Matvey Morozov

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Education

Ph.D., Applied Mathematics, 2015
Technion – Israel Institute of Technology, Haifa, Israel
Thesis "Interfacial convection in surfactant solutions"

M.S., Applied Mathematics, 2011 (completed in the course of Ph.D. studies)
Technion – Israel Institute of Technology, Haifa, Israel

Specialist, Condensed Matter Physics, 2009
Perm State University, Perm, Russia

Research interests

Reduced-order models and asymptotic methods in fluid dynamics and soft matter; interfacial flows and Marangoni convection; hydrodynamic stability; acoustic streaming; wavelet analysis.

Professional experience

Postdoctoral Fellow, Sept 2017 – Present
LadHyX, École Polytechnique, Palaiseau, France

- Carried out asymptotic analysis of the symmetry breaking of the Marangoni flow stirred by a chemically active deformable drop in the presence of advection. The analysis revealed that the type of symmetry-breaking bifurcation depends on the droplet deformability (Morozov and Michelin, *J. Fluid Mech.* **860**, 711-738, 2019).
- Carried out numerical and asymptotic analyses of the dynamics of a chemically active drop driven by the competition between diffusiophoresis and the Marangoni effect in the presence of advection. The investigation reveals advection-driven transition to chaos (Morozov and Michelin, *J. Chem. Phys.* **150**, 044110, 2019).
- Developed a model of a chemically active nematic droplet sustained in the bulk of surfactant solution. The model features a novel mode of orientational instability leading to spontaneous rotation of the drop (manuscript in review).

Postdoctoral Fellow, Aug 2015 – Aug 2017
Department of Chemical Engineering, Technion – Israel Institute of Technology, Haifa, Israel

- Developed a theoretical model for the dragging of a thin liquid film with a propagating surface acoustic wave. The model is now employed in a new method of analysis of gas-liquid interfaces (Morozov and Manor, *J. Fluid Mech.* **810**, 307-322, 2017; Horesh *et al.*, *Phys. Rev. E* **95**, 052803, 2017).
- Developed a wavelet-based algorithm for reconstruction of thin liquid film profiles basing on the interference fringe patterns (Horesh *et al.*, *Phys. Rev. E* **95**, 052803, 2017).
- Carried out a review of the current research on vibration-driven dynamics of droplets and films (Morozov and Manor, *Curr. Op. Col. Int. Sci.* **36**, 37-45, 2018).

Early Stage Researcher, Nov 2009 – Oct 2012
Technion Research and Development Foundation, Haifa, Israel
(Part of Ph.D. studies funded by Marie Curie fellowship via MULTIFLOW ITN.)

- Analyzed numerically the nonlinear dynamics of a thin binary liquid film in the presence of the Soret effect and long-wavelength deformations of the film surface. The investigation revealed the onset of chaotic waves and also highlighted the limitations of the long-wave approach (Morozov *et al.*, *Phys. Fluids* **25**, 052107, 2013).

– Carried out asymptotic and numerical analysis of the long-wave Marangoni instability in a layer of surfactant solution. The study showed that surfactant solubility hinders the onset of the deformational mode of the Marangoni instability (Morozov *et al.*, *Phys. Fluids* **26**, 112101, 2014; Morozov *et al.* *Phys. Fluids* **27**, 082107, 2015).

Programmer, Jul 2008 – Dec 2008
Institute of Continuous Media Mechanics, Perm, Russia

– Developed an extension for the LabView software implementing the wavelet cross-correlation function aimed to measure phase shifts between noisy signals.

Algorithm Developer, Dec 2006 – June 2009
Control Systems, Perm, Russia

– Implemented (i) the gapped wavelet algorithm to suppress boundary effects in experimental data and (ii) the wavelet cross-correlation algorithm to estimate the correlation of skin temperature and cutaneous blood flow at various timescales (Podtaev *et al.*, *Cardiovasc. Eng.* **8**, 185, 2008).
– Developed a wavelet-based pattern recognition algorithm to interpret noisy ECG signals.

Publications

1. S. Podtaev, M. Morozov, and P. Frik, "Wavelet-based correlations of skin temperature and blood flow oscillation," *Cardiovasc. Eng.* **8**, 185, 2008.
2. M. Morozov, A. Oron, and A. A. Nepomnyashchy, "Nonlinear dynamics of long-wave Marangoni convection in a binary mixture with the Soret effect," *Phys. Fluids* **25**, 052107, 2013.
3. M. Morozov, A. Oron, and A. A. Nepomnyashchy, "Long-wave Marangoni convection in a layer of surfactant solution," *Phys. Fluids* **26**, 112101, 2014.
4. O. Schnitzer and M. Morozov, "A generalized Derjaguin approximation for electrical-double-layer interactions at arbitrary separations," *J. Chem. Phys* **142**, 244102, 2015.
5. M. Morozov, A. Oron, and A. A. Nepomnyashchy, "Long-wave Marangoni convection in a layer of surfactant solution: bifurcation analysis," *Phys. Fluids* **27**, 082107, 2015.
6. M. Morozov and O. Manor, "An extended Landau-Levich model for the dragging of a thin liquid film with a propagating surface acoustic wave," *J. Fluid Mech* **810**, 307-322, 2017.
7. A. Horesh, M. Morozov, and O. Manor, "Enhanced drainage and thinning of liquid films between bubbles and solids that support surface waves," *Phys. Rev. E* **95**, 052803, 2017.
   A.H. and M.M. contributed equally to this work.
8. M. Morozov and O. Manor, "Vibration-driven mass transfer and dynamic wetting," *Curr. Op. Col. Int. Sci.* **36**, 37-45, 2018.
9. M. Morozov and S. Michelin, "Self-propulsion near the onset of Marangoni instability of deformable active droplets," *J. Fluid Mech.* **860**, 711-738, 2019.
10. M. Morozov and S. Michelin, "Nonlinear dynamics of a chemically-active drop: from steady to chaotic self-propulsion," *J. Chem. Phys.* **150**, 044110, 2019.
11. M. Morozov and S. Michelin, "Orientational instability and spontaneous rotation of active nematic droplets," (manuscript in review).

Grants

1. M. Morozov, A. Horesh, and O. Manor (principal investigator), "Accessing interfacial properties of fluid-fluid interfaces by means of excitation of thin films with surface acoustic waves," Technion internal call for research proposals 2015, 60k NIS.

Patents

1. S. Podtaev, A. Ershova, A. Popov, and M. Morozov, "Sposob registratsii mikrocirkuliatsii krovi," ("Algorithm of measurement of blood microcirculation," in Russian).

Conference Talks

1. M. Morozov, A. Oron, and A. A. Nepomnyashchy, "Marangoni convection in binary fluids with soluble surfactant," in: IMA6, Haifa, June 2012.
2. M. Morozov, A. Oron, and A. A. Nepomnyashchy, "Nonlinear dynamics of long-wave Marangoni convection in a 2D layer of binary liquid," in: BIFD 2013, Haifa, July 2013.
3. M. Morozov, A. Oron, and A. A. Nepomnyashchy, "Long-wave Marangoni convection in a heated layer of binary liquid with surfactant adsorption/desorption," in: APS DFD 2013, Pittsburgh, PA, November 2013.
4. M. Morozov, A. Oron, and A. A. Nepomnyashchy, "Long-wave Marangoni convection in a binary-liquid layer with Soret effect and surfactant adsorption/desorption," in: IMA7, Vienna, June 2014.
5. M. Morozov, A. Oron, and A. A. Nepomnyashchy, "Bifurcation analysis of the long-wave Marangoni instability emerging in a heated layer of surfactant solution in the presence of the Soret effect," in: BIFD 2015, Paris, July 2015.
6. M. Morozov, A. Horesh, and O. Manor, "Modified Landau-Levich model for dragging thin liquid films by means of MHz surface acoustic waves (SAW)," in: IMA8, Bad Honnef, June 2016.
7. M. Morozov, A. Horesh, and O. Manor, "Deformations of a thin liquid film excited with a MHz surface acoustic wave (SAW) reveal interfacial properties of liquid," in: CECAM workshop on non-equilibrium dynamics of thin films - solids, liquids and bioactive materials, Lausanne, September 2016.
8. M. Morozov, A. Horesh, and O. Manor, "Acoustic drainage," in: BIFD 2017, The Woodlands, TX, July 2017.
9. M. Morozov, A. Horesh, and O. Manor, "Propogating surface acoustic waves can drive coating flows," in: BIFD 2017, The Woodlands, TX, July 2017.
10. M. Morozov and S. Michelin, "The effect of deformability on the dynamics of active droplets," in: EFMC12 2018, Vienna, September 2018.

Conference Posters

1. M. Morozov, and A. A. Nepomnyashchy, "Long-wave Marangoni instability in a binary-liquid layer with deformable free surface in the presence of Soret effect and surfactant adsorption," in: IMA5, Florence, June 2010.
2. M. Morozov, and A. A. Nepomnyashchy, "Long-wave Marangoni convection in a liquid layer with deformable free surface in the presence of a solvable surfactant," in: MULTIFLOW ITN Conference, Brussels, November 2010.

Skills and Qualifications

Languages: native Russian, advanced English, intermediate Hebrew and French.
Programming languages: C, C++, Fortran, Mathematica, MATLAB, Maxima, Python, Octave.
Modeling software: COMSOL.
Productivity software: Emacs, LaTeX, Gnuplot, Microsoft Office.
Operating systems: Ubuntu and OpenSuse Linux, Microsoft Windows.
Musical instruments: alto and tenor saxophones, piano.

Honors and Awards

1. Vladimir Potanin National Fellowship, 2007/2008 academic year.
2. Perm City Mayor Office Scholarship, 2008/2009 academic year.
3. Marie Curie Fellowship, November 2009 – October 2012.
4. Lior Merkin Memorial Award for Excellence in Mathematics, June 2011.
5. Irwin and Joan Jacobs Fellowship, 2013/2014 academic year.