

Brian T. Fisher

Mechanical Engineer

U.S. Naval Research Laboratory

Combustion Dynamics Section (Code 6185) / Chemistry Division

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Research Interests and Specialization

Research specialization includes combustion, IC and gas-turbine engines, fuel sprays, and alternative fuels. In particular, interests involve development and application of laser-based diagnostic techniques to these areas, including elastic laser scattering, laser-induced fluorescence (LIF and PLIF), particle image velocimetry (PIV), phase-Doppler particle anemometry (PDPA), laser absorption spectroscopy (TDLAS), and Fourier transform infrared spectroscopy (FTIR).

Education

University of Florida Ph.D., Mechanical Engineering (2004)

University of Florida B.S., Mechanical Engineering; Business Administration minor (2000)

Instrumentation and Software Skills

Experience includes operation of: metal and optical engines, high-pressure vessels, laboratory-scale laminar and turbulent flame systems, high-pressure fuel-injection systems, numerous lasers (pulsed and continuous, gas-phase and solid-state, and high repetition rate), high-speed cameras, intensified cameras, and other photodetectors (photodiodes, photomultiplier tubes, etc.).

Software expertise includes: Labview and Matlab software packages for experimental control, data acquisition, and data analysis; SolidWorks and Pro-E solid modeling packages; Chemkin modeling of reacting flows; and basic-use software (MS Word, MS Excel, MS Powerpoint, Adobe Acrobat, Adobe Illustrator, EndNote, etc.).

Employment and Research Experience

U.S. Naval Research Laboratory (Washington, DC) (Jan. 2015 – present)
 Combustion Dynamics Section (Code 6185) / Chemistry Division

Title: Mechanical Engineer

Duties/Accomplishments:

- Developing and using laser-based and optical diagnostics for research in propulsion, power generation, combustion, engines, and fire suppression
- Current projects include: mixed-metal nanopowder fuel additives, crude oil spray combustion, sulfur quantification in mobility fuels, and laser-diagnostic measurements in a resistojet plume
- Led project to measure flue-gas species after treatment by pulsed electron beam
- Overseeing multiple combustion laboratory facilities
- Mentoring postdoctoral researchers and student interns

The University of Alabama (Tuscaloosa, AL) (July 2011 – Dec. 2014)
 Mechanical Engineering Department

Title: Assistant Professor

Duties/Accomplishments:

- Designed and built a constant-pressure flow vessel (CPFV) for fuel-injection experiments
- Designed and built burner system to support a laminar diffusion flame
- Designed and built burner system to support a swirl-stabilized turbulent diffusion flame, configurable for both lean premixed (LPM) and lean direct-injection (LDI) combustion
- Developed laser-based system for soot measurements in laminar diffusion flame, combining laser extinction and laser-scattering diagnostics
- Developed high-speed imaging system for fuel-spray experiments in CPFV
- Developed custom Matlab codes and GUI (graphic user interface) for batch processing of high-speed fuel-spray images to determine critical global spray properties
- Developed custom Labview codes for experimental control and data acquisition
- Developed custom Matlab codes for processing of high-speed pressure data acquired in a direct-injection constant-volume combustion chamber (DI-CVCC)
- Mentored graduate and undergraduate students in research activities

Sandia National Laboratories (Livermore, CA) (Jan. 2008 – June 2011)
 Engine Combustion Department

Title: Postdoctoral researcher

Duties/Accomplishments:

- Regularly operated a heavy-duty, single-cylinder optical diesel engine, both for optical measurements and for performance/emissions measurements
- Developed laser-based high-speed imaging system for measurement of fuel-spray liquid length in an operating optical diesel engine
- Designed and built a device for measuring fuel rate of injection for a diesel injector, for *in situ* use inside the cylinder of an optical diesel engine
- Implemented pressure transducer for high-speed measurement of fuel-injection pressure
- Tore down and rebuilt optical diesel engine, as needed for specific experiments

U.S. Naval Research Laboratory (Washington, DC) (Jan. 2005 – Dec. 2007)

Combustion Dynamics Section (Code 6185) / Chemistry Division

Title: NRC Postdoctoral researcher

Duties/Accomplishments:

- Appointment received through prestigious National Research Council (NRC) program
- Developed laboratory-scale non-premixed “cup burner” flame system for study of fire suppression mechanisms
- Developed water mist generator system to supply “ultrafine” (diameter < 10 μm) water drops to burner system for flame suppression/extinction
- Used multiple laser-diagnostic methods to quantify water drop behavior, including PIV (particle image velocimetry) and PDPA (phasor Doppler particle anemometry)
- Developed and used laser-based absorption method (TDLAS, or tunable diode laser absorption spectroscopy) to quantify water mist and gas-phase species

University of Florida (Gainesville, FL) (May 2000 – Dec. 2004)

Department of Mechanical and Aerospace Engineering

Title: Graduate researcher (Ph.D. research; Supervised by Dr. David Hahn)

Duties/Accomplishments:

- Doctoral research was supported for four years by the University of Florida Stephen C. O’Connell Presidential Fellowship
- Developed laser-based system to measure time-resolved reflectivity and absorptivity of corneal tissue with respect to 193-nm ArF excimer laser light
- Determined average corneal tissue ablation rate using optical interferometry
- Developed ***and patented*** (U.S. Patent No. 7207983, issued 4/24/2007) method to correlate reflectivity measurement to tissue ablation rate, and to use this method to make real-time adjustments to laser energy and/or delivery algorithms in corneal refractive surgery systems

Teaching Experience

University of Alabama (Aug. 2011 – Dec. 2014)

Thermodynamics I (ME 215)

- Undergraduate lecture course
- Taught in Fall 2011, Spring 2012 (with distance-learning component), Spring 2013 (with distance-learning component), Fall 2013, Fall 2014

Combustion Engines (ME 418/591)

- Combined undergraduate/graduate lecture course with laboratory component
- Taught in Fall 2012, Fall 2013

Principles of Combustion I (ME 518)

- Graduate lecture course
- Taught in Spring 2013, Spring 2014

Publications and Scholarly Activity

Refereed journal papers:

- [1] **B.T. Fisher**, J.C. Allen, R.L. Hancock, J.A. Bittle. Evaluating the potential of a direct-injection constant-volume combustion chamber as a tool to validate chemical-kinetic models for liquid fuels. *Combustion Science and Technology* (submitted). 2015.
- [2] J. Wang, E.M. Mirynowski, J.A. Bittle, **B.T. Fisher**. Experimental measurements of *n*-heptane liquid penetration distance and spray cone angle for steady conditions relevant to early direct-injection low-temperature combustion in diesel engines. *International Journal of Engine Research*. 2015. In press (DOI: 10.1177/1468087415580916)
- [3] C.E. Dumitrescu, C.J. Polonowski, **B.T. Fisher**, G.K. Lilik, C.J. Mueller. Fuel-property effects on spray liquid penetration and its impact on smoke emissions and mixture fraction estimates at lift-off length location. *Energy and Fuels*. 2015; 29: 7689-7704.
- [4] K.C. James, J. Wang, M.C. Maynard, Z.B. Morris, **B.T. Fisher**. Development of a high-pressure, high-temperature, optically accessible continuous-flow vessel for fuel-injection experiments. *Journal of Engineering for Gas Turbines and Power*. 2014; 136: 0915121-0915127.
- [5] C.E. Dumitrescu, C. Polonowski, **B.T. Fisher**, A.S. Cheng, G.K. Lilik, C.J. Mueller. An experimental study of fuel-property effects on mixing-controlled combustion in a heavy-duty optical diesel engine. *SAE International Journal of Fuels and Lubricants*. 2014; 7: 65-81.
- [6] J.C. Allen, W.J. Pitz, **B.T. Fisher**. Experimental and computational study of *n*-heptane autoignition in a direct-injection constant-volume combustion chamber. *Journal of Engineering for Gas Turbines and Power*. 2014; 136: 0915101-0915108.
- [7] **B.T. Fisher**, C.J. Mueller. Effects of injection pressure, injection-rate shape, and heat release on liquid length. *SAE International Journal of Engines*. 2012; 5: 415-429.
- [8] **B.T. Fisher**, D.W. Hahn. Real-time measurement of ArF excimer laser corneal tissue ablation rates using cross-correlation of laser waveforms. *Optics Express*. 2011; 19: 4231-4241.
- [9] **B.T. Fisher**, G. Knothe, C.J. Mueller. Liquid-phase penetration under unsteady in-cylinder conditions: Soy- and cuphea-derived biodiesel fuels versus conventional diesel. *Energy and Fuels*. 2010; 24: 5163-5180.
- [10] **B.T. Fisher**, C.J. Mueller. Liquid penetration length of heptamethylnonane and trimethylpentane under unsteady in-cylinder conditions. *Fuel*. 2010; 89: 2673-2696.
- [11] A.S. Cheng, **B.T. Fisher**, G.C. Martin, C.J. Mueller. Effects of fuel volatility on early direct-injection, low-temperature combustion in an optical diesel engine. *Energy and Fuels*. 2010; 24: 1538-1551.
- [12] S. Wagner, **B.T. Fisher**, J.W. Fleming, V. Ebert. TDLAS-based *in situ* measurement of absolute acetylene concentrations in laminar 2D diffusion flames. *Proceedings of the Combustion Institute*. 2009; 32: 839-846.

- [13] J.A. Sutton, **B.T. Fisher**, J.W. Fleming. A laser-induced fluorescence measurement for aqueous fluid flows with improved temperature sensitivity. *Experiments in Fluids*. 2008; 45: 869-881.
- [14] A.R. Awtry, **B.T. Fisher**, R.A. Moffatt, V. Ebert, J.W. Fleming. Simultaneous diode laser based *in situ* quantification of oxygen, carbon monoxide, water vapor, and liquid water in a dense water mist environment. *Proceedings of the Combustion Institute*. 2007; 31: 799-806.
- [15] **B.T. Fisher**, A.R. Awtry, R.S. Sheinson, J.W. Fleming. Flow behavior impact on the suppression effectiveness of sub-10- μm water drops in propane/air co-flow non-premixed flames. *Proceedings of the Combustion Institute*. 2007; 31: 2731-2739.
- [16] **B.T. Fisher**, D.W. Hahn. Development and numerical solution of a mechanistic model for corneal tissue ablation with the 193-nm argon fluoride excimer laser. *Journal of the Optical Society of America A—Optics, Image Science, and Vision*. 2007; 24: 265-277.
- [17] **B.T. Fisher**, D.W. Hahn. Measurement of small-signal absorption coefficient and absorption cross-section of collagen for 193-nm excimer laser light and the role of collagen in tissue ablation. *Applied Optics*. 2004; 43: 5443-5451.
- [18] **B.T. Fisher**, D.W. Hahn. Determination of excimer laser ablation rates of corneal tissue using wax impressions of ablation craters and white-light interferometry. *Ophthalmic Surgery Lasers and Imaging*. 2004; 35: 41-51.
- [19] **B.T. Fisher**, K.A. Masiello, M.H. Goldstein, D.W. Hahn. Assessment of transient changes in corneal hydration using confocal Raman spectroscopy. *Cornea*. 2003; 22: 363-370.
- [20] **B.T. Fisher**, H.A. Johnsen, S.G. Buckley, D.W. Hahn. Temporal gating for the optimization of laser-induced breakdown spectroscopy detection and analysis of toxic metals. *Applied Spectroscopy*. 2001; 55: 1312-1319.
- [21] J.E. Carranza, **B.T. Fisher**, G.D. Yoder, D.W. Hahn. On-line analysis of ambient air aerosols using laser-induced breakdown spectroscopy. *Spectrochimica Acta B*. 2001; 56: 851-864.

Conference papers with presentation: (* = presenting author)

- [1] M.R. Weismiller*, B.T. Fisher, Z.J. Huba, A. Epshteyn, S.G. Tuttle, B.A. Williams. Combustion of sonochemically-generated amorphous reactive mixed-metal nanopowders in an *n*-decane spray flame. AIAA SciTech 2016. San Diego, CA; 2016.
- [2] J.C. Allen*, B.T. Fisher, A.K. Agrawal. Effect of porous insert on flame dynamics in a lean premixed swirl stabilized combustor using planar laser induced fluorescence. AIAA SciTech 2016. San Diego, CA; 2016.
- [3] J.C. Allen*, B.T. Fisher, A.K. Agrawal. Effect of mixing tube length on flame dynamics with porous inert media in a swirl stabilized combustor. 9th U.S. National Combustion Meeting. Cincinnati, OH; 2015.
- [4] J. Wang*, K.C. James, M.C. Maynard, B.T. Fisher. Measurements of *n*-heptane liquid length and spray cone angle for low-temperature, low-density conditions in an optically accessible flow vessel. ASME Internal Combustion Engine Division Fall Technical Conference. Columbus, IN; 2014.

- [5] C.E. Dumitrescu*, C. Polonowski, B.T. Fisher, A.S. Cheng, G.K. Lilik, C.J. Mueller. An experimental study of fuel-property effects on mixing-controlled combustion in a heavy-duty optical diesel engine. SAE World Congress. Detroit, MI; 2014.
- [6] S.R. Fletcher, Z.B. Morris, B.T. Fisher*. Development of a burner system and laser-diagnostic method to characterize soot evolution for diesel-relevant fuels. Spring Technical Meeting of the Central States Section of the Combustion Institute. Tulsa, OK; 2014.
- [7] K.C. James*, J. Wang, M.C. Maynard, Z.B. Morris, B.T. Fisher. Development of a high-pressure, high-temperature, optically accessible continuous-flow vessel for fuel-injection experiments. ASME Internal Combustion Engine Division Fall Technical Conference. Dearborn, MI; 2013.
- [8] J.C. Allen*, W.J. Pitz, B.T. Fisher. Ignition delay and heat-release rate for *n*-heptane in a direct-injection constant-volume combustion chamber: Experiments and computations. ASME Internal Combustion Engine Division Fall Technical Conference. Dearborn, MI; 2013.
- [9] B.T. Fisher*, C.J. Mueller. Effects of injection pressure, injection-rate shape, and heat release on liquid length. SAE World Congress. Detroit, MI; 2012.
- [10] S. Wagner*, A.R. Awtry, B.T. Fisher, J.W. Fleming, V. Ebert. Spatially resolved *in situ* TDLAS measurement of absolute H₂O and OH mole fraction in a laminar 2D diffusion flame. 50th AIAA Aerospace Sciences Meeting. Nashville, TN; 2012.
- [11] S. Wagner*, B.T. Fisher, A.R. Awtry, J.W. Fleming, V. Ebert. Calibration free *in situ* measurement of concentration profiles in laminar diffusion flames with diode laser absorption spectroscopy (TDLAS). Bunsentagung. Graz, Austria; 2007.
- [12] A.R. Awtry, B.T. Fisher, J.W. Fleming, S. Wagner, V. Ebert*. Liquid and vapor water measurements in an optically dense environment. Laser Applications to Chemical, Security and Environmental Analysis Topical Meeting. Lake Tahoe, NV; 2006.
- [13] B.T. Fisher*, A.R. Awtry, R.S. Sheinson, J.W. Fleming. The impact of evaporation and flow behavior on the suppression effectiveness of sub-10- μ m water drops in a propane/air co-flow non-premixed cup burner flame. Eastern States Section of the Combustion Institute Fall Meeting. Orlando, FL; 2005.
- [14] B.T. Fisher, A.R. Awtry, R.S. Sheinson, J.W. Fleming*. The behavior of sub 10 μ m water mist drops in propane/air co-flow non-premixed “cup burner” flames. Halon Options Technical Working Conference. Albuquerque, NM; 2005.

Conference presentations (oral only, no paper): (* = presenting author)

- [1] T. Toops*, E. Nafziger, C. Finney, H. Bilheux, J.-C. Bilheux, K. James, B.T. Fisher. Neutron imaging of diesel and gasoline fuel injectors. SAE World Congress. Detroit, MI; 2014.
- [2] B.T. Fisher*, C.J. Mueller. Liquid-phase penetration of soy and cuphea biodiesels under unsteady in-cylinder conditions. Advanced Engine Combustion Working Group Meeting. Livermore, CA; 2010.

- [3] A.S. Cheng, B.T. Fisher, G.C. Martin, C.J. Mueller*. Effects of fuel volatility on early direct-injection, low-temperature combustion in an optical diesel engine. SAE Powertrains, Fuels, and Lubricants Meeting. San Antonio, TX; 2009.
- [4] B.T. Fisher*, C.J. Mueller. Liquid penetration length of heptamethylnonane and trimethylpentane under unsteady in-cylinder conditions. Advanced Engine Combustion Working Group Meeting. Southfield, MI; 2009.
- [5] B.T. Fisher*, C.J. Mueller. High-speed measurement of liquid penetration length of heptamethylnonane under unsteady in-cylinder conditions. Advanced Engine Combustion Working Group Meeting. Livermore, CA; 2009.
- [6] C.J. Mueller*, B.T. Fisher, G. Martin, D. Milam, C. Gehrke, A.S. Cheng. Fuel-volatility effects on an early direct-injection, low-temperature combustion strategy in an optical engine utilizing a 15-hole, dual-row, narrow-included-angle nozzle. Advanced Engine Combustion Working Group Meeting. Auburn Hills, MI; 2008.

Posters:

- [1] R.L. Hancock, B.T. Fisher. Autoignition of *n*-heptane in a direct-injection constant-volume combustion chamber. University of Alabama Undergraduate Research and Creative Activity Conference. Tuscaloosa, AL; 2014.
- [2] S.R. Fletcher, B.T. Fisher. Development of a burner system and Rayleigh scattering method to measure soot concentration for diesel-relevant fuels. 66th Annual Meeting of the APS (American Physical Society) Division of Fluid Dynamics. Pittsburgh, PA; 2013.
- [3] B.T. Fisher, Z.B. Morris. Characterization of soot generated in a diffusion flame. University of Alabama Undergraduate Research and Creative Activity Conference. Tuscaloosa, AL; 2013.
- [4] B.T. Fisher, M.C. Maynard. Development and solid modeling of spray test chamber. University of Alabama Undergraduate Research and Creative Activity Conference. Tuscaloosa, AL; 2013.
- [5] B.T. Fisher, Z.B. Morris. Design of a spray chamber for fuel injector experimentation. University of Alabama Undergraduate Research and Creative Activity Conference. Tuscaloosa, AL; 2012.
- [6] B.T. Fisher. *In situ* diagnostic studies of flames inhibited by water aerosols. NRL/NRC Postdoctoral Fellow Networking and Poster Session. Washington, DC; 2005.
- [7] D.W. Hahn, B.T. Fisher. Measurement of small-signal absorption coefficient and absorption cross-section of collagen for 193-nm excimer laser light. Association for Research in Vision and Ophthalmology Annual Meeting. Ft. Lauderdale, FL; 2004.
- [8] D.W. Hahn, B.T. Fisher. Quantitative measurement of corneal tissue excimer laser ablation rates. Association for Research in Vision and Ophthalmology Annual Meeting. Ft. Lauderdale, FL; 2003.
- [9] D.W. Hahn, K.A. McDow, B.T. Fisher, M.H. Goldstein. Assessment of transient changes in corneal hydration using confocal Raman spectroscopy. Association for Research in Vision and Ophthalmology Annual Meeting. Ft. Lauderdale, FL; 2002.

Seminars and Invited Talks

- [1] Fundamental studies of physical and chemical processes relevant to low-temperature combustion in engines and gas turbines. U.S. Naval Research Laboratory (Chemistry Division), Washington, DC; June 2014.
- [2] In-cylinder mixing and combustion processes for conventional and emerging engine fuels. Graduate Student Seminar Series. Mississippi State University, Starkville, MS; November 2012.
- [3] Optical diesel engine studies of conventional and emerging fuels to understand effects of fuel volatility on in-cylinder mixing and combustion processes. Success Strategies for Emerging Faculty Workshop. University of Delaware, Newark, DE; September 2010.
- [4] Optical diesel engine studies of conventional and emerging fuels to understand effects of fuel volatility on in-cylinder mixing and combustion processes. Sandia Post-doctoral/Recent Staff Seminar. Sandia National Laboratories, Livermore, CA; April 2010.
- [5] Development of absorption diagnostics in slot burner flames. Physical-Chemistry Institute, Ruprecht-Karls-University, Heidelberg, Germany; August 2006.

Honors and Awards

Professional:

- Graduate student (Kemar James) won award for “Outstanding Research by a Master’s Student” from both University of Alabama College of Engineering and University of Alabama overall (2014)
- Oak Ridge Associated Universities (ORAU) Ralph E. Powe Junior Faculty Enhancement Award (2012)
- Awarded National Research Council (NRC) post-doctoral research associateship to conduct combustion/fire suppression research at U.S. Naval Research Laboratory (NRL)
- Awarded U.S. Patent No. 7207983: System and method for real-time feedback of ablation rate during laser refractive surgery (issued April 24, 2007)

Educational:

- Awarded University of Florida Stephen C. O’Connell Presidential Fellowship to conduct doctoral research
- Pi Tau Sigma (National Mechanical Engineering Honor Society) (1997-2000)
 - Vice-President, UF chapter (1998-1999)
 - President, UF chapter (1999-2000)
- Golden Key National Honor Society (undergraduate)
- National Merit Finalist (undergraduate)

Professional Service

- [1] Member, Board of Associates, Internal Combustion Engine Division (ICED) of the American Society of Mechanical Engineers (2015 – present)
- [2] Member of SAE Technical Quality Response Team (TQRT) (2012 – present)
- [3] Reviewer for SAE World Congress paper submissions (2008 – present)
- [4] Reviewer for International Symposium on Combustion paper submissions (2013 – present)
- [5] Reviewer and Session Organizer for ASME Internal Combustion Engine Division Fall Technical Conference (2013 – present)
- [6] Reviewer for scientific journals: *Fuel*, *Fuel Processing Technology*, *Combustion Science & Technology*, *Energy & Fuels*, *Atomization & Sprays*, *Proceedings of the Combustion Institute*

Professional Memberships

- [1] American Society of Mechanical Engineers (1997 – present)
- [2] The Combustion Institute (2006 – present)
- [3] Optical Society of America (2007 – present)
- [4] American Chemical Society (2011 – present)
- [5] American Institute of Aeronautics and Astronautics (2011 – present)