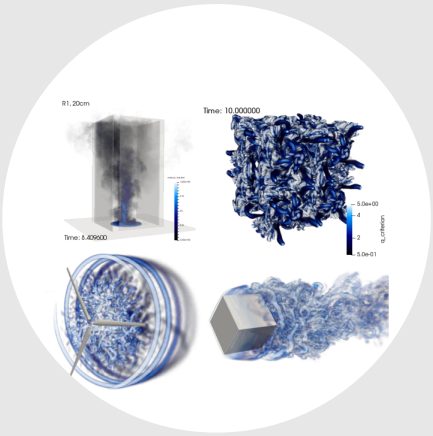

Stefan P. Domino Ph.D.

Computational Scientist

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github.com/NaluCFD

What I Do

I transform people's understanding of the world by deploying high-performing computational fluid dynamics tools. While some draw analogy to such computational tools as the rasp in Michelangelo's hand, I choose to view the partnership analogous to that of the luthier and the violinist in that both are required to make new that which was formerly unheard.

Skills/Attributes

- low-Mach Fluids
- Turbulence
- Next-generation-platforms
- Software Development
- Outgoing
- Driven
- Passionate

[Scale ranges from 0 (Fundamental Awareness) to 6 (Expert).]

Interests

My professional interest resides in the development and deployment of computational fluid dynamics (CFD) tools to facilitate a transformative understanding of otherwise intractable physical phenomena. By exercising these tools, in partnership with theory and experiments, a window into complex coupled processes can be illuminated. Studying low-Mach multi-physics applications that include turbulence, variable-density effects, buoyancy, multiphase, and chemical reactions often times reveals extraordinarily complex fluids, thermal, and species structures thereby allowing that which is generally unseen to be fully appreciated. Fostering partnerships within a diverse and high-performing team to solve grand-challenge problems provides me with ample motivation to work in the complex field of CFD.

Current Position(s) Held

Sandia — Computational Scientist; Center: Engineering Sciences, Group: Computational Thermal and Fluid Mechanics (1541); Distinguished Member of the Technical Staff.

Education

1999 — Doctor of Philosophy — Chemical Engineering, University of Utah
Researched and deployed advanced modeling and simulation techniques to more accurately predict the oxides of nitrogen (NO_x) in multiphase combustion applications. Advisor: Professor Philip Smith

1994 — Bachelor of Science — Chemical Engineering, University of Utah
Researched the use of per-fluorocarbons for advanced mammalian bioreactor design. Advisor: Professor Edward Trujillo.

Recent Peer-reviewed Publications

2022 — Domino, S. P., Horne, W., *Development and deployment of a credible unstructured, six-DOF, implicit low-Mach overset simulation tool for wave energy applications*, Accepted, Renewable Energy (in production).

2021 — Domino, S. P., Hewson, J., Knaus, R., Hansen, M., *Predicting large-scale pool fire dynamics using an unsteady flamelet- and large-eddy simulation-based model suite*, Phys. Fluids, https://doi.org/10.1063/5.0060267 (Editor's pick).

2021 — Domino, S. P., *A case study on pathogen transport, deposition, evaporation and transmission: linking high-fidelity computational fluid dynamics simulations to probability of infection*, Int. J. CFD, https://doi.org/10.1080/10618562.2021.1905801.

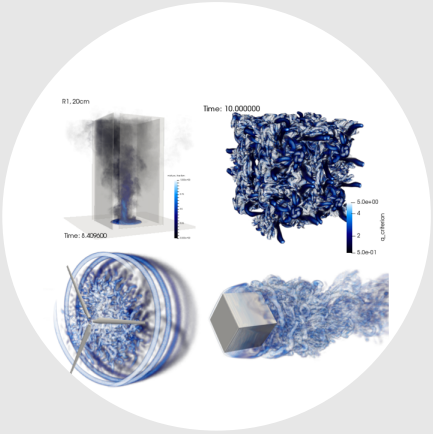
2021 — Domino, S. P., Pierce, F., Hubbard, J., *A multi-physics computational investigation of droplet pathogen transport emanating from synthetic coughs and breathing*, Atom. Sprays, https://doi.org/10.1615/AtomizSpr.2021036313.

2019 — Jofre, L., Domino, S. P., Iaacarino, G., *Eigensensitivity analysis of subgrid-scale stresses in large-eddy simulation of a turbulent axisymmetric jet*, Int. J. Heat Mass, https://doi.org/DOI:10.1016/J.IJHEATFLUIDFLOW.2019.04.014.

2019 — Domino, S. P., Sakievich, P., Barone, M., *An assessment of atypical mesh topologies for low-Mach large-eddy simulation*, Comp. Fluids, https://doi.org/10.1016/j.compfluid.2018.12.002.

2018 — Domino, S. P., *Design-order, non-conformal low-Mach fluid algorithms using a hybrid CVFEM/DG approach*, J. Comput. Phys., https://doi.org/10.1016/j.jcp.2018.01.007.

2018 — Jofre, L., Domino, S. P., Iaacarino, G., *A framework for characterizing structural uncertainty in large-eddy simulation closures*, Flow Turb. Combust., https://doi.org/10.1007/s10494-017-9844-8.



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Goals

My primary career goal centers on extending state-of-the art in CFD methods to facilitate the advanced deployment of credible tools that support a wide range of atypical, e.g., fire, wind and wave-energy, computational ethology, etc., multi-physics applications. Mentoring, teaching, and motivating the next generation of computational scientists captures my core passion.

Investment Areas

Wave Energy

Next-Generation Platforms

Ember Transport

Marine Ethology

VVUQ

Wildfires

Accidental Fires

[Scale ranges from 0 (low-interest) to 6 (high-interest).]

Recent Experience

2021-2022 Adjunct Professor — Stanford/ICME

Co-teaching responsibilities for Stanford's ME469 Mechanical Engineering graduate Computational Methods for Fluid Dynamics class where Nalu is used as pedagogical tool to bridge foundational numerical methods development and practical production CFD; support mentoring of graduate students and post-doctoral appointees.

2005-now Member of the Technical Staff — Sandia National Laboratories

My experience at Sandia rests within low-Mach turbulent fluid mechanics methods development for complex systems that drive the coupling of mass, momentum, species and energy transport. As PI, my research projects reside within the intersection of physics model development, numerical methods research, V&V techniques exploration, and high-performance computing and coding methods for low-Mach flow. I am the originator of the BSD open-source Nalu code base, https://github.com/NaluCFD. I am proud to have served the Lab's response to National crises such as Deep Water Horizon and the COVID-19 pandemic. I also served as PI and lead developer for the generally unstructured, massively parallel Sierra/Fuego code base and was a team contributor to the NNSA Defense Programs Awards of Excellence for significant contributions Stockpile Stewardship Program. Promotion to Senior Member of the Technical Staff (2001), Principal Member of the Technical Staff (2005), and Distinguished Member of the Technical Staff (2022)

2000-2001 Postdoctoral appointee — Sandia National Laboratories

Development of a smoke transport simulation tool for cargo bay fires in support of the FAA's response to ValueJet Flight 592. This work was recognized as part of the NASA Associate Administrator's Choice Award for Outstanding Accomplishment, (Glenn Research Center) and a R&D 100 Award for the development of a multi-parameter, micro-sensor-based low false alarm fire detection system.

Notable Projects as PI

2021-now *Developing credible high-fidelity mod/sim tools for wave energy converter design*. Development of implicit overset methods coupled to six-DOF and volume of fluid transport.

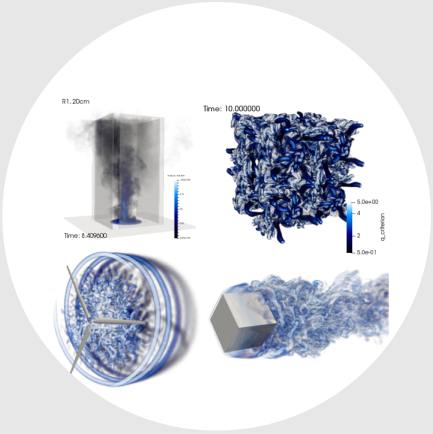
2020-2021 *COVID-19 Transportation and Transmission*. High-fidelity pathogen modeling approaches for breathing and coughing events using an Eulerian/point-Lagrangian multi-physics paradigm that allows for the ability to distinguish between droplets that deposit and those that form persisting aerosol plumes.

2020-now *Agile Physics and Engineering Models*. Developing advanced coupling techniques for thermal response in the presence of thermal radiation; elucidation of non-isothermal jet impingement physics; wall-resolved large-eddy simulation modeling.

2019-now *Uncertainty quantification in crash-and-burn environments*. Exploring fire dynamics for accident scenarios that include varying pool shape and crosswind magnitude; developing structural uncertainties for large-eddy simulation through eigenvalue decomposition and perturbation of stresses towards limiting turbulence states.

2012-2015 *Computer Science Advanced Research: Core Computational Methodologies*. Duties as a portfolio manager for a multi-discipline Advanced Simulation and Computing (Research Foundations) included making funding decisions ($1.25 million per year) and technical oversight. Projects ranged from advanced methods of algebraic multigrid, to the development of Helmholtz solvers.

2003 - 2006 *Sierra/Fuego Integrated Codes Project*. Fuego is the Sandia National Laboratories turbulent reacting flagship fire physics simulation tool that supports Science-based Stockpile Stewardship.



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Why I do it

The ability to explore multi-physics applications from a foundational modeling and simulation perspective is critical to future scientific advances. This high-level motivation has driven my desire to work within the intersection of physics elucidation, numerical methods development, and code development. More recently, the ability to deploy advanced uncertainty quantification (UQ) techniques to drive physics understanding, which may include structural uncertainty methods, machine learning approaches, etc., has transformed the former research paradigm.

Favorite Things

Replication of Past Work

Family

Mountains

Snow

CFD

Pursuit of Knowledge

Science

Ocean

[Scale ranges from 0 (unfavorable) to 6 (favorable).]

Noteworthy Publications

2022 Hubbard, J., Hansen, M., Kirsch, J., Hewson, J., Domino, S. P., *Medium scale methanol pool fire model validation*, J. Heat Transfer, 144(6), 2022.

2021 Barone, M., Ray, J., Domino, S. P., *Feature selection, clustering, and prototype placement for turbulence datasets"*, AIAA J., https://doi.org/10.2514/1.J060919.

2016 Safta, C., Blaylock, M., Templeton, J., Domino, S. P., Sargsyan, K., Najm, H., *Uncertainty quantification in LES of channel flow*, Int. J. Numer. Method. Fluids, 83 (4).

2014 Lin, P., Bettencourt, M., Domino, S. P., et al., *Towards extreme-scale simulations for low-Mach fluids with second-generation Trilinos*, Parallel Processing Letters, 24 (4).

2000 Domino, S. P., Smith, P. J., *State space sensitivity to a prescribed probability density function shape in coal combustion systems: Joint β-PDF versus clipped Gaussian PDF*, Proc. Combust. Inst., 28 (2).

Stanford Center for Turbulence (CTR) Briefs

2018 Domino, S. P., Jofre, L., Iaccarino, G, *The suitability of hybrid meshes for low-Mach large-eddy simulation*, Proceedings of the CTR Summer Program.

2018 Jofre, L., Domino, S. P., Iaccarino, G, *Characterization of structural uncertainty in LES of a round jet*, Annual CTR Research Briefs.

2016 Domino, S. P., Jofre, L., Iaccarino, G, *Exploring model-form uncertainties in large-eddy simulation*, Proceedings of the CTR Summer Program.

2016 Jofre, L., Domino, S. P., Iaccarino, G, *A framework for estimating uncertainty in LES closures*, Annual CTR Research Briefs.

2014 Domino, S. P., *A comparison between low-order and higher-order low-Mach discretization approaches*, Proceedings of the CTR Summer Program.

2010 Domino, S. P., *Towards verification of sliding mesh algorithms for complex applications using MMS*, Proceedings of the CTR Summer Program.

2008 Domino, S. P., *A comparison of various equal-order interpolation methodologies using the method of manufactured solutions*, Proceedings of the CTR Summer Program.

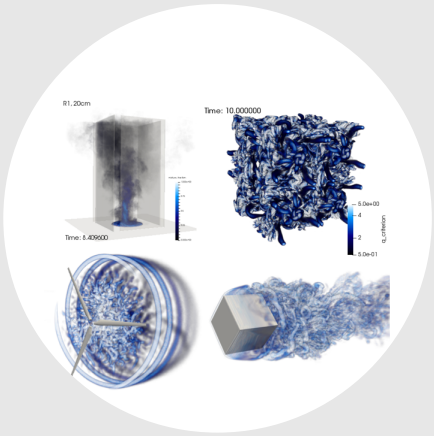
2006 Domino, S. P., *Toward verification of formal time accuracy for a family of approximate projection methods using the method of manufactured solutions*, Proceedings of the CTR Summer Program.

Select Conference Papers

2007 Domino, S. P., Wagner, G., Luketa-Hanlin, A., Black, A., Sutherland, J., *Verification for multi-mechanics applications*, 48^{th} AAIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference.

2002 Domino, S. P., Moen, C., Burns, S., Evans, G., *SIERRA/Fuego: A multi-mechanics fire environment simulation tool*, 41^{st} Aerospace Sciences Meeting and Exhibit.

2002 Domino, S. P., DesJardin, P., Suo-Antilla, J., *Development of a smoke transport model to enhance the certification process for cargo bay smoke detection systems*, Fire Safety Science Proceedings of the Seventh International Symposium.



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Select Sandia National Laboratories Reports

2019 Domino, S. P., Ananthan, S., Knaus, R., Williams, A., *Deploying Nalu/Kokos algorithmic infrastructure with performance benchmarking*, Sandia National Laboratories, Sandia Report SAND2017-10549R.

2019 Domino, S. P., Williams, A., *Nalu's linear system assembly using T-Petra*, Sandia National Laboratories, Sandia Report SAND2019-0120.

2018 Domino, S. P., Thomas, S., Barone, M., et al., *Deploying production sliding mesh capability with linear solver benchmarking*, Sandia National Laboratories, Sandia Report SAND2018-1807R.

2005 Nicolette, V., Tieszen, S., Black, A., Domino, S. P., O'Hern, T., *A turbulence model for buoyant flows based on vorticity generation*, Sandia National Laboratories, Sandia Report SAND2005-6273.

Noteworthy Presentations

2022 Domino, S. P., *Exploring high-fidelity computational fluid dynamics approaches for airborne pandemic risk mitigation*, Invited Stanford CTR Tea Seminar Series.

2021 Domino, S. P., *A historical perspective on Sandia National Laboratories fire science mod/sim philosophy: The role of high performance computing and unstructured numerical methods advances*, Invited University of Utah Graduate Seminar Series.

2020 Domino, S. P., *An evolution of a mindset: A historical perspective on Sandia National Laboratories Fire Science philosophy*, Invited Stanford CTR Tea Seminar Series.

2018 Domino, S. P., *Multi-phase use cases within the abnormal thermal environment*, PSAAP-2 Multi-phase Workshop.

2018 Domino, S. P., *The suitability of hybrid meshes for low-Mach large-eddy simulation*, Invited Lawrence Livermore National Laboratory CASC Seminar Series.

2017 Domino, S. P., *ECP ExaWind experience in transitioning Nalu to MPI+x*, Invited presentation, PSAAP-2 Review.

2014 Domino, S. P., *Leveraging the ASC Sierra Mechanics tools for battery fire prediction*, DOE Office of Electricity Energy Storage Peer Review.

2009 Domino, S. P., *Computational approaches to multi-physics applications: Predicting an object's thermal response within a turbulent reacting, participating media radiation environment*, Plenary Invitation, SIAM Conference on Computational Science and Engineering.

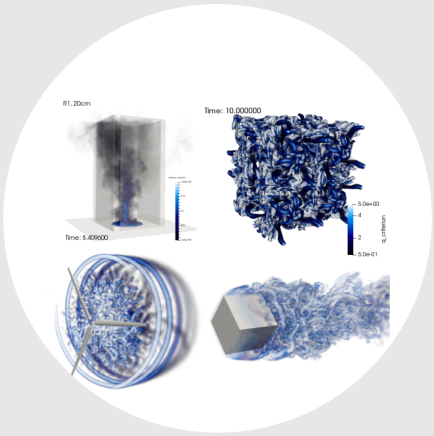
Under-Review/In-Preparation Manuscripts

2022 Domino, S. P., Wenzel, E., *A Direct Numerical Simulation study for Re^{τ} 505 non-isothermal jet impingement*, under review, J. Fluid Mech.

2022 Scott, S., Domino, S. P., *Large-scale pool fire dynamics/attributes for fires in crossflow: exploring flame shape sensitivity to pool shapes*, under review, Flow.

Distinguished Awards

2017 Sheldon R. Tieszen Sandia National Laboratories Engineering Sciences Award for a distinguished career in pursuit of technical excellence.



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Book Chapters

2022 Domino, S. P., *Unstructured finite volume approaches for turbulence.*, In: Moser, R., Numerical Methods in Turbulence Simulation, Elsevier. (in production)

2017 Eldred, M., Ng, A., Barone, M., Domino, S. P., *Multifidelity uncertainty quantification using spectral stochastic discrepancy models*, In: Ghanem R., Higdon D., Owhadi H. (eds) Handbook of Uncertainty Quantification.

Noteworthy Experiences

2020 & 2021 Co-teaching Me469, Stanford Mechanical Engineering Departments Graduate class, *Computational Methods for Fluid Dynamics*.

2006-2018 Six-time visiting scholar at Stanford's Center for Turbulence Research.

2000-now Numerous internal and external peer-reviews supported including journals, DOE panels, NSF, and others.

2000-now Mentoring of four post-doctoral researchers and five graduate students.

References

Please contact me for a comprehensive list of references.

Synergistic Efforts

2018-now CEO/President/Senior Technical Staff COMERI
Lead the management, research, and funding objectives for the Computational Marine Ethology Research Institute (COMERI) - a 501(c)(3) nonprofit research Institute that drives foundational understanding of marine ethology using first-principles physics. https://comeri.org

Review

Dr. Stefan Domino is a computational domain specialist researcher who develops tools and techniques to support advancement of multi-physics understanding of complex phenomena including turbulent fluid mechanics, heat transfer, and chemical reactions. Specific research thrusts center on high-fidelity computational modeling and simulation approaches for fire, wave- & wind-energy.