John A. Palmore JR — PhD

Assistant Professor – Mechanical Engineering, University of Washington
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Expertise

Dr. John Palmore Jr leads the C*ombustion, A*t*omization, M*u*ltiphase, & P*a*rticulate* Phy*sics* R*esearch &* E*ducation* (CAMP-PhyRE) group at the University of Washington. CAMP-PhyRE studies a wide range of problems in the energy and the environment sectors. The unifying tread of the research is a focus on multiphase flows, *i.e.*, fluid flows of bubbles, droplets, and particles in a carrier fluid. CAMP-PhyRE currently has open projects in spray & droplet combustion for aviation engines, environmental dust & ice particle ingestion in aviation engines, and hydroacoustic methods for invasive fish species deterrence. CAMP-PhyRE deploys a wide range of strategies to study multiphase flows including mathematical analysis, an in-house high fidelity numerical solver, commercial computational fluid dynamics packages, and open-source machine learning tools.

Dr. Palmore also performs education research which focuses on increasing engagement of students in the classroom and improving educational outcomes in fluid dynamics.

Cornell University
PhD in Aerospace Engineering *2012–2018*
Thesis: Numerical Framework for Simulating Multiphase Flows with Phase Change
Advisor: Professor Olivier Desjardins, PhD
MS in Aerospace Engineering *2012–2015*

University of Alabama
BS in Aerospace Engineering *2008–2012*
Honors: Magna Cum Laude

Experience

University of Washington
Assistant Professor, Mechanical Engineering *2024–NOW*

Virginia Tech
Assistant Professor, Mechanical Engineering *2018–2024*

Cornell University
Postdoctoral Researcher, Mechanical and Aerospace Engineering *2018*
Graduate Researcher, Mechanical and Aerospace Engineering *2012–2018*

NASA Marshall Space Flight Center
Propulsion Academy Intern, NASA Academy *2012*

University of Alabama
Undergraduate Researcher, Aerospace Engineering and Mechanics *2010–2012*

Awards and Fellowships

New Investigator Award
Virginia Space Grant Consortium *2021*

Air Force Summer Faculty Fellowship
US Air Force Research Lab, Aerospace Systems Division *2021*

NSF Graduate Research Fellowship
National Science Foundation *2012*

Minority PhD Fellowship
Alfred P. Sloan Foundation *2012*

Outstanding Senior
University of Alabama, Department of Aerospace Engineering and Mechanics *2012*

Tau Beta Pi
University of Alabama *2012*

Outstanding Junior
University of Alabama, Department of Aerospace Engineering and Mechanics *2011*

McNair Scholar
University of Alabama *2011*

Grants Awarded

Particle Dispersion Modeling
Rolls-Royce Corporation
Role: PI (100% Responsibility)
01 May 2023 – 15 Jan 2024 *$58,017*

Effects of Gravity on Droplet Evaporation and Combustion of Liquid Fuels
Institute for Critical Technology and Applied Science at Virginia Tech
Role: PI (100% Responsibility), Collaborator : Y. Xu (Clemson University)
01 Jan 2023 – 30 Jun 2024 *$20,000*

Modeling acoustic fields using OpenFOAM to determine fish deterrence
US Army Engineer Research and Development Center
Role: PI (75% Responsibility), Collaborator: N. Alexander
30 Sep 2022 – 29 Sep 2025 *$338,731*

Generalization of the Impact of Airborne Particulates on Different Sizes of Engines
Pratt & Whitney - Rolls-Royce Academic Alliance
Role: Co-PI (16% Responsibility), Collaborators: C. Son (PI), M. Caddick, T. Lowe, W. Ng, R. Qiao
01 Jan 2023 – 31 Dec 2023 *$500,000*
07 July 2022 – 31 Dec 2022 *$300,000*

Engine Environmental Protection–Non-Aqueous Particulates
Rolls-Royce Corporation
Role: Co-PI (15% Responsibility), Collaborators: C. Son (PI), M. Caddick, T. Lowe, W. Ng, R. Qiao
01 Jan 2023 – 31 Dec 2023 *$225,000*
01 Jan 2022 – 31 Dec 2022 *$225,000*
01 Jan 2021 – 31 Dec 2021 *$225,000*

01 May 2020 – 31 Dec 2020 *$167,000*

The motion of inertial particles in canonical flows
Sloan Scholars Mentoring Network
Role: PI (100% Responsibility)

10 Aug 2021 – 31 Aug 2022 *$17,470*

Predicting motion of engine-ingested ice using machine learning
NASA (via Virginia Space Grant Consortium)
Role: PI (100% Responsibility)

01 Mar 2021 – 31 Aug 2022 *$10,000*

Professional Memberships

American Institute of Aeronautics Astronautics

American Physical Society
Forum for Early Career Scientists Committee

Past Chair *2026*

Chair *2025*

Chair Elect *2024*

American Society for Engineering Education

American Society of Mechanical Engineers

Combustion Institute

National Society of Black Engineers

Society for Industrial and Applied Mathematics

Reviewing for Journals and Conferences

2023-NOW: International Journal of Heat and Mass Transfer
2022-NOW: Combustion & Flame
2022-NOW: Proceedings of the Combustion Institute
2021-NOW: Proceedings of the ASEE Annual Convention
2020-NOW: Proceedings of the ASME IMECE
2020-NOW: Journal of Computational Physics
2021: ASME Journal of Gas Turbines and Power
2019: Physics of Fluids
2019: ASME Journal of Heat Transfer

Service as Conference Organizer and Chair

2023: SIAM Southeastern Atlantic Section; Minisymposium Organizer & Chair
2023: US Sections of the Combustion Institute Joint Meeting; Session Chair
2022-: ASME IMECE; Session Organizer & Chair

2022: AIAA SciTech Forum; Session Chair

2021: US Sections of the Combustion Institute Joint Meeting; Session Chair

2020: Eastern States Section of the Combustion Institute; Session Chair

Current Student Research Advising

S. Sulman Ahmad
Mechanical Engineering, University of Washington *PhD–*

Yushu Lin
Mechanical Engineering, University of Washington *PhD–*
Mechanical Engineering, Virginia Tech *MS–*

Cairen Miranda
Mechanical Engineering, Virginia Tech *PhD–*
Aerospace Engineering, Virginia Tech *MS, 2021*

Edwin George
Mechanical Engineering, Virginia Tech *MS–*

Florian Stoll
Mechanical Engineering, Virginia Tech *MS–*

Former Graduate Student Advising

Meha Setiya
Mechanical Engineering, Virginia Tech *PhD, 2023*
Employment: AtmosZero Inc.

Travis Bowman
Mechanical Engineering, Virginia Tech *MS, 2022*
Employment: Framatome Inc.

Former Undergraduate Student Research Advising

Jeremiah Essandoh
Aerospace & Ocean Engineering, Virginia Tech

Michelle Fike
Computer Engineering, Virginia Tech

Duncan Young
Mechanical Engineering, Virginia Tech

Service to the University

Mechanical Engineering Department **Virginia Tech**
Diversity Committee *2020-2023*
Initiated "3+1+1"-style joint BS/MS program with Virginia State University (an HBCU). Students complete 3 years at VSU and 1 year at VT for a dual BS degree. Students have an option to join VT's 1 year accelerated MS program.
Virginia Tech – TU Darmstadt Dual MS Program *2022-2024*

Supervised and financially supported first student in international dual-degree MS program in mechanical engineering between Virginia Tech and Technische Universität Darmstadt (Germany). In the process I helped form/reform the rules and processes for the dual degree program.

Teaching Experience

Dr. Palmore's teaching experience lies principally in the areas of fluid mechanics, heat transfer, and computational methods.

ME3414 (formerly ME3404) **Virginia Tech**
Undergraduate Fluid Dynamics, Instructor
Each Spring 2019–2023

ME5404 **Virginia Tech**
Graduate Fluid Dynamics, Instructor
Each Fall 2019–2023

ME4015&ME4016 **Virginia Tech**
Senior Design, Secondary Instructor
Fall 2023, Fall 2022–Spring 2023, Fall 2020–Spring 2021

MAE 4272 **Cornell University**
Experimental Laboratory in Fluid Mechanics and Heat Transfer, Graduate Teaching Assistant
Fall 2016

AEM 249 **University of Alabama**
Algorithms, Undergraduate Teaching Assistant
Each Fall 2010–2011

AEM 264 **University of Alabama**
Dynamics, Undergraduate Teaching Assistant
Fall 2010

Outreach

As an African-American who has benefited from many STEM outreach programs such as the MIT MITES program and the U. S. Department of Education's McNair Scholars program, John Palmore actively seeks to be involved in helping others to achieve their dreams through outreach and mentoring. At Virginia Tech he has done outreach primarily with Center for the Enhancement of Engineering Diversity. However, he has also worked with the NSF funded Louis Stokes Alliance for Minority Participation (LSAMP), National Society of Black Engineers, and various on campus living-learning dormitory communities.

Publications

Asterisk (*) by an author's name indicates that the work was performed as a student or postdoc under the supervision of Dr. Palmore

Peer-Reviewed Journal Articles

[1] M. Setiya* and J. Palmore Jr, "Combustion and evaporation of deformable fuel droplets," *ASME Journal of Heat and Mass Transfer*, vol. 145, no. 10, 2023. https://doi.org/10.1115/1.4062784.

[2] C. Miranda* and J. Palmore Jr, "Importance of preferential segregation by aerodynamics in dust rig tests," *ASME Journal of Fluids Engineering*, vol. 145, no. 10, 2023. https://doi.org/10.1115/1.4062716.

[3] M. Setiya* and J. Palmore Jr, "Quasi-steady evaporation of deformable liquid fuel droplets,"

International Journal of Multiphase Flow, vol. 164, 2023. https://doi.org/10.1016/j.ijmultiphaseflow.2023.104455.

[4] Y. Lin* and J. Palmore Jr, "Effect of droplet deformation and internal circulation on drag coefficient," *Physical Review Fluids*, vol. 7, no. 12, 2022. https://doi.org/10.1103/PhysRevFluids.7.123602.

[5] J. Palmore Jr, "On the vaporization rate and flame shape of non-spherical droplets," *ASME Journal of Heat Transfer*, vol. 144, no. 6, 2022. https://doi.org/10.1115/1.4053729.

[6] J. Palmore Jr and O. Desjardins, "A volume of fluid framework for interface-resolved simulations of vaporizing liquid-gas flows," *Journal of Computational Physics*, vol. 399, 2019. https://doi.org/10.1016/j.jcp.2019.108954.

[7] J. Palmore Jr and O. Desjardins, "Technique for forcing high Reynolds number isotropic turbulence in physical space," *Physical Review Fluids*, vol. 3, no. 3, 2018. https://doi.org/10.1103/PhysRevFluids.3.034605.

Peer-Reviewed Conference Proceedings in Public Archives

[8] M. Setiya* and J. Palmore Jr, "Combustion and Vaporization of Deformable Fuel Droplets Using Direct Numerical Simulation," in *International Mechanical Engineering Congress and Exposition*, (Columbus, OH, USA), American Society of Mechanical Engineers, Oct. 2022.

[9] J. Palmore Jr, "Development of a Small Project on Spray Combustion for an Undergraduate Fluid Dynamics Class," in *International Mechanical Engineering Congress and Exposition*, (Columbus, OH, USA), American Society of Mechanical Engineers, Oct. 2022.

[10] C. Miranda* and J. Palmore Jr, "A Computational Analysis of the Aerodynamic Effects on Particles Flowing From a Duct," in *International Mechanical Engineering Congress and Exposition*, (Columbus, OH, USA), American Society of Mechanical Engineers, Oct. 2022.

[11] T. Bowman*, C. Miranda*, and J. Palmore Jr, "Predicting Motion of Engine-Ingested Particles Using Deep Neural Networks," in *International Mechanical Engineering Congress and Exposition*, (Columbus, OH, USA), American Society of Mechanical Engineers, Oct. 2022.

[12] J. Palmore Jr, "On the vaporization rate and flame shape of non-spherical droplets," in *International Mechanical Engineering Congress and Exposition*, (Virtual), American Society of Mechanical Engineers, Nov. 2021.

[13] J. Palmore Jr, "Evaluation of evidence-based teaching techniques in a graduate fluid dynamics course," in *ASEE Annual Conference and Exposition*, (Virtual), American Society of Engineering Education, June 2020.

Other Conference Papers

[14] M. Setiya*, J. Palmore Jr, and Y. Xu, "Evaporation of deformable droplets under natural convection: comparison of DNS results with experiments," in *AIAA SciTech Forum*, (Orlando, FL, USA), American Institute of Aeronautics and Astronautics, Jan. 2024.

[15] T. Bowman*, C. Miranda*, and J. Palmore Jr, "Predicting Particle Acceleration Using Flow Feature Extraction in a Louver Particle Separator," in *AIAA SciTech Forum*, (National Harbor, MD, USA), American Institute of Aeronautics and Astronautics, Jan. 2023.

[16] J. Palmore Jr and Y. Lin*, "Interface-capturing numerical studies of multicomponent spray and droplet vaporization," in *AIAA SciTech Forum*, (Virtual), American Institute of Aeronautics and Astronautics, Jan. 2022.

[17] Y. Lin*, M. Setiya*, and J. Palmore Jr, "A Numerical Strategy for Investigating Internal Circulation in Droplets," in *AIAA SciTech Forum*, (Virtual), American Institute of Aeronautics and Astronautics, Jan. 2022.

[18] C. Miranda* and J. Palmore Jr, "Predicting Erosion from Airborne Particles on a Single Stage Rotor-Stator using a Soft-Sphere Collision Model," in *AIAA Aviation Forum*, (Virtual), American Institute of Aeronautics and Astronautics, Aug. 2021.

[19] Y. Lin* and J. Palmore Jr, "A gravity update scheme using PID controller for droplet traveling at terminal velocity in air flow," in *12th US National Combustion Meeting*, (Virtual), Joint US Sections of The Combustion Institute, May 2021.

[20] C. Miranda* and J. A. Palmore Jr., "High Stokes Number Droplets in Homogeneous Isotropic Turbulent Flow," in *Eastern States Section of the Combustion Institute Meeting*, (Columbia, SC, USA), Eastern States Sections of the Combustion Institute, Mar. 2020.

[21] M. Setiya* and J. A. Palmore Jr., "Method to study effect of straining flow on droplet vaporization at low Reynolds number," in *Eastern States Section of the Combustion Institute Meeting*, (Columbia, SC, USA), Eastern States Sections of the Combustion Institute, Mar. 2020.

[22] J. Palmore Jr, "Gamification in a graduate fluid dynamics course," in *ASEE Southeastern Annual Section Conference*, (Aurburn, AL, USA), American Society of Engineering Education, Mar. 2020.

[23] J. Palmore Jr, "Interface-resolved DNS of Spray Vaporization and Combustion in Isotropic Turbulence," in *AIAA Science and Technology Forum and Exposition*, (Orlando, FL, USA), American Institute of Aeronautics and Astronautics, Jan. 2020.

[24] J. Palmore Jr, "DNS of n-heptane droplet vaporization and combustion," in *11th US National Combustion Meeting*, (Pasadena, CA, USA), Joint US Sections of the Combustion Institute, Mar. 2019.

[25] J. A. Palmore Jr and O. Desjardins, "Validating a numerical framework for resolved simulations of vaporizing droplets," in *International Conference on Liquid Atomization and Spray Systems*, (Chicago, IL, USA), Institute for Liquid Atomization and Spray Systems, July 2018.

[26] J. Palmore Jr and O. Desjardins, "Simulations of vaporizing droplets in turbulence," in *10th National Combustion Meeting*, (College Park, MD, USA), Joint US Sections of the Combustion Institute, Apr. 2017.

[27] J. Palmore Jr and O. Desjardins, "Direct numerical simulations of turbulent multiphase flows undergoing evaporation," in *AIAA Science and Technology Forum and Exposition*, (Grapevine, TX, USA), American Institute of Aeronautics and Astronautics, Jan. 2017.

[28] J. Palmore Jr and O. Desjardins, "Detailed numerical simulations of resolved multi-component fuel droplets evaporating in homogeneous isotropic turbulence," in *9th International Conference on Multiphase Flow*, (Florence, Italy), May 2016.

Conference Presentations and Posters

[29] F. Stoll* and J. Palmore Jr, "Comparing turbulent dispersion models for RANS simulations of particle-laden flows," in *76th Annual Meeting of the APS Division of Fluid Dynamics*, (Washington DC, USA), American Physical Society, Nov. 2023.

[30] Y. Lin* and J. Palmore Jr, "The study of droplet internal circulation and its interaction with droplet deformation," in *76th Annual Meeting of the APS Division of Fluid Dynamics*, (Washington DC, USA), American Physical Society, Nov. 2023.

[31] E. George*, J. Palmore Jr, N. Alexander, M. Politano, D. Smith, and C. Woodley, "Development of an OpenFOAM Solver for Hydroacoustic Simulations: An Application for Acoustic Fish Deterrence," in *76th Annual Meeting of the APS Division of Fluid Dynamics*, (Washington DC, USA), American Physical Society, Nov. 2023.

[32] J. Palmore Jr, "Advances in fluid flow simulation: focus on evaporating multiphase flows," in *SIAM Southeastern Atlantic Section Meeting*, (Blacksburg, VA, USA), Society for Industrial and Applied Mathematics, Mar. 2023.

[33] J. Palmore Jr, M. Setiya*, and Y. Lin*, "Droplet Evaporation and Combustion Research at CAMPhyRE Group," in *US National Combustion Meeting*, (College Station, TX, USA), US Sections of the Combustion Institute, Mar. 2023.

[34] Y. Lin* and J. Palmore Jr, "An investigation on the influence of droplet deformation and internal circulation on drag coefficient," in *75th Annual Meeting of the APS Division of Fluid Dynamics*, (Indianapolis, Indiana, USA), American Physical Society, Nov. 2022.

[35] J. Palmore Jr, "Interface-Resolving Simulations of Liquid-Gas Flows with Heat and Mass Transfer," in *SIAM Conference on Computational Science and Engineering*, (Virtual), Society for Industrial and Applied Mathematics, Mar. 2021.

[36] M. Setiya* and J. Palmore Jr, "Effect of straining flow and droplet shape on vaporization rate of liquid fuel droplet," in *73rd Annual Meeting of the APS Division of Fluid Dynamics*, (Virtual), American Physical Society, Nov. 2020.

[37] Y. Lin* and J. Palmore Jr, "The effect of droplet internal circulation on droplet vaporization," in *73rd Annual Meeting of the APS Division of Fluid Dynamics*, (Virtual), American Physical Society, Nov. 2020.

[38] C. Miranda* and J. Palmore Jr, "Numerical Forcing of Dense Particle-Laden HIT Flows," in *73rd Annual Meeting of the APS Division of Fluid Dynamics*, (Virtual), American Physical Society, Nov. 2020.

[39] J. Palmore Jr, "Kahoot! Games in a Graduate Fluid Dynamics Course," in *International Mechanical Engineering Congress and Exposition*, (Salt Lake City, UT, USA), American Society of Mechanical Engineers, Nov. 2019.

[40] J. Palmore Jr, "Internal Circulation and the Vaporization of Droplets in Convective Flow," in *International Mechanical Engineering Congress and Exposition*, (Salt Lake City, UT, USA), American Society of Mechanical Engineers, Nov. 2019.

[41] J. Palmore Jr and O. Desjardins, "Framework for simulating droplet vaporization in turbulent flows," in *70th Annual Meeting of the Division of Fluid Dynamics*, (Denver, CO, USA), American Physical Society, Nov. 2017.

[42] J. Palmore Jr and O. Desjardins, "Comparing volume of fluid and level set methods for evaporating liquid-gas flows," in *69th Annual Meeting of the Division of Fluid Dynamics*, (Portland, OR, USA), American Physical Society, Nov. 2016.

[43] J. Palmore Jr and O. Desjardins, "Filtered linear forcing: a technique for simulating high Reynolds number turbulence in physical space," in *67th Annual Meeting of the Division of Fluid Dynamics*, (San Francisco, CA, USA), American Physical Society, Nov. 2014.

[44] J. Palmore Jr, A. Lang, and M. Sharif, "Computational analysis of vortex formation over a flat plate with gradient-based slip condition," in *64th Annual Meeting of the Division of Fluid Dynamics*, (Baltimore, MD, USA), American Physical Society, Nov. 2011.

[45] J. Palmore Jr, M. Sharif, and A. Lang, "Computational analysis of vortex formation over a plunge oscillating flat plate with various slip conditions," in *63rd Annual Meeting of the Division of Fluid Dynamics*, (Long Beach, CA, USA), American Physical Society, Nov. 2010.

Invited Talks

[46] "Recent Research on Droplets & Particles in Multiphase Flows," University of Washington, Apr. 2023.

[47] "High-fidelity fluid dynamics simulation: recent results on droplet evaporation," Prairie View A & M University, Mar. 2023.

[48] "Go with the Flow: Understanding Turbulence," in *FaculTeas*, Virginia Tech, Feb. 2023.

[49] "Droplet deformation and its effect on droplet evaporation," in *Mechanical Engineering Seminar*, University of South Carolina, Jan. 2023.

[50] "Research at the CAMPhyRE," in *Hypatia Seminar*, Virginia Tech, Nov. 2022.

[51] "Recent Work on Particulates and Icing in Aviation Engines," in *ICE Seminar*, NASA Glenn Research Center, Sept. 2022.

[52] "Multiphase Flow Research for Aviation Engines," in *Mechanical Engineering & Material Science Seminar*, University of Pittsburgh, July 2022.

[53] "Numerical strategies for studying droplet and spray vaporization," in *Biomedical Engineering and Mechanics Seminar Series*, Virginia Tech, Nov. 2021.

[54] "Studies on droplet and spray vaporization and combustion," Air Force Research Laboratory – Aerospace Systems Directorate, May 2021.

[55] "Multiphase Flows, Combustion, and the Environment," in *SIRC Investigator Series*, Virginia Tech, Feb. 2021.

[56] "Internal Circulation and the Vaporization of Droplets," in *Fluids Mechanics Symposium*, Virginia Tech, Nov. 2019.

[57] "Turbulent Multiphase Flows, Energy, and the Environment," in *Freshman Engineering Seminar*, Virginia Tech, Sept. 2019.

[58] "Numerical methods for simulating vaporizing droplets in crossflow," in *Cornell Fluids Seminar*, Cornell University, Jan. 2018.

[59] "Simulating evaporating droplets in turbulence," in *Cornell Fluids Seminar*, Cornell University, May 2017.

[60] "Evaporating droplets in turbulence," in *Mechanical Engineering Seminar*, Virginia Tech, Apr. 2017.

[61] "Technique for simulating higher Reynolds number turbulence in physical space," in *Cornell Fluid Dynamics Seminar*, Cornell University, Feb. 2015.