VITALIY GYRYA
CURRICULUM VITAE

Business Address:

T-5 Group, Mail Stop B-284   Phone: (973) 865-1226
Applied Mathematics and Plasma Physics,   E-mail: `vitaliy_gyrya@lanl.gov`
Los Alamos National Laboratory   E-mail: `vitaliy.gyrya@gmail.com`
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Research Interests:

Numerical methods for PDEs; Partial Differential Equations (PDEs); Fluid dynamics; Calculus of Variations; Homogenization; Modeling of biological systems

Education:

Ph.D. Applied Mathematics, Penn State, 2010
Advisor: *Leonid Berlyand*,
"Effective viscosity and dynamics of suspensions of micro-swimmers"

M.S. Applied Mathematics, University of Akron, 2005
Advisor: *Dmitry Golovaty*
"Variational problems on domains with inclusions: Homogenization through Γ-convegrence"

B.A. Applied Mathematics & **B.A.** Computer Science, Rutgers, 2003

Computational and Programming Experience

MatLab, Mathematica, C/C++, CUDA, Fortran, Java

Selected Honors, Awards, and Certificates

2008	Teaching Associate
2001	Certified Java Developer, Sun Microsystems
2001	Certified Java Programmer, Sun Microsystems
2000	John Bogart Prize
1998–2000	Member of the 3-student team that represented Rutgers University in the Putnam Examination.
	Made top 200 (out of ∼3000 nationwide, 1999).
1995	Two 1st degree diplomas in the International Mathematical Tournament of Towns (Novi Sad, Yugoslavia) in the problems of "Coloring" and "Reversal sorting".
1996	2nd degree diploma at the All-Ukrainian Mathematical Olympiad.
1995	3rd degree diploma at the All-Ukrainian Mathematical Olympiad.

Employment History:

09/2010-present	*Postdoc*, T-5, Applied Mathematics and Plasma Physics Los Alamos National Laboratory, Los Alamos, NM.
08/2005-08/2010	*Graduate Teaching and Research Assistant* Department of Mathematics, Penn State University State College, PA.

Employment History (continued):

06/2008-08/2008 and 06/2007-08/2007	*Graduate Research Assistant* T-7 Group (now T-5), Mathematical Modeling and Analysis, Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM
06/2006-08/2006	*Graduate Research Assistant* Mathematics and Computer Science Division Argonne National Laboratory, Argonne, IL
08/2003-08/2005	*Graduate Teaching and Research Assistant* Department of Theoretical and Applied Mathematics The University of Akron, Akron, OH

Research Experience:

09/2010-present   *Postdoc*
T-5, Applied Mathematics and Plasma Physics,
Los Alamos National Laboratory, Los Alamos, NM.
- Development and analysis of numerical methods with emphasis on Mimetic Finite Difference (MFD) discretizations. Developed an m-adaptation technology for MFD methods on structured meshes in 2D and 3D that significantly increases the order of the discretization while preserving the low computational complexity. For acoustic wave equation this technology dramatically reduced the numerical artifacts such as numerical dispersion and anisotropy. Work is underway to extend this technology to other wave phenomena (elasticity, electromagnetics) and further improve it by combining with advanced variable time-step time integration techniques.
- Modeled the process of the cell division from the point of view of geometry in 2D under the influenced of microtubules.

08/2005-08/2010   *Graduate Teaching and Research Assistant*
Department of Mathematics,
Penn State University, State College, PA.
Performed the modeling and the analysis (asymptotical and numerical) of the dynamics of microswimmers (low Reynolds number, e.g. self-propelled bacteria) due to hydrodynamic interactions. Demonstrated well-posedness of the models. Numerically analyzed the dependence of the effective shear viscosity of the suspension of microswimmers in the fluid on the propulsion strength of the microswimmers.

06/2008-08/2008   *Graduate Research Assistant*
T-7, Mathematical Modeling and Analysis Group,
Los Alamos National Laboratory, Los Alamos, NM.

Research Experience (continued):

Developed and implemented a new numerical method (Mimetic Finite Difference method) for the incompressible Stokes equation (resolve microscale fluid motion). Applied the method to estimate the effective viscosity for a suspension of microswimmers (e.g. self-propelled bacteria).

06/2007-08/2007 *Graduate Research Assistant*
Mathematical Modeling and Analysis Group, Theoretical Division,
Los Alamos National Laboratory, Los Alamos, NM.
Developed and implemented a new numerical method (higher-order Mimetic Finite Difference method) for diffusion equation.

06/2006-08/2006 *Graduate Research Assistant*
Mathematics and Computer Science Division,
Argonne National Laboratory, Argonne, IL.
Modeled the motion of microswimmers (e.g. bacteria) in a fluid.

Analyzed the dynamics of microswimmers as a function of the location of the propulsion apparatus. Critical dependence is observed.

08/2003-08/2005 *Graduate Teaching and Research Assistant*
Department of Theoretical and Applied Mathematics,
The University of Akron, Akron, OH.
Numerical analysis of the propagating polymerization front.

Scientific Presentations

1. "Effective shear viscosity of suspensions of micro-swimmers from small to moderate concentrations", International Conference on PDEs and Dynamical Systems in Biology, *Bar Ilan University, Ramat Gan, Israel*, October 2013.

2. "Adaptation of the Mimetic Finite Difference schemes for wave equations", LANL seminar, *Los Alamos*, NM, April 2013.

3. "Mimetic Finite Difference Method for the Stokes Equations", SIAM Conference on Computational Science and Engineering, *Boston*, MA, February 2013.

4. "Dispersion Reduction for Acoustic Wave Equation Using M-adaptation", SIAM Conference on Computational Science and Engineering, *Boston*, MA, February 2013.

5. "Adaptation of MFD discretization to reducing numerical dispersion in wave equation", T-5 postdoc seminar series, *Los Alamos*, NM, September 2011.

6. "Adaptation of Mimetic Finite Difference discretization to reducing numerical dispersion in wave equation", International Conference on Mathematical and Numerical Aspects of Waves, *Simon Fraser University*, Vancouver, BC, Canada, July 2011.

7. "Effective shear viscosity of suspensions of micro-swimmers from small to moderate concentrations", Annual Technical Meeting of Society of Engineering Science, *Iowa State University* at *Ames*, IA, October 2010.

8. "Suspensions of microswimmers at small and moderate concentrations: effective shear viscosity and dynamics", Workshop on Self-Organization and Multi-Scale Mathemat-

ical Modeling of Active Biological Systems, *SAMSI*, NC, October 2009 and Workshop on Interdisciplinary Mathematics, *Penn State*, PA, May 2010.

9. "Asymptotic and numerical analysis of PDE models for suspensions of micro-swimmers: interaction and effective viscosity", *CCMA Luncheon Seminar*, Department of Mathematics, *Penn State*, PA, October 2009.

10. "The new Mimetic Finite Difference method for stationary Stokes equation with applications to bacterial suspensions", Applied Math Days, Department of Mathematical Sciences, *Rensselaer Polytechnic Institute*, NY, November 2008.

11. "A model of hydrodynamic interaction between self-propelled bacteria", Annual Technical Meeting of Society of Engineering Science, *University of Illinois* at *Urbana-Champaign*, IL, October 2008.

12. "New Mimetic Finite Difference Method for stationary Stokes equation", 8-th Annual Student Symposium, *University of New Mexico*, Los Alamos, NM, August 2008.

13. "New high-order Mimetic Finite Difference discretization for diffusion problems", *Los Alamos National Laboratory*, NM, July 2007.

Peer reviewed publications

1. "Dispersion reduction for the edge discretizations of Maxwell equations", V. A. Bokil, N. L. Gibson, V. Gyrya, and D. A. McGregor, in preparation (2013).

2. "Collision of microswimmers in viscous fluid", M. Potomkin, V. Gyrya, I. Aranson, L. Berlyand, *Physical Review E* vol.87, no.5, pp. 3005 1-8 (2013).

3. "M-adaptation in the mimetic finite difference method", V. Gyrya, K. Lipnikov, G. Manzini, and D. Svyatskiy, under review (2012).

4. "M-adaptation method for acoustic wave equation on cuboid meshes", V. Gyrya and K. Lipnikov, under review (2012).

5. "M-adaptation method for acoustic wave equation on rectangular meshes", V. Gyrya and K. Lipnikov, accepted to *ENUMATH 2011 Proceedings Volume*, LA-UR-12-10101 (2012).

6. "M-adaptation method for acoustic wave equation on square meshes", V. Gyrya and K. Lipnikov, *Journal of Computational Acoustics*, vol. 20, pp. 1–23, LA-UR 12-10047 (2012).

7. "Adaptation of mimetic finite difference discretization to reducing numerical dispersion in wave equation", V. Gyrya and K. Lipnikov, Proceedings of the 10th International Conference on Mathematical and Numerical Aspects of Waves, pp. 343-346 (2012).

8. "Effective shear viscosity and dynamics of suspensions of micro-swimmers from small to moderate concentrations", V. Gyrya, K. Lipnikov, I. Aronson, and L. Berlyand, *Journal of Mathematical Biology*, vol. 62, no. 5, pp. 707-740 (2011).

9. "Mimetic finite difference method for the Stokes problem on polygonal meshes" L. Beirão da Veiga, V. Gyrya, G. Manzini, and K. Lipnikov, *Journal of Computational Physics*, vol. 228, no. 19, pp. 7215-7232 (2009).

10. "High-order mimetic finite difference method for diffusion problems on polygonal meshes" V. Gyrya and K. Lipnikov, *Journal of Computational Physics*, vol. 227, n.20, pp. 8841-8854 (2008).

11. "A model of hydrodynamic interaction between swimming bacteria" V. Gyrya, L. Berlyand, I. Aranson, and D. Karpeev, *Bulletin of Mathematical Biology*, published online (2009).

12. "A Numerical Study of One-Step Models of Polymerization: Frontal vs. Bulk Mode" with S.A. Cardarelli, D. Golovaty, L.K. Gross, V. Gyrya, and J. Zhu, *Physica D*, 206 (3-4), pp. 145-165 (2005).

Other Activities

1. *Organizer* of the minisymposium on "Efficient and accurate modeling of waves" at the SIAM Conference on Computational Science and Engineering, 2013.

2. *Extensive teaching experience:* Taught *twelve classes* in mathematics for engineering and general education students in Penn State and The University of Akron. (Teaching Associate since 2008).

3. *Mentored undergraduate and graduate students*:
   Courtney Lea Jones, undergraduate, Penn State, summer, 2007,
   Alan Samuel Slipak, undergraduate, Penn State, summer, 2008,
   Duncan McGregor, PhD student, Oregon State, summer, 2013.

4. *Judge* at the 2013 Student Symposium, Los Alamos National Laboratory.

5. During 2011-2013 *submitted four* LDRD ER (Laboratory Directed Research and Development Exploratory Research) *proposals* in the Los Alamos National Laboratory. All four proposals were selected as finalists. The proposal titled "From Final Element Method to Virtual Element Method" was selected to be funded starting in FY14.