



Exponent®

Engineering & Scientific Consulting

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Professional Profile

Dr. Zimmerman is a physicist with a research background in magnetohydrodynamics and turbulence in rotating fluids. He brings extensive professional experience in robotics hardware development, hydrokinetic energy R&D, and software development. This includes experience in electromechanical and electronics design, sensors and signal processing, embedded systems and firmware, mechanical and electromagnetic simulation, real-time control, and robotics motion planning. He has experience in C, C++, and Python software development, robotics software frameworks and simulation tools including Robot Operating System (ROS) and Gazebo, and numerous engineering design and analysis tools including SOLIDWORKS and Abaqus.

Prior to joining Exponent, Dr. Zimmerman worked for several years in robotics software design and development, including ROS 2 application development with soft-real-time requirements and algorithm selection and implementation for robotic manipulator motion planning with obstacle avoidance, singularity avoidance, and other constraints.

Dr. Zimmerman has additionally acted as the primary investigator for federal R&D contract projects funded by the Office of Naval Research and Department of Energy. He led the detailed design and performance characterization of an autonomous amphibious vehicle platform with compliant-mechanism thrusters, contributing embedded systems and control design, robot firmware and software development, actuator and mechanism design, and nonlinear dynamic finite element analysis (FEA) simulation of compliant components. He also developed software for laboratory automation, experimental and simulation data postprocessing, and automated setup and metadata management for parametric FEA studies.

Dr. Zimmerman received his Ph.D. from University of Maryland, College Park. During his Ph.D., he helped to design, construct, and commission one of the largest liquid metal magnetohydrodynamic research facilities in the world, contributing to the electrical systems design, structural engineering, thermal management systems, and instrumentation design. He studied the behavior of rapidly rotating and magnetized shear flow, contributing significantly to the understanding of bi-stable coexistence of multiple dynamic states in highly turbulent flow.

Academic Credentials & Professional Honors

Ph.D., Physics, University of Maryland, College Park, 2010

B.S., Physics, Clarkson University, 2001

Prior Experience

Chief Scientist, Polarworks, 2020-2022

Director of Science and Engineering, Pliant Energy Systems, 2013-2020

Faculty Research Assistant, University of Maryland, College Park, 2009-2013

Research Assistant, University of Maryland, College Park, 2001-2009

Patents

U.S. Patent 10,060,406: Apparatuses, methods and systems for harnessing fluid flow with flexible mechanical transducers, Aug 2018 (Filardo, B.P., Weaker M.I.)

U.S. Patent 11,209,022: Vehicle with traveling wave thrust module apparatuses, methods and systems, Dec 2021 (Filardo B.P., Weaker, M.I.)

Publications

Adams, M. M., Stone, D. R., Zimmerman, D. S. and Lathrop, D. P., Liquid sodium models of the Earth's core, Progress in Earth and Planetary Science, 2015, Vol. 2(1), pp. 29

Triana, S. A., Zimmerman, D. S., Nataf, H.-C., Thorette, A., Lekic, V. and Lathrop, D. P., Helioseismology in a bottle: modal acoustic velocimetry, New Journal of Physics, IOP Publishing, 2014, Vol. 16(11), pp. 113005

Zimmerman, D. S., Triana, S. A., Nataf, H.-C. and Lathrop, D. P., A turbulent, high magnetic Reynolds number experimental model of Earth's core, Journal of Geophysical Research: Solid Earth, 2014, Vol. 119(6), pp. 4538-4557

Rieutord, M., Triana, S. A., Zimmerman, D. S. and Lathrop, D. P., Excitation of inertial modes in an experimental spherical Couette flow, Phys. Rev. E, American Physical Society, 2012, Vol. 86, pp. 026304

Triana, S. A., Zimmerman, D. S. and Lathrop, D. P., Precessional states in a laboratory model of the Earth's core, J. Geophys. Res., AGU, 2012, Vol. 117(B4), pp. B04103-

Matsui, H., Adams, M. M., Kelley, D. H., Triana, S. A., Zimmerman, D. S., Buffet, B. and Lathrop, D. P., Numerical and experimental investigation of shear-driven inertial oscillations in an Earth-like geometry, Physics of the Earth and Planetary Interiors, 2011, Vol. 188, pp. 194 - 202

Zimmerman, D. S., Triana, S. A. and Lathrop D., P., Bi-stability in turbulent, rotating spherical Couette flow, Physics of Fluids, AIP, 2011, Vol. 23(6), pp. 065104

Kelley, D. H., Triana, S. A., Zimmerman, D. S. and Lathrop, D. P., Selection Of Inertial Modes In Spherical Couette Flow, Phys. Rev. E, American Physical Society, 2010, Vol. 81(2), pp. 026311

Triana, S. A., Kelley, D. H., Zimmerman, D. S., Sisan, D. R. and Lathrop, D. P., Hopf Bifurcations With Fluctuating Gain, Astronomische Nachrichten, WILEY-V C H VERLAG GMBH, 2008, Vol. 329(7), pp. 701-705

Kelley D. H., Triana, S. A., Zimmerman, D. S., Tilgner, A. and Lathrop, D. P., Inertial Waves Driven By Differential Rotation In A Planetary Geometry, Geophysical and Astrophysical Fluid Dynamics, 2007, Vol. 101, pp. 469-487

Kelley, D. H., Triana, S. A., Zimmerman, D. S., Brawn, B., Lathrop, D. P. and Martin, D. H., Driven Inertial

Waves In Spherical Couette Flow, Chaos, 2006, Vol. 16(4)

Zimmerman, D. S., Triana, S. A., Sisan, D. R., Tillotson, W. A., Dorland, W. and Lathrop, D. P., Characterization of the Magnetorotational Instability from a Turbulent Background State, AIP Conference Proceedings, 2004, Vol. 733(1), pp. 13-20

Mihóková, E., Schulman, L. S., Nikl, M., Gaveau, B., Polák, K., Nitsch, K. and Zimmerman, D. S., Temperature Dependence Of Anomalous Luminescence Decay: Theory And Experiment, Phys. Rev. B, American Physical Society, 2002, Vol. 66(15), pp. 155102

Nikl, M., Boháček, P., Mihóková, E., Solovieva, N., Martini, M., Vedda, A., Fabeni, P., Pazzi, G. P., Kobayashi, M., Ishii, M., Usuki, Y. and Zimmerman, D. S., Modification Of PbWO₄ Scintillator Characteristics By Doping, Journal of Crystal Growth, 2001, Vol. 229(1-4), pp. 312 – 315

Walters M. J., Garland, J. E., Pettit, C. M., Zimmerman, D. S., Marr, D. R. and Roy, D., Weak Adsorption Of Anions On Gold: Measurement of Partial Charge Transfer Using Fast Fourier Transform Electrochemical Impedance Spectroscopy, Journal of Electroanalytical Chemistry, 2001, Vol. 499(1), pp. 48 – 60

Presentations

Zimmerman, D.S., A Laboratory Planetary Core: Invited Talk, Session 1.2 Experimental MHD and Hydrodynamic Processes, XIIth IAGA Scientific Assembly; Merida, Yucatan, Mexico, 2013.

Zimmerman, D.S., Planetary Fluid Mechanics in the Lab: Invited Talk, University of Colorado Boulder Fluid and Thermal Sciences Seminar Series; Boulder, CO, 2013.

Zimmerman, D.S., Turbulence, Waves, Transport (and Perhaps Dynamo) in Laboratory Model Cores: Invited Talk, European Geosciences Union General Assembly; Vienna, Austria, 2012.

Zimmerman, D.S., Triana, S.A., and Lathrop, D.P., Hydromagnetic Waves and Progress in the University of Maryland Three Meter Experiment: Poster Presentation, American Geophysical Union Fall Meeting; San Francisco, CA, 2012.

Zimmerman, D.S., Triana, S.A., and Lathrop, D.P., Angular Momentum Transport in Turbulent Spherical Couette Flow: Poster Presentation, American Geophysical Union Fall Meeting; San Francisco, CA, 2011.

Zimmerman, D.S., Triana, S.A., and Lathrop, D.P., Spatial variation of angular momentum transport in turbulent spherical Couette flow: Contributed Talk, 64th Annual Meeting of the American Physical Society Division of Fluid Dynamics; Baltimore, MD, 2011.

Zimmerman, D.S., Triana, S.A., and Lathrop, D.P., Bi-Stable Turbulent Spherical Couette: Contributed Talk, 62nd Annual Meeting of the American Physical Society Division of Fluid Dynamics; Minneapolis, MN, 2009.

Zimmerman D. S., Brawn, B., and Lathrop D.P., Hydromagnetic Taylor-Couette Experiments in Liquid Sodium: Contributed Talk, 60th Annual Meeting of the American Physical Society Division of Fluid Dynamics; Salt Lake City, UT, 2007.