

# ARAVIND RAMACHANDRAN

## Curriculum Vitae

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### EDUCATION

- Ph.D., Mechanical Engineering** Expected May 2019  
North Carolina State University, Raleigh, NC  
Dissertation (in progress): *Studies of Autoignition and Flame Stabilization in Lifted Turbulent Flames*
- Master of Science, Aerospace Engineering** December 2015  
North Carolina State University, Raleigh, NC
- Bachelor of Engineering, Mechanical Engineering** May 2012  
Anna University, Chennai, India
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### RESEARCH INTERESTS

- Turbulent combustion, autoignition and Moderate or Intense Low-oxygen Dilution (MILD) combustion
  - Stabilization mechanisms of lifted flames
  - Laser diagnostics for combustion and for non-reacting turbulent flows
  - Design and operation of sequential combustors
  - Developing methods to reduce pollutant emissions
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### RESEARCH EXPERIENCE

- Graduate Researcher** August 2013 – Present  
*Turbulent Shear Flow Laboratory, North Carolina State University*  
(Advisors: Venkat Narayanaswamy and Kevin M. Lyons)

**Summary:** Performed experimental investigations to uncover the complex physics of turbulent combustion in high temperature, low oxygen environments relevant to modern gas turbines and clean combustors

#### Design and Setting up of Jet in Vitiated Coflow (JIVCF) Facility

- Designed and built a portable jet-in-coflow combustor capable of operating across very different combustion regimes with vastly differing mechanisms of flame stabilization, making it an excellent facility for studying phenomena relevant to next generation clean combustion technologies
- Modular design of the burner allows for modifications for convenient use with different fuels and diluents, a large range of jet Reynolds numbers and provides easy optical access for all configurations
- Set up the laboratory from scratch, being the first student in the combustion wing of the research group

#### Investigation of Stabilization Mechanisms of Turbulent Flames

- Performed luminosity imaging to investigate the flame dynamics in the ‘autoignition-assisted’ regime of jet flames
- Implemented methods for quick contrast stretching and background noise reduction of the acquired images using ImageJ
- Wrote Matlab codes that employed edge detection and morphological segmentation algorithms to track the motion of the flame base and autoignition kernels

#### Velocity Measurements in the Stabilization Region of Lifted Autoignitive Turbulent Jet Flames

- Built a particle image velocimetry (PIV) setup and obtained high resolution velocity data in the turbulent flow field

- Oversaw the development of a fluidized bed particle seeding system for the PIV setup, designed using Solidworks and ANSYS
- Processed (using DaVis) and post-processed (using Matlab) several gigabytes of raw data and derived impactful inferences about the stabilization mechanism of lifted flames from statistics of computed velocities and instantaneous strain rates in the stabilization region of the flames

#### Scalar Imaging in the Low Temperature Reaction Zone of Autoignitive Jet Flames (Ongoing)

- Designed and set up a facility to perform planar laser induced fluorescence (PLIF) imaging of formaldehyde, a low temperature reaction intermediate in hydrocarbon combustion
- Wrote scripts to aid in analyzing the structure of the low temperature reaction zone
- Project funded by the U.S. Army Research Office

#### Project Associate

Gas Dynamics Laboratory, Indian Institute of Technology Madras

June 2012 – May 2013

- Explored a novel design concept for a compact diaphragmless shock tube using a spring and piston system which reduced experiment time and complexity
- Implemented flow visualization techniques such as Shadowgraph and Background Oriented Schlieren photography and wrote Matlab codes to recognize and track the shock wave
- Constructed an electronic trigger circuit for the shock tube experiments which enabled high speed recording of the unsteady shock wave at frame rates up to 18,000 frames per second

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### PUBLICATIONS, PRESENTATIONS AND POSTERS

#### Peer-reviewed Journal Articles

- **Ramachandran, A.**, Narayanaswamy, V., Lyons, K. M., *“Observations on the Role of Autoignition in Flame Stabilization in Turbulent Non-premixed Jet Flames in Vitiating Coflow”*, ASME Journal of Engineering for Gas Turbines and Power (under review).

#### Conference Papers

- **Ramachandran, A.**, Tyler, D. A., Patel, P. K., Narayanaswamy, V., Lyons, K. M., *“Global Features of Flame Stabilization in Turbulent Non-premixed Jet Flames in Vitiating Coflow”*, 45th AIAA Fluid Dynamics Conference (p. 2313), June 2015, Dallas, TX.

#### Conference Presentations

- **Ramachandran, A.**, Narayanaswamy, V., Lyons, K. M., *“Influence of Aerodynamic Strain Rate on Local Extinction in Turbulent Non-Premixed Jet Flames”*, American Physical Society (APS) Division of Fluid Dynamics Meeting Abstracts, November 2016, Portland, OR.
- **Ramachandran, A.**, Mothe, A.R., Narayanaswamy, V., Lyons, K. M., *“Local Velocity Field Measurements towards Understanding Flame Stabilization of Turbulent Non-premixed Jet Flames in Vitiating Coflow”*, American Physical Society (APS) Division of Fluid Dynamics Meeting Abstracts, November 2015, Boston, MA.

#### Poster Presentations

- *“Investigations of Flame Stabilization Mechanisms in Lifted Turbulent Non-premixed Jet Flames in Vitiating Coflow”*, Mechanical and Aerospace Engineering Graduate Symposium, North Carolina State University, February 2018.
  - *“Global Features of Flame Stabilization in Turbulent Non-premixed Jet Flames in Vitiating Coflow”*, Mechanical and Aerospace Engineering Graduate Symposium, North Carolina State University, February 2016.
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## TEACHING EXPERIENCE

### Laboratory Instructor

*Instrumentation and Solid Mechanics Laboratory, North Carolina State University*

May 2014 – August 2016

- Trained over 200 undergraduate students to build simple circuits on breadboards and acquire accurate measurements of quantities such as temperature, resistance, voltage, strain and force using various instruments and machines in conjunction with LabVIEW
- Taught students the lay-up process of fabricating fiberglass composites and conducted strength testing of composite structures under tensile and bending loads
- Advised students in scientific writing and critiqued their reports

### Laboratory Course Designer

*Instrumentation and Solid Mechanics Laboratory, North Carolina State University*

May 2015 – August 2015

- Collaborated with other instructors to implement a new syllabus for the Instrumentation and Solid Mechanics laboratory course
- Devised a temperature compensated load cell experiment as part of the new syllabus
- Designed and tested a load cell using ANSYS and added simultaneous temperature measurements using thermocouples which provided real time compensation of load measurement under heated conditions
- Authored a report on the experiment, with detailed instructions for students to follow in the laboratory

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## INDUSTRIAL EXPERIENCE

### Noise, Vibration & Harshness Intern

*Ashok Leyland Ltd.*

August 2011 – April 2012

- Developed a method to predict acoustic properties such as Transmission Loss and Insertion Loss which are crucial for the design of an exhaust muffler
- Wrote a Matlab script to implement the method and successfully verified the results with experimental data
- Contributed to improving the process of muffler design by predicting exhaust noise during the design stage

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## PROFESSIONAL MEMBERSHIPS

- American Institute of Aeronautics and Astronautics (AIAA) Student Member
- American Physical Society (APS) Student Member

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## SKILLS

**Research:** Highly skilled at designing experiments, data analysis, image processing, operating and troubleshooting high energy lasers (up to Class IV), using and handling optical and imaging equipment and safe usage of high pressure flammable gases

**Experimental Techniques:** Particle Image Velocimetry (PIV), Planar Laser Induced Fluorescence (PLIF), Chemiluminescence and High Speed Imaging, Background Oriented Schlieren photography

**Tools and Languages:** Highly skilled in Matlab, ImageJ, TecPlot and DaVis; competent in performing chemical kinetics simulations in Cantera and basic programming in Python and C++

**Software Packages:** Proficient in MS Word, PowerPoint and Excel, Solidworks, Pro-E, AutoCAD, ANSYS Fluent, ANSYS, LabVIEW

**Fabrication:** Experienced in milling, drilling and lathe operations

**Other:** Adept at writing and typesetting documents in LaTeX

**Interests:** Guitar and bass player, also enjoy chess and volleyball