurs in a stratified medium near an inclined substrate. The paper [35] presents the results of numerical simulation of mixed turbulent convection in a rotating thin cylindrical cavity with axial blowing by a cooling air stream. The simulation was carried out by two different numerical methods with and without the buoyancy forces. A better agreement with experimental data was obtained using the zonal RANS/ILES approach. Numerical modeling of the processes of pollution of water bodies during the flow of soil water through soils with heterogeneous mineralization was carried out in [36] for a specific example of the removal of pollutants into the Vyatka River in the region of the Kirovo-Chepetsk industrial complex.

The paper [37] discusses the need to combine educational and scientific-research processes in teaching CFD modeling to students.

1. V. Vyatkin, D. Bratsun. Determination of the stability boundary of a two-layer system of miscible liquids with linear diffusion laws.
2. D. Bratsun, A. Mizev, E. Mosheva, L. Pismen, R. Siraev, A. Shmyrov. On mechanisms of mixing by forced and natural convection in microfluidic devices.
3. N. Kozlov. Numerical investigation of double-diffusive convection at vibrations.
4. A.I. Mizev, A.V. Shmyrov, E.A. Mosheva. Concentration-dependent diffusion of lithium, sodium, potassium, and cesium hydroxides in water.
5. M.O. Denisova, K.G. Kostarev. Diffusion of a reagent from a slowly rising droplet with accompanying surface chemical reaction.
6. V. Utochkin, R. Siraev, D. Bratsun. Centrifugal convection in a two-layer system of reacting miscible fluids.
7. A. Mizev, A. Shmyrova. Buoyancy-driven instabilities induced by a neutralization reaction in immiscible fluids.
8. V.A. Demin, B.S. Maryshev, A.I. Menshikov. On a Threshold of Desorption during the Pumping of a Nanofluid through Porous Medium.
9. B.S. Maryshev, L.S. Klimenko. Solutal convection in a horizontal porous layer with Clogging At A High Solute Concentration.

10. L. Kh. Ingel. On the effect of reversing the direction of convection in a two-component fluid.
11. K.S. Rushinskaya, T.P. Lyubimova, N.A. Zubova. The gravity level influence on the onset and nonlinear regimes of a binary mixture convection in a rectangular cavity heated from below.
12. D.P. Sokolchik, D.V. Makarov. Wave-like concentration profiles of a diamagnetic admixture in a cholesteric liquid crystal.
13. B.S. Maryshev, L.S. Klimenko. Diffusion Effect On Passive Solute Transport Inside An Infinite Two-Dimensional Array Of Vortices.
14. D. Vinogradov, I. Teplyakov, Yu. Ivochkin. Stirring of the liquid metal in an electrovortex flow in a hemispherical volume under the influence of an external magnetic field.
15. C.A. Khokhryakova, E.V. Kolesnichenko. Stability of a Ferrofluid layer on a liquid substrate.
16. E.S. Sadilov. The joint influence of electric field and vibrations on the instability of fluid dielectric layer with free boundary.
17. T. Lyubimova, A. Ivantsov, D. Beysens. On Dispersion relation for Faraday waves in a near-critical fluid under weightlessness.
18. N.G. Burago, A.I. Fedyushkin. Numerical solution of the Stefan problem.
19. A.V. Proskurin. Mathematical modelling of an unstable bent flow using the selective frequency damping method.
20. V.A. Demin, M.I. Petukhov. Nonlinear behavior of an insoluble surfactant partially covering liquid during the transition to equilibrium.
21. S.A. Somov, A.S. Ivanov, M.M. Goncharov, A.N. Kondrashov. Experimental study of thermal convection in dry air by holographic interferometry method.
22. A. Rogotnev, A. Nikitiuk, Yu. Bayandin, O. Naimark. Blow-up singular dynamics in breast cancer metabolism.
23. K. Tsiberkin. Traveling magnetization waves In diluted magnetic material.
24. D. Polezhaev, V. Kozlov. Experimental study of the effect of air oscillations on vapor diffusion in a channel of variable cross-section and in a granular medium.
25. I.E. Karpunin, N.V. Kozlov, V.G. Kozlov. Experimental Study of Liquid-Liquid Interface Oscillating in Radial Hele-Shaw Cell.
26. O. Vlasova, V. Kozlov. Oscillatory dynamics of two liquids interface in straight narrow gap.
27. S. Subbotin. Non-axisymmetric flow excited by fluid oscillations in a rotating cylinder with sloping ends.
28. K. Rysin, V. Kozlov, A. Vjatkin. Effect of rotation on thermal convection in horizontal plane layer subject to circular vibration.
29. A. Vjatkin, R. Sabirov. Effect of vibrations on thermal convection in thick rotating annulus.
30. V.G. Kozlov, J.S. Dementieva, V.S. Kobeleva, M.A. Petuhova. Stability of Interface Between liquids with high viscosity contrast in an unevenly rotating cavity.
31. M.O. Kuchinskiy, T.P. Lyubimova, K.A. Rybkin, O.O. Fattalov, L.S. Klimenko. Experimental and numerical study of acoustic pressure distribution in a sonochemical reactor.
32. O.O. Fattalov, T.P. Lyubimova, K.A. Rybkin, I.V. Lunegov, M.O. Kuchinskiy. Experimental study of cavitation erosion of quartz in the presence of surfactant molecules.
33. T.P. Lyubimova, K.A. Rybkin, O.O. Fattalov, M.O. Kuchinskiy, M.V. Kozlov, A.A. Kugaevskaya. On the mechanism of selective fixation of bubbles under the action of ultrasound in NaCl and KCl solutions during degassing.
34. L. Kh. Ingel. Regular flow emergence at inclined surface in a stratified turbulent medium.

35. A.G. Abramov, S.I. Smirnov, E.E. Kitanina, E.M. Smirnov. Numerical study of turbulent mixed convection in a rotating inter-disk cavity with axial throughflow of cooling air.
36. T.P. Lyubimova, Ya.N. Parshakova. Numerical modeling of the flow of polluted groundwater into the Vyatka river.
37. A.I. Fedyushkin, A.A. Puntus. On the need to combine educational and scientific-research processes in teaching CFD modeling to students.

Special Issue Editor, Chairman of the Scientific Committee of the Forum,

Prof. T.P. Lyubimova

Institute of Continuous Media Mechanics UB RAS,

Perm State University

Short Programm of VII Perm Hydrodynamical Forum (PHD-Forum 2020) <i>October 22-24, 2020</i>	
October 22, Thursday	
9.00-9.10	Opening of the Conference
9.10-9.45	Invited lecture 1 E.V. Ermanyuk (Novosibirsk, Russia) Wave attractors: geophysical applications
9.45-11.45	Session 1
11.45-12.20	Break
12.20-12.55	Invited lecture 2 A.Nepomnyaschy (Haifa, Israel) Parametric excitations and control of interfacial instabilities
12.55-13.30	Invited lecture 3 E.N. Pelinovsky (Nizhny Novgorod, Russia) Korteweg-de Vries hierarchy in mechanics of continuum media
13.30-15.35	Session 2
15.35-16.00	Break
16.00-18.45	Session 3
October 23, Friday	
9.00-9.35	Invited lecture 4 O.A. Kabov (Novosibirsk, Russia) High heat dissipation liquid, evaporative cooling of microelectronics
9.35-10.10	Invited lecture 5 I.I. Ryzhkov (Krasnoyarsk, Russia) Controlling the transport of ions in nanoporous membranes using an electric field: theory and experiment
10.10-12.15	Session 4
12.15-12.50	Break
12.50-13.15	Invited lecture 6 E.N. Pelinovsky (Nizhny Novgorod, Russia) Analysis of coronavirus dynamics using logistic models
13.15-15.15	Session 5
15.15-15.45	Break
15.45-17.45	Session 6
October 24, Saturday	
9.00-9.35	Invited lecture 7 D. Fornasiero (Mawson Lakes, Australia) Kinetics of particle-bubble interaction in flotation
9.35-12.05	Session 7
12.05-12.40	Break

12.40-13.15	Invited lecture 8 L.O. Filippov (Nancy, France) Investigation of the effect of process water salinity on the fine particle flotation
13.15-15.45	Session 8
13.30-16.30	5-rd International workshop "Mechanics and Ecological Problems"/ Invited lectures: Y. Ni, G. Moradi, S.N. Lane. Lausanne, Switzerland. The role of particle interactions in determining how sediment moves through river junctions. C. Gualtieri. Naples, Italy. Mega-rivers under the global change: some field observations from Amazon, Orinoco and Yangtze. B. Roux, E. Alekseenko. Marseille, France. Sedimentary dynamics of muddy sediments in a narrow and shallow channel confluencing a wide reservoir in a windy area. T.P. Lyubimova (Perm, Russia), A.P. Lepikhin, Ya.N. Parshakova, V. Kolchanov, C. Gualtieri, S. Lane, B. Roux. Influence of hydrodynamic regimes on mixing of waters of confluent rivers.
15.45-16.15	Break
16.15-18.40	Session 9

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