

Arvind Thiruvengadam

Assistant Professor

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I. Professional Preparation:

University of Madras, India	Mechanical Engineering	B.E 2004
West Virginia University	Mechanical Engineering	M.S 2007
West Virginia University	Mechanical Engineering	Ph.D. 2012

II. Appointments

Assistant Professor (Tenure Track)	Department of Mechanical And Aerospace Engineering, West Virginia University	Jan, 2016- Present
Research Assistant Professor	Department of Mechanical And Aerospace Engineering, West Virginia University	Sep, 2013- Jan, 2016
Research Assistant	Center for Alternative, Fuels, Engines and Emissions (CAFEE), West Virginia University	2012-2013

III. Publications

1. Tianyang Wang, David C. Quiros, **Arvind Thiruvengadam**, Saroj Pradhan, Shaohua Hu, Tao Huai, Eon S. Lee, and Yifang Zhu, Total Particle Number Emissions from Modern Diesel, Natural Gas, and Hybrid Heavy-Duty Vehicles During On-Road Operation. Environmental Science & Technology 2017 51 (12), 6990-6998
2. **Thiruvengadam, A.**; Besch, M.; Carder, Gautam, M.; Oshinuga, A.; Hogo, H; Pasek, R. Unregulated greenhouse gas and ammonia emissions from current technology heavy-duty vehicles. Journal of Air Water and Waste Management Association 2016, 66 (11): 1045-1060.
3. Quiros, D.C., **Thiruvengadam, A.**, Pradhan, S. et al. Real-World Emissions from Modern Heavy-Duty Diesel, Natural Gas, and Hybrid Diesel Trucks Operating Along Major California Freight Corridors. Emission Control Science and Technology 2016, 2 (3): 156-172
4. **Thiruvengadam, A.**; Besch, M.; Thiruvengadam, P.; Pradhan, S.; Carder, D.; Kappanna, H.; Gautam, M.; Oshinuga, A.; Hogo, H.; Miyasato, M., Emission Rates of Regulated Pollutants from Current Technology Heavy-Duty Diesel and Natural Gas Goods Movement Vehicles. Environmental Science and technology **2015**, 49 (1), 5236-5244.
5. Besch, M.; Israel, J.; **Thiruvengadam, A.**; Kappanna, H.; Carder, D., Emissions Characterization from Different Technology Heavy-Duty Engines Retrofitted for CNG/Diesel Dual-Fuel Operation. SAE International Journal of Engines **2015**, 8 (3)
6. Pradhan, S.; **Thiruvengadam, A.**; Thiruvengadam, P.; Besch, M.; Carder, D, 2015. Investigating the Potential of Waste Heat Recovery as a Pathway for Heavy-Duty Exhaust Aftertreatment Thermal Management. *SAE*, 2015-01-1606.

7. **Thiruvengadam, A.**; Besch, Yoon, S.; Collins, J., Herner, J.; Ayala, A.; Carder, D.; Gautam, M., Characterization of Particulate Matter Emissions from a Current Technology Natural Gas Engine. Environmental Science and Technology, 2014, 48 (14), 8235-8242.
8. **Thiruvengadam, A.**; Besch, C. M.; Carder, D.; Oshinuga, A.; Gautam, M., Influence of Real-World Engine Load Conditions on Nanoparticle Emissions from a DPF and SCR Equipped Heavy-Duty Diesel Engine. Environmental Science and Technology 2011, 46 (3), 1907-1913
9. **Thiruvengadam, A.**; Carder, D. K.; Krishnamurthy, M.; Oshinuga, A.; Gautam, M., Effect of an economical oxidation catalyst formulation on regulated and unregulated pollutants from natural gas fueled heavy duty transit buses. Transportation Research Part D: Transport and Environment 2011, 16 (6), 469-473
10. Yoon, S.; Collins, J.; **Thiruvengadam, A.**; Gautam, M.; Herner, J.; Ayala, A.; Criteria pollutant and greenhouse gas emissions from CNG transit buses equipped with three-way catalysts compared to lean-burn engines and oxidation catalyst technologies. J Air Waste Manag Assoc. 2013, 63 (8), 926-933
11. Yoon, S.; Shaohua, H.; Kado, N.; **Thiruvengadam, A.**; Collins, J.; Gautam, M.; Herner, J.; Ayala, A.; Chemical and Toxicological Properties of Emissions from CNG Transit Buses Equipped with Three-Way Catalysts Compared to Lean-Burn Engines and Oxidation Catalyst Technologies. Atmospheric Environment, 2014, 83, 220-228.
12. Littera, D.; Cozzolini, A.; Besch, C. M.; **Thiruvengadam, A.**; Gautam, M., High Temperature Sampling System for Real Time Measurement of Solid and Volatile Fractions of Exhaust Particulate Matter. SAE International Journal of Engines 2011, 4 (2), 2477-2489.
13. Ardanese, R., Ardanese, M., Besch, M. C., Adams, T. R., **Thiruvengadam, A.**, Shade, B. C., et al. (2009). PM Concentration and Size Distributions from a Heavy-duty Diesel Engine Programmed with Different Engine-out Calibrations to meet the 2010 Emission Limits. SAE , 2009-01-1183.

IV. **Synergistic Activities**

1. Development of one-of-a-kind on-board diagnostic (OBD) research platform for heavy-duty engines.
2. Co-principal investigator in funded programs that have contributed to policy making and refinement of emissions inventory of regulatory agencies such as South Coast Air Quality Management District and the California Air Resources Board.
3. Supervising and mentoring a large group of undergraduate and graduate (Ph.D. and M.S) students pursuing research in CAFEE.
4. Development of a database for the dissemination of emissions inventory of a large population heavy-duty vehicles characterized by different fuels, vocation and engine technology.
5. Development of a web based portal for continuous tracking of ambient and vehicle pollution through mobile on-board communication system.

V. **Collaborators & Other Affiliations**

- **Collaborators**
- Adewale Oshinuga, South Coast Air Quality Management District
- Dr. Alberto Ayala, California Air Resources Board
- Dr. John Collins, California Air Resources Board
- Dr. Kent Johnson, University of California, Riverside
- Dr. Yoon Seungju, California Air Resources Board
- Dr. Tao Huai, California Air Resources Board

- **Graduate Advisor**
Dr. Mridul Gautam, West Virginia University

VI. Recent Recognition

- Core member of the team that uncovered the Volkswagen emissions scandal, that resulted in a \$14.7 billion settlement with the USEPA
- Ranked 2 on the Motor trend power list in the automotive industry for 2016
- Named 2016 All-Stars in the Automotive News for the Environmental team

VII. Select Recent Presentations:

- **Thiruvengadam, A. (Invited Speaker)**, (2017). Investigation of DPF Failure Modes and cation Strategies, *Conference on Combustion generated nanoparticles, Cambridge, U.K*
- **Thiruvengadam, A. (Speaker)**, (2017). Evaluation of In-Use Emissions Using On-Board NOx Sensors On Heavy-Duty Diesel Trucks, *27th CRC ON-ROAD VEHICLE EMISSIONS WORKSHOP*. Long Beach, CA
- **Thiruvengadam, A. (Invited Speaker)**, (2015). Real-world on-road particulate matter emissions from latest technology heavy-duty vehicles using a mobile cvs laboratory, *Conference on Combustion generated nanoparticles, ETH Zurich, Switzerland*
- **Thiruvengadam, A. (Invited Speaker)**, (2015). Real-world on-road particulate matter emissions from latest technology heavy-duty vehicles using a mobile cvs laboratory, *Conference on Combustion generated nanoparticles, Cambridge, U.K*
- **Thiruvengadam, A. (Invited Speaker)**, (2015). Efficiency Limitations of Current Traffic Management Strategies Aimed at Reducing Air Pollutions, *Horiba Seminar, SAE World Congress, Detroit, MI*
- **Thiruvengadam, A. (Speaker)**, (2015). Heavy- and Medium-duty Diesel Engine Efficiency Evaluation and Energy Audit, *25th CRC ON-ROAD VEHICLE EMISSIONS WORKSHOP*. Long Beach, CA
- **Thiruvengadam, A. (Invited Speaker)**, (2015). Unregulated, GHG and Ammonia Emissions from heavy-duty natural gas vehicles-past and present, *CRC Mobile Source Air Toxics Workshop*. Sacramento, CA.
- **Thiruvengadam, A. (Speaker)**, Carder, D., Besch, M., & Gautam, M. (2014). Comparison of regulated and unregulated emissions from current natural gas and diesel heavy-duty vehicles. *24th CRC ON-ROAD VEHICLE EMISSIONS WORKSHOP*. San Diego, CA.
- **Thiruvengadam, A. (Speaker)**, Besch, M.; Carder, D., & Gautam, M. (2013). NOx, ammonia and greenhouse gas emissions from current model year heavy-duty vehicles. *23rd CRC ON-ROAD VEHICLE EMISSIONS WORKSHOP*. San Diego, CA.
- **Thiruvengadam, A. (Speaker)**, Besch, M.; Carder, D., & Gautam, M. (2013). Characterization of the composition and toxicity of particulate matter emissions from advanced heavy-duty natural gas engines. *17th ETH-Conference on Combustion Generated Nanoparticles*. Zurich, Switzerland.
- **Thiruvengadam, A. (Speaker)**, Carder, D., & Gautam, M. (2010). Comparison Of Regulated And Unregulated Exhaust Emissions From A Fleet Of Multi-Fuel Solid Resource Collection Vehicles. *ASME ICEF 2010, Fall Technical Conference, San Antonio, TX*.

VIII. Select Recent Sponsored Research:

- **Title:** “In-Use Emissions Testing and Fuel Usage Profile of On-Road Heavy-Duty Vehicles”
Principal Investigator
Funding Agency: South Coast Air Quality Management District (Jan 1, 2017 – May, 2018);
Amount: \$ 1,600,000
- **Title:**“Development of Ammonia Retrofit Solution for Stoichiometric Natural Gas Engines”,
Principal Investigator
Funding Agency: South Coast Air Quality Management District (Nov 1, 2014 – August 31, 2015);
Amount: \$ 240,000
- **Title:**“Diesel Engine Modeling Development for Heavy-Duty Vehicle Simulation Tool”, **Principal Investigator**
Funding Agency: International Council for Clean Transportation (ICCT) (Nov 1, 2013 - May, 2014);
Amount: \$ 59,943
- **Title:**“ Real-World Evaluation of Modern Heavy-Duty Truck Emissions Using PEMS and a Transportable CVS Emissions Measurement System”, **Co-Principal Investigator**
Funding Agency: California Air Resources Board and South Coast AQMD (Nov 1, 2013 – Nov 30, 2015); **Amount:** \$ 190,000
- **Title:**“ In-use Emissions Testing and Demonstration of Retrofit Technology for Control of On-Road Heavy-Duty Engines”, **Co-Principal Investigator**
Funding Agency: South Coast Air Quality Management District (July, 2011 - Oct, 2013); **Amount:** \$ 734,742

IX. Teaching Experience

- **MAE 320: Thermodynamics**; summer session 2011 (2 months course); the course presents the introduction to thermodynamic principles, closed and open systems, entropy, enthalpy, properties of pure substances and ideal gases. Enrollment: 17
- **MAE 525: Heavy-duty diesel vehicle emissions**; Fall 2016; the course introduces the basics of emissions formation from diesel engines, regulations governing the certification of heavy-duty diesel engines in the US, gaseous and particulate matter measurement principles, data analysis, performing emissions calculations and the fundamentals of emissions control strategy used in modern heavy-duty diesel engines