ALINA A. ALEXEENKO

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EDUCATION

2003   Ph.D.   Aerospace Engineering   The Pennsylvania State University
       Dissertation: "Modeling of Microscale Gas Flows using the DSMC Method"
       Advisor: Deborah A. Levin
1999   M.S.   Applied Mathematics   Novosibirsk State University, Russia
       Thesis: "Vibrational Relaxation in the Normal Shock" Advisor: Mikhail S. Ivanov
1997   B.S.   Mathematics   Novosibirsk State University, Russia
       Thesis: "On the Rectilinear Steiner Tree Problem"   Advisor: Adil Erzin

PROFESSIONAL EXPERIENCE

2019 – now   ***Associate Dean for Undergraduate Education***
             College of Engineering, Purdue University
2020 – now   ***Professor,*** Davidson School of Chemical Engineering (joint appointment)
2006 – now   School of Aeronautics and Astronautics, ***Professor*** (2016-now), ***Associate Head for Strategic Initiatives*** (2019), ***Associate Professor*** (2012-2016), ***Assistant Professor*** (2006-2012)
2014 – now   ***Founding co-Director,*** Advanced Lyophilization Technology Consortium LyoHUB, Purdue University
2011 – now   ***Resident Faculty,*** Birck Nanotechnology Center, Purdue University
2004 – 2006 ***Postdoctoral Scholar,*** Dept of Aerospace & Mechanical Engineering, University of Southern California   Advisor: E. Phillip Muntz
2004 – 2006 ***Consultant on Basic Research***
             ERC Inc./AFRL, Edwards, CA
2000 – 2003 ***Research Assistant,*** Department of Aerospace Engineering
             The Pennsylvania State University   Advisor: Deborah A. Levin
1999 – 2000 ***Research Assistant,*** Department of Chemistry
             George Washington University   Advisor: Deborah A. Levin
1998 – 1999 ***Senior Laboratory Assistant,*** Computational Aerodynamics Laboratory, Khristianovich Institute of Theoretical and Applied Mechanics, Siberian Branch of the Russian Academy of Sciences, Novosibirsk

HONORS AND AWARDS

Graeme A. Bird Keynote Lecture, DSMC 2019 Conference   2019
Outstanding Engineering Teachers, Purdue College of Engineering   2018
AIAA Thermophysics Technical Committee Chair   2016 – 2018
T. Jennings Best Poster Award, International Society of Lyophilization/Freeze-Drying
                                              2013, 2015, 2016, 2018

International Advisory Committee, Rarefied Gas Dynamics Symposium   2016
Purdue Innovators Hall of Fame, Office of Technology Commercialization   2015
NAE Frontiers of Engineering Symposium   2015
University Faculty Scholar, Purdue University   2015 – 2020
Seed for Success, Purdue University   2014
AIAA Associate Fellow   2013
C.-T. Sun Excellence in Research Award, Purdue School of AAE   2013
National Science Foundation CAREER Award   2011
1st Place, Poster Competition, International Rarefied Gas Dynamics Symposium   2010
Air Force Research Laboratory/Air Vehicles Directorate Summer Faculty   2009
Team Excellence Award (PRISM), Purdue University College of Engineering 2009
American Society for Engineering Education /Air Force Summer Faculty   2007
Sun Microsystems Inc. Academic Excellence Grant   2007
Women in Science and Engineering (WiSE) Postdoctoral Fellowship   2004 – 2006
Zonta International Foundation Amelia Earhart Award   2003

RESEARCH AREAS

Rarefied gas dynamics, numerical methods for Boltzmann equation, direct simulation Monte Carlo (DSMC) and particle-in-cell Monte Carlo collisions (PIC/MCC); chemically reacting flows; high-altitude aerothermodynamics, micropropulsion and smallsat technologies; MEMS sensors and actuators; nonequilibrium microplasma; vacuum gas dynamics; lyophilization/freeze-drying for biopharmaceutical manufacturing

PUBLICATIONS

Google Scholar Profile: h-index=29; i10-index=75; m-index=1.45

Book Chapters

BC1. A. Alexeenko and S. F. Gimelshein, "Direct Simulation Monte Carlo", Ch. V.6 (40 pp), *The Handbook of Fluid Dynamics*, *2nd Ed.* Editor: R.W. Johnson, CRC Press, 2016.

BC2. S. Macheret, H. Luo, A. Alexeenko, "Nonempirical Analytical Model of Nonequilibrium Dissociation in High-Temperature Air", Ch. 17, *Hypersonic Meteoroid Entry Physics,* Edited by G. Colonna, M. Capitelli, A. Laricchiuta, IOP Publishing, 2019.

BC3. A. Alexeenko, E. Topp, "Future Directions: Lyophilization Technology Roadmap to 2025 and Beyond", Chapter 18, *Drying Technologies for Biotechnology and Pharmaceutical Applications: Current Status and Future Trends*, Editors: S. Ohtake, K-I Izutsu, D. LeChuga, Wiley, 2020.

BC4. A. Alexeenko, L. Mozdzen, S. Shang, M. Long, G. Kim, M. Musser, "Freeze-Thaw Process Data Analysis and Mechanistic Modeling: Simplified Lumped Capacitance Analysis for Small Fill Volumes", Chapter 20 in *Development of Biopharmaceutical Drug-Device Products, AAPS Advances in the Pharmaceutical Sciences Series,* Editors: F. Jameel, J. W. Skoug, R. R. Nesbitt, pp. 487-498, Springer, 2020.

Journal Papers

(* indicates graduate advisee; ** - undergraduate student; *** - postdoctoral advisee)

J1. A.A. Alexeenko, D.A. Levin, S.F. Gimelshein, R.J. Collins, and G.N. Markelov, "Numerical Simulation of High-Temperature Gas Flows in a Millimeter-Scale Thruster," *Journal of Thermophysics and Heat Transfer*, 16(1):10–16, 2002.

J2. S.F. Gimelshein, A.A. Alexeenko, and D.A. Levin, "Modeling of the Interaction of a Side Jet with a Rarefied Atmosphere," *J. Spacecraft and Rockets*, 39(2):168–176, 2002.

J3. A.A. Alexeenko, N.E. Gimelshein, D.A. Levin, R.J. Collins, R. Rao, G.V. Candler, S.F. Gimelshein, J.S. Hong, and T. Schilling, "Modeling of Flow and Radiation in the Atlas Plume," *Journal of Thermophysics and Heat Transfer*, 16(1):50–57, 2002.

J4. A.A. Alexeenko, R.J. Collins, S.F. Gimelshein, D.A. Levin, and B.D. Reed, "Numerical Modeling of Axisymmetric and Three-Dimensional Flows in MEMS Nozzles," *AIAA Journal*, 40(5):897–904, 2002.

J5. A.A. Alexeenko, S.F. Gimelshein, D.A. Levin, A.D. Ketsdever, and M.S. Ivanov, "Measurements and Simulation of Orifice Flow for Micropropulsion Testing," *Journal of Propulsion and Power*, 19(4):588–594, 2003.

J6. S.F. Gimelshein, D.A. Levin, and A.A. Alexeenko, "Modeling of Chemically Reacting Flows from a Side Jet at High Altitudes," *J. Spacecraft and Rockets*, 41(4):582–591, 2004.

J7. A.A. Alexeenko, D.A. Levin, D.A. Fedosov, and S.F. Gimelshein, "Performance Analysis of Microthrusters Based on Coupled Thermal-Fluid Modeling and Simulation," *Journal of Propulsion and Power*, 21(1): 95–101, 2005.

J8. A.D. Ketsdever, M. Clarbough, S.F. Gimelshein, and A.A. Alexeenko, "Experimental and Numerical Determination of Micropropulsion Device Efficiencies at Low Reynolds Numbers," *AIAA Journal,* 43(3):633–641, 2005.

J9. A.A. Alexeenko, S.F. Gimelshein, and D.A. Levin, "Reconsideration of Low Reynolds Number Flows through Constriction Microchannels using the DSMC Method," *J. MEMS*, 14(4): 847–865, 2005.

J10. A.A. Alexeenko, D.A. Fedosov, S.F. Gimelshein, and D.A. Levin, "Transient Heat Transfer and Gas Flow in a MEMS-based Thruster," *J. MEMS*, 15(1):181–194, 2006.

J11. A.A. Alexeenko, S.F. Gimelshein, E.P. Muntz, and A.D. Ketsdever, "Kinetic Modeling of Temperature-Driven Flows in Short Microchannels," *International Journal of Thermal Sciences,* 45(11):1045-1051, 2006.

J12. Y.-L. Han, E.P. Muntz, A.A. Alexeenko, and M. Young, "Experimental and Computational Studies of Temperature Gradient Driven Molecular Transport in Gas Flows through Nano/Micro-Scale Channels," *Nanoscale and Microscale Thermophysical Engineering*, 11(1-2):151-175, 2007.

J13. W.F. Louisos, A.A. Alexeenko, D.L. Hitt, A. Zilic, "Design Considerations for Supersonic Micronozzles," *International J. Manufacturing Research*, 3(1):80-113, 2008.

J14. X. Guo*, C. Huang, A. Alexeenko, and J. Sullivan, "Numerical and Experimental Study of Gas Flows in 2D and 3D Microchannels," *Journal of Micromechanics and Microengineering*, 18(2):025034, 2008. Also in ***IOP Select,*** "articles chosen by editors for their novelty, significance and potential impact on future research," and in ***JMM 2008 Highlights***, "a showcase of the top contributions published in 2008."

J15. W. B. Stein*, A. Alexeenko, and I. Hrbud, "Performance Modeling of a Coaxial Radio-Frequency Gas Discharge Microthruster," *J. Propulsion and Power*, 24(5):1007-1017, 2008.

J16. N. Selden, C. Ngalande, S. Gimelshein, E.P. Muntz, A. Alexeenko, and A. Ketsdever, "Area and Edge Effects in Radiometric Forces," *Physical Review E,* 79:041201, 2009.

J17. X. Guo* and A. Alexeenko, "Compact Model of Squeeze-Film Damping based on Rarefied Flow Simulations," *J. Microm. & Microeng.*, 19(4): 045026, 2009.

J18. R. Bidkar, R. Tung, A. Alexeenko, H. Sumali, and A. Raman, "Unified Theory of Gas Damping of Flexible Microcantilevers at Low Ambient Pressures," *Applied Physics Letters,* 94:163117, 2009.

J19. D. Singh, X. Guo*, A. A. Alexeenko, J.Y. Murthy, and T.S. Fisher, "Modeling of Subcontinuum Thermal Transport Across Semiconductor-Gas Interfaces," *Journal of Applied Physics*, 106(2):024314, 2009.

J20. A. Alexeenko, A. Ganguly*, and S. L. Nail, "Computational Analysis of Fluid Dynamics in Pharmaceutical Freeze-Drying," *J. Pharmaceutical Sciences*, 98(9): 3484-3494, 2009.

J21. X. Guo*, D. Singh, J. Y. Murthy, and A. A. Alexeenko, "Numerical Simulation of Gas-Phonon Coupling in Thermal Transpiration Flows," *Physical Review E*, 80(4): 046310, 2009.

J22. X. Guo*, J. Li, D. Xiu, and A.A. Alexeenko, "Uncertainty Quantification Models for Microscale Squeeze-Film Damping," *Int. J. for Numerical Methods in Engineering*, 84(10):1257-1272, 2010.

J23. S. Chigullapalli*, A. Venkattraman*, M.S. Ivanov, and A.A. Alexeenko, "Entropy Considerations in Numerical Simulations of Non-Equilibrium Rarefied Flows," *Journal of Computational Physics*, 229:2139-2158, 2010.

J24. A. Venkattraman*, and A. Alexeenko, "DSMC Modeling of E-Beam Metal Deposition", *J. Vacuum Science & Technology A*, 28(4):916-924, 2010.

J25. A. B. Weaver*, A.A. Alexeenko, R. B. Greendyke, and J.A. Camberos, "Flowfield Uncertainty Analysis for Hypersonic CFD Simulations", *Journal of Thermophysics and Heat Transfer*, 25(1):10-20, 2011.

J26. J. Nabeth*, S. Chigullapalli*, and A. Alexeenko, "Quantifying the Knudsen Force on Heated Microbeams: A Compact Model and Direct Comparison with Measurements", *Physical Review E*, 83:066306, 2011.

J27. A. Alexeenko, S. Chigullapalli*, J. Zeng, X. Guo*, A. Kovacs, and D. Peroulis, "Uncertainty in Microscale Gas Damping: Implications on Dynamics of Capacitive MEMS Switches", *Reliability Engineering and System Safety*, 96(9):1171-1183, 2011.

J28. W. Stein* and A. Alexeenko, "Plug-Annular Micronozzles: A New Prospect for Microthrusters", *Journal of Propulsion and Power,* 27(6):1259-1265, 2011.

J29. A. Venkattraman* and A. Alexeenko, "DSMC Study of Effects of Thermal Non-Uniformities in Electron-Beam Physical Vapor Deposition", *Journal of Vacuum Science and Technology A*, 29(4):041509, 2011.

J30. M. Kulakhmetov* and A. A. Alexeenko, "Model Uncertainties in Simulations of Hypersonic Leading-Edge Flow", *J. Spacecraft and Rockets*, 49(3):461-473, 2012.

J31. A. Venkattraman* and A. A. Alexeenko, "Binary Scattering Model for Lennard-Jones Potential: Transport Coefficients and Collision Integrals for Non-Equilibrium Gas Flow Simulations", *Physics of Fluids*, 24:027101, 2012.

J32. A. Venkattraman*, A. Garg, D. Peroulis, and A. A. Alexeenko, "Direct Measurements and Numerical Simulations of Gas Charging in MEMS Capacitive Switches", *Applied Physics Letters*, 100:083503, 2012.

J33. A. Venkattraman* and A. A. Alexeenko, "DSMC Modeling of Metal Vapor Flows in Application to Thin Film Deposition", *Vacuum*, 86(11):1748-1758, 2012.

J34. A. Ganguly*, S. L. Nail, and A. A. Alexeenko, "Rarefied Gas Dynamics Aspects of Pharmaceutical Freeze-Drying", *Vacuum*, 86(11):1739-1747, 2012.

J35. S. Chigullapalli*, A. B. Weaver*, A. A. Alexeenko, "Non-linear Effects in Squeeze-Film Gas Damping on Microbeams", *J. Micromech. & Microeng.*, 22:065010, 2012.

J36. A. Ganguly* and A. A. Alexeenko, "Modeling and Measurements of Water-Vapor Flow and Icing at Low Pressures with Application to Pharmaceutical Freeze-Drying", *International Journal of Heat and Mass Transfer*, 55(21-22):5503-5513, 2012.

J37. L. Michalas, A. Garg, A. Venkattraman*, M. Koutsoureli, A. Alexeenko, D. Peroulis, G. Papaioannou, "A Study of Field Emission Process in Electrostatically Actuated MEMS Switches", *Microelectronics Reliability*, 52(9-10):2267-2271, 2012.

J38. A. Venkattraman*, A. A. Alexeenko, "Scaling law for direct current field emission-driven microscale gas breakdown", *Physics of Plasmas*, 19:123515, 2012.

J39. A. Ganguly*, S.L. Nail, A. Alexeenko, "Experimental Determination of the Key Heat Transfer Mechanisms in Pharmaceutical Freeze Drying", *Journal of Pharmaceutical Sciences*, 102(5):1610-1625, 2013.

J40. A. Semnani, A. Venkattraman*, A. Alexeenko, and D. Peroulis, "Pre-breakdown evaluation of gas discharge mechanisms in microgaps", *Applied Physics Letters*,102: 174102, 2013.

J41. D. Parkos*, N. Raghunathan, A. Venkattraman, B. Sanborn, W. Chen, D. Peroulis, A. Alexeenko, "Near-Contact Damping and Dynamic Response of High-G MEMS Accelerometer Beams", *J. MEMS*, 22(5):1089-1099, 2013.

J42. A. Ganguly*, A. Alexeenko, S. Kim, S. Schultz, "Freeze-Drying Simulation Framework Coupling Product Attributes and Equipment Capability", *European Journal of Pharmaceutics and Biopharmaceutics,* 85(2): 223-235, 2013.

J43. A. Semnani, A. Venkattraman*, A. Alexeenko, D. Peroulis, "Frequency Response of Atmospheric Pressure Gas Breakdown in Micro/Nanogaps", *Applied Physics Letters,* 103:063102, 2013.

J44. S. Tholeti*, M. Schneider, A. Alexeenko, "Kinetic Modeling of Evolution of 3+1:REMPI Plasma in Argon at Low Pressures", *Physics of Plasmas*, 21:063507, 2014.

J45. A. Strongrich*, W. O'Neill*, A. Cofer*, A. Alexeenko, "Experimental Measurements and Numerical Simulations of Knudsen Force on a Non-Uniformly Heated Beam", *Vacuum*, 109:405-416, 2014.

J46. A. Weaver*, A. Venkattraman*, and A. Alexeenko, "Effect of Intermolecular Potential on Compressible Couette Flow in Slip and Transitional Regimes", *Physics of Fluids*, 26(10):107102, 18 pages, 2014.

J47. W. Su*, A. Alexeenko, C. Cai, "A Parallel Runge-Kutta Discontinuous Galerkin Solver for Rarefied Gas Flows Based on 2D Boltzmann Kinetic Equations", *Computers & Fluids,* 109:123-136, 2015.

J48. S. Das, S.R. Mathur, A. Alexeenko, J.Y. Murthy, "A Coupled Ordinates Method for Solution Acceleration of Rarefied Gas Dynamics Simulations", *J. Computational Physics,* 289:96-115, 2015.

J49. A. B. Weaver* and A. Alexeenko, "Revised Variable Soft Sphere and Lennard-Jones Model Parameters for 8 Common Gases up to 2,200 K", *J. Physical and Chemical Reference Data*, 44(2):023103, 14 pages, 2015.

J50. M. Kulakhmetov*, M. Gallis, A. Alexeenko, "Effect of O2+O ab-initio and reduced dimensionality potentials on dissociation and relaxation rates for nonequilibrium flow calculations", *Physics of Fluids,* 27(8):087104, 2015.

J51. S. Tholeti*, A. Semnani, D. Peroulis, A. Alexeenko, "Dark-to-arc transition in field-emission dominated microdischarges", *Physics of Plasmas*, 22(8):083508, 2015.

J52. D. Parkos*, A. Alexeenko, M. Kulakhmetov*, B. Johnson, H. J. Melosh, "NO_x Production and Rainout from Chicxulub Impact Ejecta Reentry", *Journal of Geophysical Research: Planets*, 120(12):2152-2168, 2015.

J53. A. Strongrich*, A. Alexeenko, "Microscale Actuation and Gas Sensing by the Knudsen Thermal Force", *Applied Physics Letter,* 107(19):193508, 2015.

J54. C. Pekardan*, S. Chigullapalli*, L. Sun, A. Alexeenko, "Immersed Boundary Method for Boltzmann Model Kinetic Equations", *International Journal for Numerical Methods in Fluids*, 80(8):453-475, 2016.

J55. G. Shivkumar*, S. Tholeti*, M. Alrefae, T. Fisher, A. Alexeenko, "Analysis of Hydrogen Plasma in a Microwave Plasma Chemical Vapor Deposition Reactor", *Journal of Applied Physics,* 119(11):113301, 2016. **– Featured Cover Article**

J56. A. B. Weaver*, M. Kulakhmetov*, A. Alexeenko, "Consistent Atomic Oxygen Model for Direct Simulation Monte Carlo Below 1,000 Kelvin, *Journal of Thermophysics and Heat Transfer*, 30(3): 689-694, 2016.

J57. M. Kulakhmetov*, M. Gallis, A. Alexeenko, "Ab initio-informed maximum entropy modeling of rovibrational relaxation and state-specific dissociation with application to the O2 + O", *Journal of Chemical Physics*, 144(17):174302, 2016.

J58. S. Tholeti*, G. Shivkumar*, A. Alexeenko, "Field emission microplasma actuation for microchannel flows", *Journal of Physics D: Applied Physics*, 49 (21):215203, 2016.

J59. S. Macheret, S. Tholeti*, A. Alexeenko, "Low pressure microplasmas enabled by field ionization: kinetic modeling", *Applied Physics Letters*, 108(19):194102, 2016.

J60. I. Sebastiao*, A. Alexeenko, "Consistent Post-Reaction Vibrational Energy Redistribution in DSMC simulations using TCE model", *Physics of Fluids*, 28(10):107103, 2016.

J61. A. Ganguly*, N. Varma*, P. Sane, M. Pikal, R. Bogner, A. Alexeenko, "Spatial Variation of Pressure in the Lyophilization Product Chamber Part 1: Computational Modeling", *AAPS PharmSciTech,*18(3):577-585, 2017.

J62. P. Sane, N. Varma*, A. Ganguly*, M. Pikal, A. Alexeenko, R. Bogner, "Spatial Variation of Pressure in the Lyophilization Product Chamber Part 2: Experimental Measurements & Implications for Scale-Up", *AAPS PharmSciTech*,18(2):369–380, 2017.

J63. I. Sebastiao*, T. Robinson, A. Alexeenko, "Atmospheric Spray Freeze Drying: Numerical Modeling and Comparison with Experimental Measurements", *J. Pharmaceut. Sci.,*106(1):183–192, 2017.

J64. A. Strongrich*, A. Pikus*, I. B. Sebastiao*, A. Alexeenko, **"**Microscale In-Plane Knudsen Radiometric Actuator: Design, Characterization, and Performance Modeling", *J. Microelectromechanical Systems*, 26(3):528-538, 2017.

J65. I. Sebastiao*, M. Kulakhmetov*, A. Alexeenko, "DSMC Study of Oxygen Shockwaves Based on High-Fidelity Vibrational Relaxation and Dissociation Models", *Physics of Fluids*, 29:017102, 2017.

J66. H. Luo*, M. Kulakhmetov*, A. Alexeenko, "Ab-Initio State-Specific N_2+O Dissociation and Exchange Models for Molecular Simulations", *J. Chemical Physics*, 146:074303, 2017.

J67. S. Nail, S. Tchessalov, E. Shalaev, A. Ganguly, E. Renzi, F. Dimarco, L. Wegiel, S. Ferris, W. Kessler, M. Pikal, G. Sacha, A. Alexeenko, T. N. Thompson, C. Reiter, J. Searles, P. Coiteux, "Recommended Best Practices for Process Monitoring Instrumentation in Pharmaceutical Freeze Drying – 2017", *AAPS PharmSciTech,* 18(7):2379–2393, 2017. *– **Downloaded over 12,000 times.***

J68. C. Pekardan*, A. Alexeenko, "Rarefaction Effects for Transonic Airfoil Flows at Low Reynolds Numbers", *AIAA Journal*, 56(2):765-779, 2018.

J69. H. Luo*, A. Alexeenko, S. Macheret, "Assessment of Classical Impulsive Models of Dissociation in Thermochemical Nonequilibrium", *Journal of Thermophysics and Heat Transfer*, 32(4):861-868, 2018.

J70. D. Parkos*, A. Pikus*, A. Alexeenko, J. Melosh, "HCN production via Impact Ejecta Reentry during the Late Heavy Bombardment", *Journal of Geophysical Research – Planets*, 123(4):892-909, 2018.

J71. E. T. Liechty**, A. D. Strongrich*, E. M. Moussa, E. Topp, A. A. Alexeenko, "In-Situ Molecular Vapor Composition Measurements During Lyophilization", *Pharmaceutical Research*, 35(6):115, 2018.

J72. T. Zhou***, E. Moussa, M. Witting, D. Zhou, K. Sinha, M. Hirth, M. Gastens, S. Shang, N. Nere, S. Somashekar, A. Alexeenko, F. Jameel, "Predictive Models of Lyophilization Process for Development, Scale-up/Tech Transfer and Manufacturing", *European Journal of Pharmaceutics and Biopharmaceutics*, 128:363-378, 2018.

J73. X. Jiang, T. Zhou***, T. Kodama, N. Ragunathan, A. Alexeenko, D. Peroulis, "Multi-point Wireless Temperature Sensing System for Monitoring Pharmaceutical Lyophilization", *Frontiers in Chemistry*, 6:288, 11 pages, 2018.

J74. I. Sebastiao*, L. Qiao, A. Alexeenko, "Direct Simulation Monte Carlo Modeling of H_2-O_2 Deflagration Waves", *Combustion and Flame*, 198:40-53, 2018.

J75. H. Luo*, I. Sebastiao*, A. Alexeenko, S. Macheret, "Classical impulsive model for dissociation of diatomic molecules in DSMC", *Physical Review Fluids*, 3(11):113401, 2018.

J76. V. Kshirsagar*, S. Tchessalov, F. Kanka, D. Hiebert, A. Alexeenko, "Determining Maximum Sublimation Rate for a Production Lyophilizer: Computational Modeling and Comparison with Ice Slab Tests", *J. of Pharmaceutical Sciences,* 108:382-390 2019.

J77. S. Jaiswal*, A. Alexeenko, J. Hu, "A Discontinuous Galerkin Fast Spectral Method for the Full Boltzmann Equation with General Collision Kernels", *Journal of Computational Physics*, 378:178-208, 2019.

J78. A. Pikus*, I. B. Sebastiao*, A. Strongrich*, A. Alexeenko, "Characterization of a Knudsen Force Based Vacuum Sensor for N2-H2O Gas Mixtures", *Vacuum*, 161:130-137, 2019.

J79. I. B. Sebastiao*, B. Bhatnagar, S. Tchessalov, S. Ohtake, M. Plitzko, B. Luy, A. Alexeenko, "Bulk Dynamic Spray-Freeze Drying Part 1: Modeling of Droplet Cooling and Phase Change", *Journal of Pharmaceutical Sciences*, 108(6):2063-2074, 2019.

J80. I. B. Sebastiao*, B. Bhatnagar, S. Tchessalov, S. Ohtake, M. Plitzko, B. Luy, A. Alexeenko, "Bulk Dynamic Spray-Freeze Drying Part 2: Model-Based Parametric Study for Spray-Freezing Process Characterization", *J. Pharmac. Sci.,* 108(6):2075-2085, 2019.

J81. S. Jaiswal*, A. Alexeenko, J. Hu, "A discontinuous Galerkin fast spectral method for the multi-species Boltzmann equation", *Computer Methods in Applied Mechanics and Engineering*, 352:56-84, 2019.

J82. G. Shivkumar*, V. Kshirsagar*, T. Zhu*, I. B. Sebastiao*, S.L. Nail, G.A. Sacha, and A.A. Alexeenko, "Freeze-Dryer Equipment Capability Limit: Comparison of Computational Modeling with Experiments at Laboratory Scale", *Journal of Pharmaceutical Sciences*, 108(9): 2972-2981, 2019.

J83. G. Shivkumar*, M. Alrefae, S. Tholeti*, T. Fisher, A. Alexeenko, "Discharge regimes and emission characteristics of capacitively coupled radio frequency argon plasma with a square wave input", *Journal of Applied Physics*, 52 (38):384001, 2019.

J84. S. Jaiswal*, A. Pikus*, A. Strongrich*, I.B. Sebastião*, J. Hu, A.A. Alexeenko, "Quantification of thermally-driven flows in microsystems using Boltzmann equation in deterministic and stochastic contexts", *Physics of Fluids,* 31:082002, 2019.

J85. G. Shivkumar*, L. Qiao, Li, A. Alexeenko, "Plasma-Flow Interactions in Field-Emission Discharges with Application to Microcombustion", *Journal of Physics D: Applied Physics,* 52(38):384001, 2019.

J86. H. Luo*, A. Alexeenko, S. Macheret, "Development of an impulsive model of dissociation in direct simulation Monte Carlo", *Physics of Fluids*, 31:087105, 2019.

J87. G. Shivkumar*, P. S. Kazarin***, A. D. Strongrich, A. A. Alexeenko. "LyoPRONTO: an Open-Source Lyophilization Process Optimization Tool", *AAPS PharmSciTech,* 20(8), 328, 2019.

J88. N. Adhikari*, T. Zhu, F. Jameel, T. Tharp, S. Shang, A. Alexeenko. "Sensitivity Study to Assess the Robustness of Primary Drying Process in Pharmaceutical Lyophilization", *Journal of Pharmaceutical Sciences,* 109(2):1043-49, 2020.

J89. S. Pugia, A. Cofer, A. Alexeenko, "Characterization of Film-Evaporating Microcapillaries for Water-based Microthrusters", accepted for publication in *Acta Astronautica*, September 2020.

Submitted Journal Papers

J90. A. Ganguly, L. Hardwick, S. Tchessalov, S. L. Nail, D. Dixon, F. Kanka, A. Guidinas, T. N. Thompson, C. Reiter, Z. Yusoff, A. Alexeenko, T. Tharp, J. Azzarella, P. Chakravarty, M. J. Pikal, "Recommended Best Practices in Freeze Dryer Equipment Performance Qualification: 2019", submitted January 2019.

J91. M. Alrefae, G. Shivkumar, A. Alexeenko, S. Macheret, T. Fisher, "Electrical and Spectroscopic Characterizations of Capacitively Coupled Radio-frequency Argon Plasma with a Square Wave Input", submitted December 2019.

Patents and Patent Applications

P1. W. Stein, A. Alexeenko, I. Hrbud, D. Hitt, "Method of Enhancing Microthruster Performance", US Patent 8,613,188 B2, granted 24 December 2013.

P2. A. Strongrich, A. Alexeenko, "Microelectromechanical Gas Sensor Based on Knudsen Thermal Force", Patent US 2016/0363553 A1, granted December 25, 2018.

P3. A. Cofer, A. Alexeenko, S. Heister, W. O'Neill, E. Cardiff, "Microelectronic Thermal Valve", Patent Application US 15/370,633, filed 6 December 2016.

P4. A. Alexeenko, A. Coffer, S. Collicott, K. Fowee, S. Pugia, "Vapor Pressure Driven Pump", US Provisional Patent Application 62741303, filed 4 October 2018.

P5. A. Strongrich, A. Alexeenko, "Process Monitoring and Control for Lyophilization using Wireless Sensor Network", US Provisional Patent, filed 26 April, 2019.

Conference Papers

(- graduate student advisee; ** - undergraduate student)*

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C98. D. Parkos*, A. Pikus*, A. Alexeenko, H. J. Melosh, "HCN production from impact ejecta on the early Earth", 30TH International Symposium on Rarefied Gas Dynamics: RGD 30, AIP Conference Proceedings, Vol. 1786 (1), article 170001, 2016.

C99. A. Pikus, I. Sebastiao, A. Strongrich, A. Alexeenko, "DSMC simulation of microstructure actuation by Knudsen thermal forces including binary mixtures", 30TH International Symposium on Rarefied Gas Dynamics: RGD 30, AIP Conference Proceedings, Vol. 1786 (1), article 080003, 2016.

C100. C. Pekardan*, A. Alexeenko, "Thermal lift generation and drag reduction in rarefied aerodynamics", 30TH International Symposium on Rarefied Gas Dynamics: RGD 30, AIP Conference Proceedings, Vol. 1786 (1), article 190002, 2016.

C101. I.B. Sebastião*, M. Kulakhmetov*, A. Alexeenko, "Comparison between phenomenological and ab-initio reaction and relaxation models in DSMC", 30TH International Symposium on Rarefied Gas Dynamics: RGD 30, AIP Conference Proceedings, Vol. 1786 (1), article 150015, 2016.

C102. A. Cofer*, W. O'Neill*, S. Heister, A. Alexeenko "Ultracompact Microthruster for Pico/Nanosat Attitude and Thermal Control based on Film-Evaporation Effect", Proceedings of AIAA/USU Conference on Small Satellites, Paper SSC16-V-3, 2016.

C103. H. Luo*, I. Sebastiao*, M. Kulakhmetov*, A. Alexeenko, "DSMC implementation of compact state-specific N2+O dissociation and exchange models", 55th AIAA Aerospace Sciences Meeting, AIAA SciTech Forum, AIAA Paper 2017-1842.

C104. Luo*, H., Macheret, S. O., & Alexeenko, A. A., "Quasi-classical Trajectory Studies of N2+ O Collisions: Trajectory Patterns and Long-lived Configurations." 47th AIAA Thermophysics Conference, AIAA Paper 2017-3166.

C105. Pikus*, A., Berger**, A., Bolliger**, M., Parkos*, D., & Alexeenko, A. (2017). DSMC Aerothermal Study for 3U CubeSat Probes in LEO. In 47th AIAA Thermophysics Conference, AIAA Paper 2017-4027.

C106. K. Fowee*, S. Pugia**, R. Clay**, M. Fuehne**, M. Linker**, A. Cofer, A. Alexeenko, "Quad-Thruster FEMTA Micropropulsion System for CubeSat 1-Axis Control", Proceedings of AIAA/USU Conference on Small Satellites, Paper SSC17-WK-48, August 2017.

C107. H. Luo*, S. Macheret, A. Alexeenko. "First-Principle Calculations of Collision Integrals for N_2-O System", 2018 Joint Thermophysics and Heat Transfer Conference, AIAA AVIATION Forum, AIAA Paper 2018-3586.

C108. N. J. Zuiker, J. Williams, Z. R. Putnam, D. A. Levin, A., M. Goggin, and A. Alexeenko. "Design of a CubeSat Mission to Investigate High-Enthalpy Nonequilibrium Flow Chemistry", 2018 AIAA Aerospace Sciences Meeting, AIAA SciTech Forum, AIAA Paper 2018-1936.

C109. Morgan, J., Nuwal, N., Williams, J., Putnam, Z.R., Levin, D.A., Pikus*, A., Berger**, A. and Alexeenko, A., "Prediction of flight measurements of high-enthalpy nonequilibrium flow from a cubesat-class atmospheric probe", 2018 AIAA Aerospace Sciences Meeting, AIAA Paper 2018-1234.

C110. K. Fowee*, D. Mathur*, N. Franks**, A. Alexeenko, "Characterizing COTS IMU Performance in High Vacuum", Proceedings of AIAA/USU Conference on Small Satellites, Paper SSC18-WKII-07, August 2018.

C111. H. Luo, A. Alexeenko, S.O. Macheret, "Classical Impulsive Models of Nonequilibrium Dissociation for CFD and DSMC", 2019 AIAA Scitech, AIAA Paper 2019-2280.

C112. A Pikus, IB Sebastião, S Jaiswal, M Gallis, AA Alexeenko, "DSMC-SPARTA implementation of majorant collision frequency scheme", AIP Conference Proceedings 2132 (1), 070026, 2019.

C113. S Jaiswal, IB Sebastião, A Strongrich, AA Alexeenko, "FEMTA micropropulsion system characterization by DSMC", AIP Conf. Proceedings 2132 (1), 070006, 2019.

C114. S Jaiswal, IB Sebastião, AA Alexeenko, "DSMC-SPARTA implementation of M-1 scattering model", AIP Conference Proceedings 2132 (1), 070023, 2019.

C115. S Jaiswal, J Hu, AA Alexeenko, "Fast deterministic solution of the full Boltzmann equation on graphics processing units", AIP Conf Proceedings 2132 (1), 060001, 2019.

C116. A Marín C, IB Sebastião, S Tamrazian, D Spencer, A Alexeenko , "DSMC-SPARTA aerodynamic characterization of a deorbiting CubeSat", AIP Conference Proceedings 2132 (1), 070024.

C117. S Jaiswal, J Hu, JK Brillon, AA Alexeenko, "A discontinuous Galerkin fast spectral method for multi-species full Boltzmann on streaming multi-processors", Proceedings of the Platform for Advanced Scientific Computing Conference, 1-9.

C118. SH Collicott, A Alexeenko, S Pugia, "Propulsion Testing in Commercial Re-usable Sub-orbital Rockets", AIAA Propulsion and Energy 2019 Forum, 4354.

C119. SM Pugia, D Mayper, A Cofer, A Alexeenko, "Failure Investigation and Improvement of MEMS Microthruster for SmallSat Attitude Control", AIAA Scitech 2020 Forum, 0928

C120. H Luo, A Alexeenko, SO Macheret, "Verification and Improvement of Impulsive Model for Dissociation of Diatomic Molecules in DSMC", AIAA Scitech 2020 Forum, 1714.

C121. N. Adhikari, A. Alexeenko, "Modeling Nonequilibrium Aerothermochemistry in a General Purpose CFD Solver", Hypersonics 2020 Conference Proceedings, AIAA Paper 2020-2408, April 2020.

Invited Presentations at Conferences

(* indicates the speaker)

I1. E.P. Muntz*, A.A. Alexeenko, S.F. Gimelshein, A.D. Ketsdever, Y.-L. Han, M.P. Young, J.H. Park, C. Ngalande, N.P. Selden, R.H. Lee, "Low Speed Nano/Micro/Meso-Scale Rarefied Flows Driven by Temperature and Pressure Gradients," 25th International Symposium on Rarefied Gas Dynamics, St. Petersburg, Russia, July 21-28, 2006.

I2. J.D. Olliges, A.D. Ketsdever*, W.B. Stein, A.A. Alexeenko, I. Hrbud, "Experimental and Computational Investigation of an RF Plasma Micro-Thruster," 26th International Symposium on Rarefied Gas Dynamics, Kyoto, Japan, July 20-25, 2008.

I3. A. Alexeenko*, "Modeling of Vapor Flow in A Freeze Dryer", Freeze-Drying of Pharmaceuticals and Biologicals Conference, Breckenridge, CO, August 7 – 9, 2008.

I4. A. Alexeenko*, "Micropropulsion Devices: Challenges and Novel Concepts," 2nd Nanotechnology International Forum, Moscow, Russia, October 6-8, 2009.

I5. A. Alexeenko*, A. Ganguly, S. Nail, "Modeling and Simulation of Vapor/Ice Dynamics in Pharmaceutical Freeze-Drying", Freeze-Drying of Pharmaceuticals and Biologicals Conference, Garmisch, Germany, September 27 – October 1, 2010.

I6. A. Alexeenko*, "Controlling the Freeze Drying Process: Simulations and Modeling", World Lyophilization Summit, Cambridge, MA, May 23 – 25, 2011.

I7. A. Alexeenko, W. Chen, D. Peroulis*, "Design, Modeling, and Experimental Validation of High-g MEMS Accelerometers", 50th AIAA Aerospace Sciences Meeting, Nashville, TN, January 9-12, 2012.

I8. A. Alexeenko*, "Fluid Dynamics Modeling for Lyophilization Technology: Quantifying and Reshaping the Design Space", International Society for Lyophilization/Freeze-Drying Midwest Chapter Annual Meeting, April 12, 2012.

I9. A. Alexeenko*, "Modeling of Vapor Flow for Quantification of Design Space and Scale-Up", 2nd World Lyophilization Summit, Boston, MA, May 31, 2012.

I10. A. Ganguly*, S. L. Nail and A. Alexeenko, "Experimental Determination of Key Heat Transfer Mechanisms in Freeze-Drying: Does Convection Matter in Scale-Up?", Freeze Drying of Pharmaceuticals and Biologicals Conference, Breckenridge, CO, August 2012.

I11. A. Alexeenko*, "Freeze-Drying Process Modeling Coupling Product Attributes and Equipment Capability", International Foundation for Process Analytical Chemistry (IFPAC) Annual Meeting 2013, Baltimore, MD, January 22-25, 2013.

I12. A. Alexeenko*, "Elastic Collision Models in DSMC: A Review and Guide", DSMC 2013 Conference, Santa Fe, NM, October 20-23, 2013.

I13. A. Alexeenko*, "Emerging Applications of Rarefied Microflows", 52nd Aerospace Sciences Meeting (SciTech 2014), National Harbor, MD, January 10-14, 2014.

I14. A. Alexeenko*, "Exploring and Exploiting Rarefied Flows for Novel Microdevices", The Fields Institute for Research in Mathematical Sciences, Workshop on Moment Methods in Kinetic Theory II, Toronto, ON, Canada, October 14-17, 2014.

I15. A. Alexeenko*, N. Varma, "In Silico Analysis and Design of Freeze-Drying Systems and Processes", Peptalk 2015, San Diego, CA, January 19-23, 2015.

I16. A. Alexeenko*, "Exploring and Exploiting Rarefied Flows for Novel Microdevices", Nonequilibrium Flow Phenomena Workshop, Khristianovich Institute of Theoretical and Applied Mechanics, Novosibirsk, Russia, June 15-18, 2015.

I17. A. Alexeenko*, "Microdevices Enabled by Rarefied Flow Phenomena", 30th International Symposium on Rarefied Gas Dynamics, Victoria, BC, Canada, July 2016.

I18. A. Alexeenko*, I. Sebastiao, T. Robinson, "Heat and Mass Transfer in Spray Freeze-Drying", CPPR 2016: Freeze Drying of Pharmaceuticals & Biologicals Conference, Breckenridge, CO, July 2016.

I19. A. Alexeenko*, "Computational Modeling for Improved Lyophilization Process Understanding and Scale-Up", NIPTE Research Conference, US Food and Drug Administration, White Oak Campus, October 3-4, 2016.

I20. A. Alexeenko*, "Germs, Blood and Spies: Stories and Lessons from Early Freeze-Drying Era", Opening Keynote at 8th International Society of Lyophilization/Freeze-Drying (ISLFD) International Conference, Havana, Cuba, April 2017.

I21. A. Alexeenko*, "Investigating Differences in Laboratory and Production Lyophilizers via Computational Analysis to Overcome Scale Up Issues", AAPS 2017 AAPS National Biotechnology Conference, May 1-3, 2017, San Diego, CA.

I22. A. Alexeenko*, I. Sebastiao*, A. Venkattraman*, "Collision modeling in DSMC. Legacy algorithms and new developments", short course at 2017 DSMC Conference, Santa Fe, NM, August 27, 2017.

I23. A. Alexeenko*, "Microdevices Exploiting Thermally-Driven Rarefied Flows", MIniaturized Gas flow for Applications with enhanced Thermal Effects (MIGRATE) 3rd International Summer School, June 24-25, 2018, Bastia, France.

I24. A. Strongrich, A. Alexeenko*, "Wireless Pressure Sensors for Enhanced Process Monitoring and Control in Lyophilization", Freeze-Drying of Pharmaceuticals and Biologicals Conference, Garmisch-Partenkirchen, Germany, September 18-21, 2018.

I25. A. Alexeenko*, "Upscaling and Validation of Ab Initio Modeling for Hypersonic Flow Simulations", The 2nd International Symposium on Hypersonics, Seoul, Republic of Korea, October 24-27, 2018.

I26. G.V. Reklaitis, A. Alexeenko, "Advances in Continuous Pharmaceutical Manufacturing & Challenges for Lyophilization", International Society of Lyophization/Freeze-Drying Meeting, Chicago, IL, April 11, 2019.

I27. A. Alexeenko, "Taming Fire: Molecular Simulations of Combustion", Graeme Bird Keynote Lecture, DSMC 2019, Santa Fe, NM, September 24, 2019.

I28. A.Alexeenko, I. Sebastiao, P. Kazarin,A.Chinnapan, "Taming Fire at Microscale: Molecular Simulations and Devices for Microcombustion", Keynote lecture, ISTEGIM, October 24, 2019, Ettlingen, Germany.

Invited Seminars at Universities, Industry and Government Laboratories

S1. "Thermally Driven Microflows: Phenomena and Modeling Approaches," School of Engineering, University of Vermont, October 20, 2006.

S2. "Modeling of Gas Flows in Freeze-Drying Systems," Baxter BioPharma, Bloomington, IN, November 16, 2007.

S3. "Thermally Driven Microflows: Phenomena and Modeling Approaches," Department of Mathematical Sciences at the George Mason University, November 30, 2007.

S4. "Cluster Formation in Supersonic Jets," Veeco Instr., St. Paul, MN, May 1, 2008.

S5. "Modeling of Flows with Translational Non-Equilibrium," invited seminar at the Computational Sciences Branch, AFRL-RB, Wright-Patterson AFB, January 22, 2009.

S6. "Fluid Dynamics of Pharmaceutical Freeze-Drying: Phenomena and Modeling Approaches," Department of Pharmaceutical Chemistry, The University of Kansas, Laurence, KS, January 27, 2009.

S7. "Gas-Phase Effects in Electrostatically Actuated MEMS," Laboratory for Computational Physics and Fluid Dynamics, Naval Research Laboratory, Washington, DC, May 7, 2009.

S8. "Freeze-Drying Condenser Modeling", IMA Edwards Pharmaceutical Systems (now IMA Life), Tonawanda, NY, November 12, 2009.

S9. "Advanced DSMC/CFD Modeling of Vacuum Deposition Systems", Veeco Instruments, St. Paul, MN, January 11, 2011.

S10. "Knudsen Forces at the Microscale: Key Mechanisms, Modeling Approaches and Pathways to Practical Devices", Oak Ridge National Laboratory, Oak Ridge, TN, March 8, 2011.

S11. "Modeling and Measurements of Vapor/Ice Dynamics for Freeze-Drying Technology", Pfizer Inc., Andover, MA, May 23, 2011.

S12. "Advanced DSMC/CFD Modeling for Freeze-Drying Technology", SP Scientific, Gardiner, NY, July 25, 2011.

S13. "Fluid Dynamics of Freeze-Drying: Phenomena, Modeling Approaches and Implications for Process Design", Department of Pharmaceutical Sciences, The University of Connecticut, September 20, 2011.

S14. "Fluid Dynamic Modeling for Lyophilization Technology: Quantifying and Reshaping the Design Space", Abbott Laboratories, Chicago, IL, December 8, 2011.

S15. "Accelerated Lyophilization for Bio/Pharmaceuticals", seminar at Department of Industrial and Physical Pharmacy, Purdue University, February 2013.

S16. "Emerging Applications of Rarefied Gas Dynamics", seminar at the Department of Aerospace Engineering, University of Illinois, Urbana-Champaign, October 2013.

S17. "Emerging Applications of Rarefied Gas Dynamics", seminar at the Department of Aerospace Engineering, University of Texas at Austin, February 2014.

S18. "Microdevices Enabled by Rarefied Flow Phenomena", Fluids seminar, University of Illinois, Urbana-Champaign, February 2017.

S19. A. Alexeenko and G. Paniagua, "Hyperloop101: Fundamentals of High-Speed Vacuum Tube Transportation", Purdue President's Faculty Colloquium, October 11, 2017.

S20. A. Alexeenko, "Microdevices Enabled by Nonequilibrium Gas Flow Phenomena", Mechanical Engineering Seminar, University of Nevada, Reno, April 5, 2019.

S21. A. Alexeenko, "Microdevices Enabled by Rarefied Flows", Mechanical Engineering Seminar, University of Pennsylvania, February 4, 2020.

S22. A. Alexeenko and E. Topp, "Modeling for Lyophilization", Division of Manufacturing and Product Quality, US Food and Drug Administration, February 25, 2020.

Software and Online Tools

T1. Co-Developer, "SMILE: Statistical Modeling in Low-density Environment." A general purpose 2D/3D parallel DSMC solver developed in Khristianovich Institute of Theoretical and Applied Mechanics.

T2. Author and Developer, "Gas Dynamics Toolbox": http://web.ics.purdue.edu/~alexeenk/GDT

T3. Co-Author, "Q-UQ: Q-factor Calculator with Uncertainty Quantification": http://nanohub.org/resources/6759

T4. Co-Author, "Coarse-Grained Model of RF MEMS Device": http://nanohub.org/resources/prismcg

T5. Co-Author, "LyoPRONTO: an Open-Source Lyophilization Process Optimization Tool", http://lyopronto.org

FUNDED RESEARCH PROGRAMS

Total external awards as PI or Co-PI: $26,246,400
Total external award budget directly responsible for: $6,883,100
Principal Investigator on 30+ sponsored research projects

TEACHING AND MENTORING

Contributions to Curriculum

Introduction to Fluid Mechanics (*AAE333*): revised the core undergraduate course in Spring 2014 through Purdue's *IMPACT: Instruction Matters, Purdue Academic Course Transformations* program with an overarching goal to improve learning outcomes by applying research findings on student-centered learning and teaching. The student interactions have been enhanced through in-class active learning exercises and by providing more immediate feedback in the large-enrollment sections through online quizzes and Q&A on Piazza. An example of new in-class activities is a Fluids-themed Jeopardy! game that easily gets students engaged but also helps re-consolidate and strengthen knowledge by fast recall. Integrative project-based learning through team design projects has enhanced the AAE333 curriculum.

Molecular Gas Dynamics (AAE590): developed a new graduate course providing an introduction to gas kinetic theory, numerical methods for solution of the Boltzmann equations and rarefied gas dynamics applications. First taught in 2006 with distance sections delivered in Fall 2014, 2016 and 2018.

Unsteady Aerodynamics (AAE517), a re-organized graduate course on analysis of unsteady incompressible and compressible flows. Reintroduced in Fall 2009 with significant new material after not being taught at AAE for over 15 years.

Introduction to Uncertainty Quantification (AAE590/ME597), a new graduate class developed together with Prof. Jayathi Murthy (ME) focusing on quantification of uncertainty in simulations for engineering analysis. First taught in Fall 2010.

Principles of Pharmaceutical Engineering (CHE551/AAE/ABE/IPPH/ME), coordinated this seminar-based course together with Professor Gintaras Reklaitis. The course is designed to provide a "big picture" view of the pharmaceutical industry including structure and key players, economic and regulatory context, product pipeline dynamics and current manufacturing technology. First taught in Spring 2019 with 7 co-instructors.

Russian, Rockets and Space (HONR399)*,* in collarboation with Dr. Olga Lyanda-Geller/College of Liberal Arts developed and taught a new course for students in Honors College to learn about space exploration history, current space technologies and space policy while simultaneously gaining a basic proficiency in the Russian language.

Undergraduate Project-Based Design Courses

Hyperloop Design (AAE450/490/590) Fall 2015, Spring 2016 This is a course themed around SpaceX Hyperloop Design competition launched in 2015. The student team developed the original Purdue Hyperloop pod design and has been selected to advance to Build phase among 22 out of over 100 teams worldwide at Hyperloop Design Weekend

at Texas A&M in January 2016. The Purdue Hyperloop placed #7 at SpaceX Hyperloop Test Weekend in August 2017 in Hawthorne, CA. Overall student enrollment of over 60 from AAE, ME, CS, ECE and other schools.

Fundamentals of Vacuum Experiment and Micropropulsion/FEMTA (AAE490) developed and taught this project-based course more than 10 times as individual independents studies and team project course in High-Vacuum Laboratory at Purdue ASL. The course provides a hands-on introduction to vacuum system instrumentation, design and operation. Taught as 4-5 member student team projects since Spring 2017 with enrollment limit set by the lab safety requirements in HVL. Course projects resulted in development of several experimental facilities such as Chambers A and C which are now used in various research and teaching activities. Students wrote and presented conference papers, have been selected for SmallSat16 Cubesat Workshop presentation, won 1st place presentation in AIAA Student Regional Conference and 1st place in Team Category at International Student conference competition at AIAA SciTech 2019.

CubeSat Design-Build-Fly SASSI2 (AAE450/490) developed and taught this hands-on design-build-fly spacecraft design course based on NASA Undergraduate Spacecraft Instrument Program project "Student Aerothermal Spectrometer Satellite of Illinois and Indiana – SASSI2". Over 60 students enrolled in 6 semesters starting Summer 2016 designed, tested and built a Cubesat-based instrument for measuring hypersonic re-entry flow. The instrument was delivered to UIUC for integration into 3U spacecraft in Spring 2018 and has been launched as part of NG-11 mission on Antares vehicle carrying Cygnus spacecraft to ISS on April 17, 2019. The student-authored paper was selected for podium presentation in SmallSat17. Student team contributed a book chapter to *Nanosatellite Revolution* (Ed. Henry Helvajian) to be published by Aerospace Corporation.

FEMTA Suborbital Spaceflight Test (AAE450/490 and ENGR 279/379/479 VIP) is a multidisciplinary project sponsored by NASA REDDI spaceflight opportunity program centered on a micropropulsion technology experiment to be flown in space on a reusable suborbital space launch vehicle. The goal of the experiment is to test a novel zero-gravity propellant management system for use with FEMTA thruster for smallsats. FEMTA student team designs and develops the hardware as well as flight and test software for a Blue Origin's New Shepard launch date in 2021.

Graduate Advisees Who Completed PhD Degree

1. William Stein (May 2008, co-advisor: I. Hrbud); *"Investigations of Microscale Fluid-Thermal Phenomena Based on the Deterministic Boltzmann-ESBGK Model";* now Propulsion Tech Fellow at Jacobs/NASA Marshall, Huntsville, AL

2. Xiaohui Guo (Aug 2006-May 2009); *"Investigations of Microscale Fluid-Thermal Phenomena Based on the Deterministic Boltzmann-ESBGK Model";* now at Xiaomi
- Amelia Earhart Fellowship from Zonta International, 2009
- AAE Doctoral Dissertation Award, 2009

3. Sruti Chigullapalli (Aug 2008-Dec 2011); *"Deterministic Approach for Unsteady Rarefied Flow Simulations in Complex Geometries and its Application to Gas Flows in Microsystems";* now at Intel

- Best Poster Awards at RGD Symposium in 2010, DOE PRISM reviews in 2010 and 2011 and ASME IMECE-2011 Nanotechnology Forum

4. Venkattraman Ayyaswamy (Aug 2009-Aug 2012); *"Particle Simulations of Ion Generation and Transport in MEMS and Micropropulsion";* now Assistant Professor at UC Merced

- AAE Doctoral Dissertation Award, 2012; Purdue nominee for D. Chorafas award

5. Arnab Ganguly (Aug 2010-Dec 2014); *"Coupled Fluid-Thermal Analysis of Low-Pressure Sublimation and Condensation with Application to Freeze-Drying";* now Scientist & Technology Manager, IMA Life

- Best poster, Purdue Office of Interdisciplinary Graduate Programs Spring 2012
- 2012 Baxter Young Investigator Award
- T. Jennings Best Poster Award, International Society of Lyophilization/Freeze-Drying, Chicago, IL, April 2013

6. Andrew Weaver (Aug 2010-May 2015); *"Assessment of High-Fidelity Collision Models in the Direct Simulation Monte Carlo Method"*; now at NASA Marshall

7. Anthony Cofer (Aug 2010-Dec 2015; co-advisor: Stephen Heister); *"Film-Evaporation Mems Tunable Array for Micropropulsion"*; now Spacecraft Laboratory Engineer at Purdue

- 2014 Purdue Forever Fellowship

8. Marat Kulakhmetov, (Aug 2011-May 2016); "Upscaling Ab Initio Chemistry Models to Nonequilibrium Flow Simulations", now at Blue Origin

- 2012-2015 Sandia Excellence in Science and Engineering Fellowship

9. Siva Sashank Tholeti, (Aug 2013-Aug 2016); *"Particle Modeling of Nonequilibrium Field Emission Driven RF Microplasmas"*; now at COMSOL Inc.

10. Matthew Lakebrink, (Aug 2011–Dec 2016; co-advisor Steven Schneider); "*A Numerical Investigation of Crossflow Instability on the HIFIRE-5*", now at Boeing

- One of the first distance PhDs completed in AAE

11. Israel Borges Sebastiao (Jan 2013 – Aug 2017); "Ab Initio Collision Models for DSMC Simulations and Their Applications to Reacting Flows"; now at Pfizer Inc.

- 2013-2017 CNPq PhD Fellowship
- T. Jennings Best Poster Award, International Society of Lyophilization/Freeze-Drying, Chicago, IL, April 2015

12. Cem Pekardan (Aug 2013 – Aug 2017); "Rarefaction Effects in Low Reynolds Number Supersonic and Transonic Aerodynamics"; now at Virgin HyperloopOne

13. Devon Parkos (Jan 2014 – Aug 2017); *"Hypersonic Chemosynthesis via Ejecta Reentry"*; now at Blue Origin

- 2013-2016 NSF Graduate Research Fellowship

14. Gayathri Shivkumar (Aug 2015 – Aug 2019); "Coupled Plasma, Fluid and Thermal Modeling of Low Pressure and Microscale Discharges"; then at AbbVie Inc.

- Rich Fellowship 2017, Bilsland Fellowship 2018-2019
- T. Jennings Best Poster Award, International Society of Lyophilization/Freeze-Drying, Chicago, IL, April 2018.

15. Han Luo (August 2016 – August 2020; co-advisor Sergey Machaeret); "Multiscale Computational Analysis and Modeling of Thermochemical Nonequilibrium Flow" , then at Applied Materials.

Graduate Advisees Who Completed MS Thesis

1. Sruti Chigullapalli, May 2008, *"Application of High-Order Numerical Schemes for the Boltzmann Transport Equations to Non-Equilibrium Flows"*

2. Venkattraman Ayyaswamy, May 2009, *"Simulations of Low-Density Gas Droplet Supersonic Flows Expanding into Vacuum"*

3. Arnab Ganguly, May 2010, *"Simulation and Experiments of Low-Pressure Water Vapor Flows Applied to Freeze-drying"*

4. Jeremy Nabeth, May 2010, *"Numerical Simulation of Knudsen Forces in Microsystems"*; then at Samsung Semi, Austin, TX.
   - Best Poster Awards at RGD Symposium in 2010 and DOE PRISM review in 2010

5. Andrew Weaver, May 2010, *"Analysis of Flowfield and Surface Heat-Flux Uncertainties Under Typical Blunt-Body Re-entry Conditions"*

6. Marat Kulakhmetov, May 2011, *"Quantification of Modeling Uncertainties in Hypersonic Nonequilibrium Flows"*; now at Purdue.

7. Siva Tholeti, May 2013, *"Particle Modeling of Expansion of Microplasma Generated by Resonance Enhanced Multiphoton Ionization"*; then at Purdue.

8. Mizuki Wada, August 2013, *"Modeling and Quantifying Thermal Knudsen Forces on Microcantilevers"*, then at J. P. Morgan Japan.

9. Cem Pekardan, August 2013, *"Immersed Boundary Method for Boltzmann Model Kinetic Equations and Its Applications to Microscale Gas Damping"*.

10. Devon Parkos, December 2013, *"Chemical Consequences of Chixculub Impact Ejecta Reentry"*.

11. Di Huang, MS, August 2014, *"Numerical Simulation of Hydrogen Plasma in MPCVD Reactor"*.

12. Nikhil Varma, MS, December 2014, *"Computational Fluid Dynamics Analysis of Freeze-Drying Process and Equipment"*.

13. Bill O'Neill, MS, December 2015, *"Heat and Mass Transfer Analysis of a Film Evaporative MEMS Tunable Array"*.

14. Andrew Strongrich, MS, August 2015, *"Microscale Radiometer based on the Knudsen Thermal Force"*
   - 2013 Andrews Fellowship

15. Gayathri Shivkumar, August 2015, *"Analysis of Hydrogen Plasma in MPCVD Reactor"*.

16. Han Luo, August 2016, *"Ab Initio Based State Specific Modeling of N2+O System"*.

17. Aizhan Ibrayeva, August 2017, "*Numerical Modeling of Thermal Edge Flow*".

18. Vaibhav Kshirsagar, December 2017, "*Development and Validation of Vapor Flow Modeling in Lyophilizers*", now at IMA Life.

19. Shashank Jaiswal, August 2018, "*Discontinuous Galerkin Fast Spectral Method for Full Boltzmann Equation with General Collision Kernels: Theory, Computation, and Applications*", now at Purdue.

20. Kate Fowee, August 2018, *"Micropropulsion Trade Study and Investigation for Attitude Control of Nanosatellites"*, now at Purdue.

21. Aaron Pikus, May 2019, "Numerical Simulations and Characterization of Thermally Driven Flows on the Microscale", now at General Atomics.

22. Steven Pugia, August 2020, "Reliability Investigation and Design Improvement of FEMTA Microthruster", now at Purdue.

Current Graduate Advisees

1. Andrew Strongrich, PhD, started Fall 2015
   - T. Jennings Best Poster Award, International Society of Lyophilization/Freeze-Drying, Chicago, IL, April 2016
   - Purdue Forever Fellowship, 2018-2019.
2. Kate Fowee, PhD, started Fall 2018.
   - Aviation Week and Space Technology 20 Twenties 2018
3. Shashank Jaiswal, PhD, started Fall 2018.
4. Steven Pugia, PhD, started Fall 2020.
5. Nirajan Adhikari, PhD, started Fall 2018.
6. Joshua Strafaccia (Co-Advisor: Sally Bane), PhD, started Fall 2018.
7. Ann Marie Karis, MS, started Fall 2019.
8. Nadia Numa, PhD (Co-Advisor: Kathleen Howell), started Fall 2019

Post-Doctoral and Visiting Scholars

1. Wei Su, visiting PhD student from Beijing University of Aeronautics and Astronautics, August 2011 – August 2012.
2. Anthony Cofer, post-doctoral associate, January 2016 – October 2017, then Spacecraft Laboratory Engineer, Purdue AAE.
3. Tong Zhu, post-doctoral associate, September 2016 – August 2018, then Senior Scientist, AbbVie Inc.
4. Tatshuhiro Kodama, LyoHUB visiting scientist from Daichii Sankyo, Japan, March 2017 – March 2018.
5. Israel Sebastiao, post-doctoral associate, July 2017 – August 2018, then at Pfizer Inc.
6. Arun Chinnappan, India-Purdue visiting PhD student, February 2019 – February 2020.
7. Petr Kazarin, post-doctoral associate, February 2019 – current.

SERVICE

Profession: Organizing and Technical Committees

American Institute of Aeronautics and Astronautics (AIAA), Associate Fellow
AIAA Thermophysics Technical Committee:
      Chair, 2016 – 2018; Chair-Elect, 2015-2016; Voting Member, 2007 – present
      Liaison to Fluid Dynamics Technical Committee, 2008 – 2015
      Member, Awards Subcommittee, 2009 – 2012
National Institute for Pharmaceutical Technology Education (NIPTE) faculty committee:
      Advanced Manufacturing focus group, 2019-now

International Advisory Committee, Rarefied Gas Dynamics Symposium, 2016 – current
U.S. Organizing Committee, 27th International Symposium on Rarefied Gas Dynamics, Pacific Grove, CA, July 10 – 15, 2010.

Chaired 20+ sessions on Non-Equilibrium Flows, Direct Simulation Monte Carlo, Microfluidics, Microscale Heat Transfer at AIAA meetings in 2007 – 2015; International Rarefied Gas Dynamics Symposium in 2010 and 2014, 20th International Symposium on Plasma Chemistry in 2011, 2015 ASME ICNMM conference.

Selection Committee for Young Scientists Competition, 2nd International Nanotechnology Forum, October 6 – 8, 2009, Moscow, Russia.

Purdue University: School, College, and University Service

Chair, College of Engineering Inclusion, Diversity, Equity Advancement Leadership (IDEAL) Committee, February 2019 – now
Chair, Undergraduate Advisory Council, College of Engineering, August 2019 – now
Chair, Grade Appeals Committee, August 2019 – now
Faculty Advisor to student organizations
  Purdue Women in Aerospace student organization, 2017 – present
  Sigma Gamma Tau Honor Society, 2007 – 2013
AAE 10-year External Report Committee, 2017
Search Committees:
  AAE: Faculty Search, 2010–15, Director of Comm. and Marketing, 2018, Hypersonics Faculty Search, 2018-19
  College of Engineering: ME Heat Transfer Faculty, 2011,2014; Predictive Science and Engineering, Cluster Hire Committee, 2013-15; Cold Plasma Preeminent Team Search, 2014-15, 2018-19
  Dean of Engineering Search Advisory Committee, 2016-2017
  Birck Nanotechnology Center, Associate Directors Search, 2019
AAE Curriculum Committee, 2012-2014
Engineering Curriculum Committee, College of Engineering, 2014-2016
Educational Coordinator, NNSA PRISM Center, 2008 – 2014.
AAE Computer Committee, 2007 – 2012

Reviewing Activities

AIAA J., Chemical Engineering Science, Eur. J. of Pharmaceut. Biopharmaceut., Int. J. of Numerical Methods for Heat and Fluid Flow, J. of Applied Physics, J. of Applied Thermal Engineering, J. of Spacecraft and Rockets, J. Thermophysics and Heat Transfer, Int. J. of Thermal Sciences, J. of Fluid Mechanics, J. of Micromechanics and Microengineering, J. of Microelectromechanical Systems, J. of Vacuum Science and Technology A, Physics of Fluids, Vacuum

Professional Certification

Engineer-in-Training (FE Exam), California Board for Professional Engineers and Land Surveyors, 2005

Professional Development
IMPACT: Instruction Matters, Purdue Academic Course Transformations, Spring 2014
Leadership Skills for Engineering and Science Faculty, March 2014
10.03x: Making Biologic Medicines for Patients: The Principles of Biopharmaceutical Manufacturing, MITx on edX, Summer 2016
Executive Leadership in Academic Technology and Engineering (ELATE), Drexel University, 2018 - 2019

Professional Societies

Associate Fellow of AIAA; Member of American Association for the Advancement of Science; Society of Women Engineers; American Vacuum Society; Nuclear and Plasma Sciences Society at Institute of Electrical & Electronics Engineers; American Society of Mechanical Engineers