

Kareem A. Ahmed, Ph.D.

Assistant Professor

Department of Mechanical & Aerospace Engineering

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EDUCATION

- **Doctor of Philosophy in Mechanical Engineering, 2009**
University at Buffalo, The State University of New York, Buffalo, NY
Dissertation Title: *"Flame Stabilization in a Ramjet Combustor using a Transverse Slot Jet"* (ONR Funded)
- **Master of Science in Mechanical Engineering, 2006**
University at Buffalo, The State University of New York, Buffalo, NY
Thesis Title: *"Linear Stability Analysis of Reacting Wake-Shear Layer Flows"*
- **Bachelor of Science in Mechanical Engineering Technology, 2004**, Summa Cum Laude
State University of New York at Alfred, Alfred, NY

PROFESSIONAL APPOINTMENTS

Assistant Professor (Dec. 2014 - Present)

University of Central Florida, Orlando, FL

Department of Mechanical & Aerospace Engineering

- Direct the Propulsion & Energy Research Laboratory (advising three Ph.D. and two M.S. students).
- Undergraduate course: Aerothermodynamics of Propulsion (97 students)

Assistant Professor (July 2013 - Dec. 2014)

Old Dominion University, Norfolk, VA

Department of Mechanical & Aerospace Engineering

- Direct the Propulsion & Energy Research Laboratory (advising three Ph.D. and four M.S. students).
- Graduate courses: Fluid Dynamics, Combustion, and Heat Transfer (Conduction and Convection).
- Research: flame-vortex dynamics, physics of deflagrated flame acceleration, plasma flame, dynamic pressure fuel injection, reacting countercurrent shear layer, and microfluidic shear stress.

Senior Engineer, Aero/Thermo (March 2011 – Aug. 2013)

Pratt & Whitney Military Engines – United Technologies Corporation, East Hartford, CT

Augmentor (Afterburner) & Exhaust Systems – Advance Engine Programs and Technologies

- Responsible for characterizing ignition, static flame stability and combustion dynamics/thermoacoustic instabilities (screech) for the Joint Strike Fighter F35 augmentor.
- Research and development of reduced order models formulated based on key physics for flame ignition, extinction, stabilization and dynamics for Air Force Research Laboratory (AFRL).
- Investigated combustion characteristics under Alternate Fuels Program for AFRL.
- Lead the transition from in-house combustion CFD code to Fluent reacting CFD.
- Applied combustion, acoustic modeling, statistical optimization techniques, CFD, heat transfer, digital signal processing and analysis tools to the F35 augmentor and advance engine programs.
- Directed aero special initiative (\$270,000) for research experiments on bluff-body stabilized turbulent flames with universities.
- Designed and developed technology demonstrators/experiments to validate reduce order models - Hot Acoustic Rig (\$1,000,000).
- Developed statistical analysis codes for F35 augmentor screech for War-on-Cost program.
- Formulated Advanced Combustion Short Course Series for advance engineers with GA Tech.
- F35 Augmentor technology development in collaboration with Creare Inc. NAVY SBIR Phase II.5

Adjunct Assistant Professor / Postdoctoral Research Scientist (Aug. 2009 – May 2011)
Florida State University, College of Engineering, Tallahassee, FL
Department of Mechanical Engineering

- Responsible for two courses per semester, lectures, quizzes, exams and grading.
- Arranged laboratory experiments for undergraduate thermal-fluids laboratory class.
- Advised undergraduate senior design projects for academic years 2009-2011.
- Prepared Heat Transfer Ph.D. qualification exam for academic years 2009-2011.
- Assessed and prepared documents associated with ABET accreditation.
- Developed multi-light source focusing system for Schlieren, PIV, and shadowgraph. (Patented) (<http://idtvision.com/videos/?vid=Y7>)
- Conducted supersonic and subsonic flow research experiments at the Florida Center for Advance Aero-Propulsion (FCAAP) facilities.
 - Controlling and enhancing mixing and combustion in a scramjet combustor.
 - Active flow control of oblique shocks generated using microjet actuators.
 - Separation control on a low-pressure turbine blade.
 - Advance optical and laser focused 3D development.
- Collaborated in the 2010 Summer Academy in Aero-science, Engineering & Mathematics.

Research Assistant (May 2006 – Aug. 2009)

The Research Foundation of State University of New York under the Office of Naval Research (ONR) grant (Dr. Gabriel D. Roy), Buffalo, NY

- Fluidic flame stabilization in a ramjet combustor research for Office of Naval Research.
- Investigation and analysis of fluidically stabilized turbulent flames and efficiency key mechanisms.
- Designed, machined, assembled, and performed ramjet experiments.
- Constructed equipment and numerical codes for data collection and analysis.
- Conducted tests using Particle Image Velocimetry & Hot Wire Anemometry, Schlieren, Chemiluminescence.
- Mentored and managed several graduate and undergraduates student in the laboratory.
- Additional conducted studies:
 - Phase-locked imaging and ignition of fuel sprays for internal combustion engines to enhance spray and combustion processes.
 - Mixing and entrainment characteristics of countercurrent reacting shear layer
 - Fluidic flow vectoring using combined transverse injection and suction
- Assisted in research proposals preparation.

Mechanical Design Engineer (Sep. 2004 - May 2006)

Aeropanel Corp. & InSCO Inc., Boonton, NJ

- Designed cockpit panels and instruments per customer specifications and requirements.
- Directed new design projects, created BOM, and routing procedures.
- Programmed codes for CNC machines.

Professional Tutor (Sep. 2003 - May 2004)

Tutoring Services at State University of New York at Alfred, Alfred, NY

Courses taught: Thermodynamics, Fluids, Thermofluids, Math, and AutoCAD

RESEARCH INTERESTS

The research interests are in the area of energy and propulsion focusing on multi-phase turbulent reacting flows, turbulent combustion, combustion dynamics, static flame stability, ignition, supersonic compressible flows, fluid mechanics, flow control, flame-fluidic interaction, hydrodynamic instabilities, experimental methods and advance laser and optical diagnostics.

SPONSORED RESEARCH

Total Active Funding: \$417,876

1. "Interaction Physics of Deflagrated Methane Flame with Fluidic Flow for Pressure Gain Combustion," ACS-PRF New Investigator Program Award, \$110,000. **(PI: Kareem Ahmed, Awarded 2014)**
2. "High Pressure Fuel Injection System for Low-Emission Clean Combustors," Continental, \$ 243,376. **(PI: Kareem Ahmed, Awarded 2014)**
3. "Measuring Shear Stress with a Microfluidic Sensor to improve Aerodynamic Efficiency," American Nanofluidics-NASA, \$37,500. **(PI: Kareem Ahmed, Awarded 2014)**
4. "Flame Extinction Physics-Based Reduced Order Model for Fuel Flexible Low-Emission Combustion," NASA-VSGC New Investigator Program Award, \$10,000. **(PI: Kareem Ahmed, Awarded 2014)**
5. "Design and Development of a Coaxial Jet Experimental Facility," AFRL, \$10,000. **(PI: Kareem Ahmed, Awarded 2014)**
6. "Enhancing the Efficiency and Performance of Confined Premixed Combustion Systems using Flame-Generated Vorticity," ODU Office of Research Summer Research Faculty Award, \$7,000. **(PI: Kareem Ahmed, Awarded 2014)**
7. "REU Site: Multi-physics of Active Systems and Structures," NSF (REU), \$120,000. **(Co-PI: Kareem Ahmed, 2011)**

AWARDS

- The American Chemical Society – Petroleum Research Fund, **Doctoral New Investigator Award**, June 2014
- NASA-Virginia Space Grant Consortium – **New Investigator Program Award**, March 2014
- The Office of Research at Old Dominion University, **Summer Research Faculty Award**, Feb. 2014
- Innovator award for focusing system from the Florida State University Office of Research, Dec. 2012
- Pratt & Whitney appreciation award, Dec. 2011
- Innovator recognition and honoring from the Florida State University Office of Research, Dec. 2011
- 1st place School of Engineering and Applied Science poster award in the April 2008
- 1st place Mechanical and Aerospace Engineering poster award in the March 2008

THESIS & DISSERTATION CHAIR

1. Marissa MacDonald (M.S. Thesis Summer 2014, Assisted in DoD SMART Scholarship Award for Ph.D.)
2. Joseph McGarry (M.S. Thesis Fall 2014)

THESIS & DISSERTATION COMMITTEE MEMBER

1. Bryce Horvath (M.S. Thesis Fall 2013)
2. Ben D. Phillips (M.S. Thesis Fall 2013)
3. Song Xue (Ph.D. Dissertation Spring 2014)
4. Selcuk Atalay (Ph.D. Dissertation Fall 2014)

UNIVERSITY & DEPARTMENT COMMITTEES/TASK FORCE

1. MAE Graduate Committee (Fall 2014)
2. MAE Laboratory Committee (2013 - 2014)
3. MAE Information Technology Committee (2013 - 2014)

PUBLICATIONS

JOURNALS

1. Lovett, J.A., AHMED, K.A., Klusmeyer, A., Smith, A.G., Lubarsky, E., **Menon, S., Zinn, B.T.**, "Influence of Fuel Distribution on the Flame Structure of Bluff-Body Stabilized Flames," Journal of Engineering for Gas Turbines and Power, Vol. 136, 2014.
2. Ali, M., AHMED, K.A., Kumar, R., Alvi, F., "Flowfield Characteristics of Oblique Shocks Generated Using Microjet Arrays," International Journal of Flow Control, Vol. 47, No. 11, 2014.
3. AHMED, K.A., Forliti, D.J., "Fluidic Flame Stabilization in a Planar Combustor Using a Transverse Slot Jet," AIAA Journal, Vol. 47, No. 11, 2009, pp. 2770-2775.
4. AHMED, K.A., Ali, M., Alvi, F., "Mixing Characteristics of Transverse Microjet Arrays in a Supersonic Backward-Facing Step Flow," AIAA Journal, Volume 52, No. 12, 2014.

5. AHMED, K.A., Forliti, D.J., Moody, J., and Yamanaka, R., "Flowfield Characteristics of a Confined Transverse Slot," AIAA Journal, Vol. 46, No. 1, 2008, pp. 94-103.
6. AHMED, K.A., Forliti, D.J., Moody, J., "The Effect of Slot Jet Size on the Confined Transverse Slot Jet," Experiments in Fluids, Vol. 45, No. 1, 2008, pp. 13-26.
7. Carr, Z.R., AHMED, K.A., Forliti, D.J., "Spatially-Correlated Precision Error in Digital Particle Image Velocimetry Measurement of Turbulent Flows," Experiment in Fluids, Vol. 47, No. 1, 2009, pp. 95-106.
8. AHMED, K.A., Forliti, D.J., "Premixed Flame Stabilization using a Wall-bounded Bluff Body: Influence of Equivalence Ratio and Boundary Layer Tripping," Combustion Science and Technology, under review.
9. MacDonald, M., AHMED, K.A., "Flame Dynamics and Extinction Physics for Fuel Flexible Low-Emission Combustion," Combustion and Flame, under prep.
10. AHMED, K.A., Forliti, D.J., "Mechanisms Influencing Turbulent Flame Structures of Fluidic Flame Holding," Combustion and Flame, under review.
11. AHMED, K.A., Wiley, A., Lourenco, L. "Sharp Focus Multi-Light Source System for Schlieren, PIV, and Shadowgraph," Experiments in Fluids, under prep.

PROCEEDINGS

1. Hughes, C.N., Dutta, D., Bashirzadeh, Y., AHMED, K.A., Qian, S., "Measuring Shear Stress with a Microfluidic Sensor to improve Aerodynamic Efficiency," 53rd AIAA Aerospace Sciences Meeting, Kissimmee, FL, 5-9 Jan., 2015.
2. MacDonald, M., AHMED, K.A., "Flame Extinction Dynamics of Lean Premixed Bluff-Body Stabilized Flames," 53rd AIAA Aerospace Sciences Meeting, Kissimmee, FL, 5-9 Jan., 2015.
3. Lovett, J.A., AHMED, K.A., Klusmeyer, A., Smith, A.G., Lubarsky, E., **Menon, S., Zinn, B.T.**, "Influence of Fuel Distribution on the Flame Structure of Bluff-Body Stabilized Flames," Proceedings of ASME Turbo Expo, San Antonio, TX, 3-7 June, 2013.
4. AHMED, K.A., Ali, M., Alvi, F., "Mixing Characteristics of Transverse Microjet Arrays in a Supersonic Backward-Facing Step Flow," 49th AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL, 4-7 Jan., 2011.
5. Ali, M., AHMED, K.A., Kumar, R., Alvi, F., Forliti, D.J., "Flowfield Characteristics of Oblique Shocks Generated Using Microjet Arrays," 49th AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL, 4-7 Jan., 2011.
6. AHMED, K.A., Forliti, D.J., "Turbulent Flame Structures and Flame-Generated Vorticity Influence on Combustor Performance Employing Fluidic Flame Holding," 48th AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL, 4-7 Jan., 2010.
7. AHMED, K.A., Forliti, D.J., "On the Mechanisms of Combustion Rate Enhancement of the Fluidic Dump Combustor," Advanced Propulsion Review, Monterey, CA, 9-11 June, 2009.
8. AHMED, K.A., Forliti, D.J., "Performance of Combustors Employing Fluidic Flame Holding," International Symposium on Recent Advances in Combustion and Noise Control for Propulsion, Kauai, HI, 10-12 December, 2008.
9. AHMED, K.A., Forliti, D.J., "Combustor Flowfield Measurements of a Transverse Jet Flame Holder," 47th AIAA Aerospace Sciences Meeting and Exhibit, Orlando, FL, 5-8 Jan., 2009.
10. AHMED, K.A., Forliti, D.J., "Flame Holding and Combustion Characteristics of a Geometrical Flame Holder," ASME Heat Transfer, Jacksonville, FL, 10-14 Aug., 2008.
11. Forliti, D.J., AHMED, K.A., "Flame Stabilization in a Model Ramjet Combustor Using a Transverse Slot Jet," 46th AIAA Aerospace Sciences Meeting and Exhibit, Reno, Nevada, 7-10 Jan., 2008
12. Forliti, D.J., AHMED, K.A., "Flame Stabilization and Flowfield Characteristics of a Fluidic Dump Combustor," Proceedings of the 20th ONR Propulsion Conference, Arlington, VA, 12-14 December, 2007.
13. Forliti, D.J., AHMED, K.A., "Induced Recirculation using Planar Jet Injection for Flame Stabilization," Proceedings of the 19th ONR Propulsion Conference, Orange County, CA, 18-20 December, 2006.

PRESENTATIONS

1. AHMED, K.A., Forliti, D.J., "Experimental Studies of Confined Premixed Flames Stabilized using Bluff Bodies and Transverse Jets," **Sandia National Laboratory** Technical Seminar, Livermore, CA, 13 April, 2009.

- AHMED, K.A., Carr, Zakery, Forliti, D.J., “Operating Characteristics of a Fluidic Premixed Dump,” 60th APS DFD, Salt Lake City, UT 18-20 Nov., 2007.
- Carr, Zakery, AHMED, K.A., Forliti, D.J., “Flow Field Measurements of a Fluidic Dump Combustor,” 60th APS DFD, Salt Lake City, UT 18-20 Nov., 2007.
- AHMED, K.A., Forliti, D.J., “Flame Stabilization in a Model Ramjet Combustor Using a Transverse Slot Jet,” MAE Praxair seminar, SUNY at Buffalo, NY, 18 Oct., 2007.
- AHMED, K.A., Moody, J., Forliti, D.J., “Flow Field Features of the Induced Recirculation Zone using Planar Jet Injection,” 59th APS DFD, Tampa, FL, 19-21 Nov., 2007.
- Moody, J., AHMED, K.A., Forliti, D.J., “A Parametric Study of the Induced Recirculation Zone using Single/Double Planar Jet Injection,” 59th APS DFD, Tampa, FL, 19-21 Nov., 2007.

PATENTS

- “Focusing Systems and Methods for Flow Visualization” K. AHMED, L. Lourenco, A. Wiley, Patent 61/498,809, 2011
- “Shear Stress Sensor” C. Hughes, S. Qian, K. AHMED, Patent 61/918,045, 2014

PROFESSIONAL MEMBERSHIPS

- American Institute of Aeronautics and Astronautics (AIAA, since 2006)
- American Physical Society - Division of Fluid Mechanics (APS – DFD, since 2006)
- American Society of Mechanical Engineering (ASME, since 2007)
- The Combustion Institute (since 2007)
- Florida Center for Advance Aero-Propulsion (FCAAP, since 2009)

SYNERGISTIC ACTIVITIES

- Presentations at AIAA ASM, APS DFD, ASME Turbo Expo, ASME Heat Transfer and others
- Invited talks at Universities and Sandia National Laboratories
- Mentored undergraduates in McNair, BEAM, and Zimmer programs (2007 – 2008)
- Reviewer for fluid mechanics and combustion journals

COURSES TAUGHT

- University of Central Florida, Mechanical & Aerospace Eng., Orlando, FL (2014-Present)**
EAS 4300 Aerothermodynamics of Propulsion (Spring 2015 undergraduate course, 97 students, 1 GTA)
- Old Dominion University, Mechanical & Aerospace Eng., Norfolk, VA (2013-2014)**
MAE 602 Fluid Dynamics & Aerodynamics (Spring 2013 graduate course)
MAE 620 Heat Transfer I (Fall 2013 and Fall 2014 Conduction & Convection graduate course)
MAE 721/821 Fundamentals of Combustion (Fall 2014 graduate course)
MAE 797/897 Experimental Methods in Reacting & Non-Reacting Turbulent Flows (Fall 2014 graduate course)
- Florida State University, Mechanical Engineering, Tallahassee, FL (2009-2011)**
EML 4304 Thermal - Fluids Lab (undergraduate course)
EML 4711/ 5710 Introduction to Gas Dynamics (undergraduate/graduate course)
EML 5152 Fundamentals of Heat Transfer (Conduction Heat transfer graduate course)
EML 5155 Convective Heat Transfer (graduate course)
- University at Buffalo, The State University of New York, Mechanical & Aerospace Eng., Buffalo, NY**
MAE 510 Experimental Methods in Thermal Science (Spring 2009 undergraduate/graduate course)

CURRENT STUDENTS

- Marissa MacDonald (M.S. Thesis Defended Summer 2014, continuing for Ph.D. Mechanical Engineering)
- Joseph McGarry (M.S. Thesis Defended Fall 2014, continuing for Ph.D. Aerospace Engineering)
- Yashar Bashirzadeh (Ph.D. Mechanical Engineering)
- Brendan Wiedow (M.S. Aerospace Engineering)
- Joshua Beverly (M.S. Aerospace Engineering, NASA Langley Test Engineer)
- Henry Haskin (M.S. Aerospace Engineering, NASA Langley Combustion Engineer)
- Wilmer Flores (M.S. Mechanical Engineering, U.S. NAVY)

RELEVANT COURSEWORK

Fluid Mechanics, Turbulence, Combustion, Gas Dynamics, Heat Transfer, Fire Dynamics, Turbomachinery, CFD, Thermodynamics, Propulsion, Advance Internal Compressible Flow (MIT), Instrumentation, Mechanical Design.

SKILLS

Computer:

- MATLAB
- Fluent
- Cantera
- Catia
- Linux
- FORTRAN
- ANSYS CFX
- Inventor
- I-DEAS
- Python
- Labview
- AutoCAD
- Solidworks
- Mastercam
- UG
- Tecplot
- Chemkin II
- Pro-E
- Cosmos Floworks
- Office

Developed codes:

- Dynamic Particle Image Velocimetry (PIV) code
- Fluorescence statistical analysis (PLIF) codes
- Advanced Statistical post-processing codes for PIV data analysis.
- Proper Orthogonal Decomposition (POD) code
- Static flame stability reduced order model
- Spray flame dynamics reduced order model

Instrumentation:

- Particle Image Velocimetry (PIV)
- Planar Laser Induced Fluorescence (PLIF)
- Schlieren
- Hotwire
- Shadowgraph
- Unsteady pressure measurements
- Filtered/unfiltered Chemiluminescence

Communication: Technical writing, public speaking and presentation preparation

Technical: Automotive, gas turbine, and simple electronics

Mechanical: Programming CNC machines, end mill, and lathe

PROJECTS

Basic Utility Vehicle (BUV) 2003-2004

- Designed machined and assembled BUV with team of four students.

Turbocharger Gas Turbine Engine 2003

- Designed and assembled Gas Turbine Engine from a Turbocharger and can combustor, and performed research experiments.

Pulse Jet Engine 2002-2003

- Designed, machined, assembled, and performed Pulse Jet Engine experiments.