

Sarma L. Rani

Assistant Professor

Department of Mechanical and Aerospace Engineering

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Education

- Post-Doctoral Associate, Cornell University, Ithaca, Mechanical and Aerospace Engineering, 2003-2004
- Ph.D., University of Illinois at Urbana-Champaign, Mechanical Engineering, 2002
- M.S., Texas A&M University, College Station, Mechanical Engineering, 1998
- B.Engr., Birla Institute of Technology and Science, Pilani, India, Mechanical Engineering, 1996

Academic and Professional Experience

- Assistant Professor, University of Alabama in Huntsville, August 2011-Present
- Part-Time Lecturer, University of Alabama in Huntsville, 2009-2011
- Principal Research Engineer, CFD Research Corporation, July 2008-July 2011
- Senior Research Engineer, CFD Research Corporation, January 2007-June 2008
- Research Engineer, CFD Research Corporation, April 2005-December 2006
- Associate, Continuum Dynamics, Inc., October 2004-March 2005
- Post-Doctoral Associate, Cornell University, 2003-2004
- Graduate Research Assistant, University of Illinois at Urbana-Champaign, 1998-2002
- Graduate Teaching Assistant, Texas A&M University, 1996-1998

Academic Honors

- Paper (Winkler, Rani, and Vanka (2006) [10]) selected for inclusion in May 2006 Highlights of International Journal of Numerical Methods in Heat and Fluid Flow
- Recipient of National Science Talent Scholarship, Government of India, from 1990-1996
- Recipient of Andhra Pradesh State Science Talent Scholarship, India, from 1987-1996

Teaching at UAHuntsville

- Fall 2011: MAE488–Analysis of Engineering Systems; MAE645–Combustion I
- Spring 2012: MAE745–Combustion II
- Fall 2012: MAE488–Analysis of Engineering Systems; MAE651–Viscous Fluid Mechanics
- Spring 2013: MAE488–Analysis of Engineering Systems
- Fall 2013: MAE488–Analysis of Engineering Systems; MAE645–Combustion I
- Spring 2014: MAE745–Combustion II

- Fall 2014: MAE488–Analysis of Engineering Systems; MAE651–Viscous Fluid Mechanics
- Spring 2015: MAE488–Analysis of Engineering Systems; MAE310–Fluid Mechanics I

Student Supervision

1. Advisor of Ph.D. student Mr. Rohit Dhariwal
2. Advisor of Ph.D. student Mr. Vijaya Krishna Rani
3. Advisor of M.S. student Ms. Kiruthika Sundararajan

Students Graduated

1. Master’s students: Mr. Vijaya Krishna Rani (Spring 2013)
2. Ph.D. students: Mr. Bassem R. Girgis (Fall 2013)
3. Ph.D. students: Mr. Shreyas Bidadi (Spring 2015)

Service At UAHuntsville

1. Served on the Faculty Search Committee, 2012
2. Served on the Dean’s Scholarship Award Committee for the North Alabama Regional Science Fair, 2012.
3. Served on the Faculty Search Committee, 2013.
4. Served on the Display and Safety Committee for the North Alabama Regional Science Fair, 2013.
5. Served on the Dean’s Scholarship Award Committee for the North Alabama Regional Science Fair, 2013.
6. Served on the Committee for drafting the COE Strategic Plan 2013.
7. Served on NSF Panel Review Committee for the Division of Fluid Dynamics.
8. Served on the MAE Department Graduate Committee.
9. Served on the Dean’s Scholarship Award Committee for the North Alabama Regional Science Fair, 2014.
10. Served on the Display and Safety Committee for the North Alabama Regional Science Fair, 2014.
11. Served as faculty advisor to the UAH Chapter of Society of Women Engineers (SWE).
12. Served as an observer for a Doctor of Nursing thesis in the College of Nursing.

Professional Service

1. Acted as referee for the Journal of Fluid Mechanics
2. Acted as referee for the International Journal of Multiphase Flow
3. Acted as referee for the Journal of Propulsion and Power
4. Acted as referee for the Chemical Engineering Science journal
5. Acted as referee for the Powder Technology journal
6. Acted as referee for the Journal of Computational Physics

Professional Affiliations

1. Member of the American Physical Society (APS)
2. Member of AIAA

Publications

Journal Articles

1. Sarma L. Rani, and M. S. Wooldridge, "Quantitative flow visualization using the hydraulic analogy," *Experiments in Fluids*, Vol. 28(2), pp. 165-169, 2000.
2. Sarma L. Rani, and S. Balachandar, "Evaluation of the equilibrium Eulerian approach for the evolution of particle concentration in isotropic turbulence," *International Journal of Multiphase Flow*, Vol. 29(12), pp. 1793-1816, 2003.
3. Jim Ferry, Sarma L. Rani, and S. Balachandar, "A locally implicit improvement of the equilibrium Eulerian method," *International Journal of Multiphase Flow*, Vol. 29(6), pp. 869-891, 2003.
4. Sarma L. Rani, and S. Balachandar, "Preferential concentration of particles in isotropic turbulence: A comparison of the Lagrangian and the equilibrium Eulerian approaches," *Powder Technology journal*, Vol. 141, pp. 109-118, 2004.
5. Sarma L. Rani, C. M. Winkler, and S. P. Vanka, "Numerical simulations of turbulence modulation by dense particles in a fully developed pipe flow," *Powder Technology journal*, Vol. 141, pp. 80-99, 2004.
6. D. L. Cottrell, Sarma L. Rani, and A. J. Pearlstein, "Computational assessment of subcritical instability and apparent transition delay in spiral Poiseuille flow experiments," *Journal of Fluid Mechanics*, Vol. 509, pp. 353-378, 2004.
7. C. M. Winkler, Sarma L. Rani, and S. P. Vanka, "Preferential concentration of particles in a fully developed turbulent square duct flow," *International Journal of Multiphase Flow*, Vol. 30(1), pp. 27-50, 2004.
8. Sarma L. Rani, C. M. Winkler, and S. P. Vanka, "A new algorithm for computing binary collisions in dispersed two-phase flows," *Numerical Heat Transfer: Part B: Fundamentals*, Vol. 45(1), pp. 99-107, 2004.
9. J. Chun, D. L. Koch, Sarma L. Rani, A. Ahluwalia, and L. R. Collins, "Clustering of aerosol particles in isotropic turbulence," *Journal of Fluid Mechanics*, Vol. 536, pp. 219-251, 2005.
10. C. M. Winkler, Sarma L. Rani, and S. P. Vanka, "Evaluation of subgrid scale kinetic energy models in large eddy simulations of turbulent channel flow," *International Journal of Numerical Methods for Heat and Fluid Flow*, Vol. 16, No. 2, pp. 226-239, 2006.
11. C. M. Winkler, Sarma L. Rani, and S. P. Vanka, "A numerical study of particle wall-deposition in a turbulent square duct flow," *Powder Technology*, Vol. 170(1), pp. 12-25, 2006.
12. J. F. Horn, D. O. Bridges, D. A. Wachspress, and Sarma L. Rani, "Implementation of a Free-Vortex Wake Model in Real-Time Simulation of Rotorcraft," *Journal of Aerospace Computing, Information, and Communication*, Vol. 3 (March), 2006.

13. Sarma L. Rani, Clifford E. Smith, and Andrew C. Nix, "Boundary Layer Equation-Based Wall Modeling for Large Eddy Simulation of Turbulent Flows with Wall Heat Transfer," *Numerical Heat Transfer: Part B*, Vol. 55, No. 2, 2009.
14. C. M. Winkler, and Sarma L. Rani, "Lift Forces on Dense Particles Due to Turbulence-Driven Secondary Flows," *Powder Technology*, Vol. 190, No. 3, 2009.
15. Sarma L. Rani, "Reduced Order Model for Combustion Instability in a 2-D Duct with a Bluffbody Flameholder," *AIAA Journal of Propulsion and Power*, Vol. 25, No. 1, 2009.
16. Sarma L. Rani, "Computationally efficient stochastic simulations of high stokes number particles in isotropic turbulence," *Powder Technology journal*, Vol. 250, pp. 67-74, 2013.
17. S. Bidadi, and Sarma L. Rani, "Quantification of numerical diffusivity due to TVD schemes in the advection equation," *Journal of Computational Physics*, Vol. 261, pp. 65-82, 2014.
18. R. Dhariwal, Sarma L. Rani, and D. L. Koch, "A Stochastic Model for the Relative Motion of High Stokes Number Particle Pairs in Isotropic Turbulence", *Journal of Fluid Mechanics*, Vol. 756, pp. 870-902, 2014.
19. V. K. Rani and Sarma L. Rani, "An Acoustically Consistent Investigation of Combustion Instabilities in a Dump Combustor," *Journal of Propulsion and Power*, Vol. 31, No. 1, pp. 294-308, 2015.
20. S. Bidadi, and Sarma L. Rani, "Investigation of numerical viscosities and dissipation rates of second-order TVD-MUSCL schemes for implicit large-eddy simulation," *Journal of Computational Physics*, Vol. 281, pp. 1003-1031, 2015.
21. J. W. Bennewitz, Sarma L. Rani, J. T. Cranford, and R. A. Frederick, "Combustion Instability Control through Acoustic Modulation at the Inlet Boundary: Part B - Analysis," Accepted for publication in the *Journal of Propulsion and Power*, 2015.
22. S. Bidadi, and Sarma L. Rani, "On the stability and diffusive characteristics of Roe-MUSCL and Runge-Kutta schemes for inviscid Taylor-Green vortex," *Journal of Computational Physics*, Vol. 299, pp. 339-351, 2015.
23. B. R. Girgis, Sarma L. Rani, and A. Frendi, "Flowfield Dependent Variation Method: A Numerical Scheme for the Solution of Low- to High-Mach Number Flow Problems," Accepted for publication in the *International Journal of Numerical Methods in Heat and Fluid Flow*, 2015.
24. S. F. Olatoyinbo, Sarma L. Rani, and A. Frendi, "Large-Eddy Simulation of Decaying Isotropic Turbulence using the Flowfield Dependent Variation Method," Accepted for publication in the *International Journal of Numerical Methods in Heat and Fluid Flow*, 2015.

Journal Manuscripts Under Review

1. R. Dhariwal, Sarma L. Rani, and D. L. Koch, "Closure of Kinetic Equation for High-Stokes-Number Particle Pairs in Isotropic Turbulence: Analysis and Comparison with DNS", *Journal of Fluid Mechanics*, 2015.

2. V. K. Rani, and Sarma L. Rani, "Analysis of Premixed Flame Response and Rayleigh Criterion through a Novel Flame Transfer Function," to be submitted to the Proceedings of Combustion Institute journal, 2015.

Refereed Conference Proceedings

1. Sarma L. Rani, and M. S. Wooldridge, "Quantitative supersonic flow visualization by the hydraulic analogy," ASME International Mechanical Engineering Congress and Exposition 1997, Dallas.
2. Sarma L. Rani, and S. P. Vanka, "DNS of two-way coupling effects in a fully-developed turbulent pipe flow," ASME Fluids Engineering Division Summer Conference, June 11-15 2000, Boston.
3. Sarma L. Rani, and S. P. Vanka, "LES and DNS of turbulence modification by dispersed solid particles in a fully developed pipe flow," The 36th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, July 16-19 2000, Huntsville.
4. J. Ferry, S. Balachandar, and Sarma L. Rani, "A locally implicit improvement of the equilibrium Eulerian method," ASME Fluids Engineering Division Summer Conference 2002, Montreal, Canada.
5. Sarma L. Rani, C. M. Winkler, and S. P. Vanka, "Large eddy simulations of particle dispersion by turbulence driven secondary flows in a square duct," The 6th ASME-JSME Thermal Engineering Joint Conference, March 16-20 2003, Kohala Coast, Hawaii.
6. J. F. Horn, D. O. Bridges, D. A. Wachspress and Sarma L. Rani, "Implementation of a Free-Vortex Wake Model in Real-Time Simulation of Rotorcraft," Proceedings of the 61st Annual Forum of the American Helicopter Society, 2005.
7. Sarma L. Rani, C. E. Smith, S. Hemchandra, T. C. Lieuwen, B. Sekar, "Reduced-Order Stability Analysis Model for Predicting Dynamic Instabilities in Bluffbody Flameholder Geometries," 43rd AIAA/ASME/SAE/ASEE Joint Propulsion Conference Proceedings, AIAA Paper No. 2007-5649.
8. Sarma L. Rani and Edward A. Luke, "Advanced Non-Gray Radiation Module in the Loci Framework for Combustion CFD," 44th AIAA/ASME/SAE/ASEE Joint Propulsion Conference Proceedings, AIAA Paper No. 2008-5253.
9. H. Q. Yang and Sarma Rani, "Micro Air Vehicle Performance Enhancement Using Excited Flexible Lifting Surface," 50th AIAA Aerospace Sciences Meeting 2012.
10. H. Q. Yang, A. Przekwas, Sarma L. Rani, and J. Dudley, "Direct Numerical Simulation Validation Study of a Fully Coupled Fluid-Structure Interaction Tool," 51st AIAA Aerospace Sciences Meeting 2013.
11. V. Rani and Sarma L. Rani, "An Acoustically Consistent Investigation of Combustion Instabilities in a Dump Combustor," 50th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, Cincinnati, 2014.
12. J. T. Cranford, J. W. Bennewitz, Sarma L. Rani, and R. A. Frederick, "An Analytical Investigation Characterizing the Application of Single Frequency Acoustic Modulation for High Frequency Combustion Instability Suppression," 50th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, Cincinnati, 2014.

Conference Presentations

1. Sarma L. Rani, and S. P. Vanka, "Large eddy simulation of turbulence modification and particle dispersion in a fully developed flow," American Physical Society 52nd Annual Meeting of the Division of Fluid Dynamics, Nov. 21-23 1999, New Orleans.
2. D. L. Cotrell, Sarma L. Rani, and A. J. Pearlstein, "The complete linear stability boundary for spiral Poiseuille flow," American Physical Society 53rd Annual Meeting of the Division of Fluid Dynamics, Nov. 19-21 2000, Washington D.C.
3. D. L. Cotrell, Sarma L. Rani, and A. J. Pearlstein, "The complete linear stability boundary for spiral Poiseuille flow," The 12th International Taylor-Couette Flow Workshop, Sep. 6-8 2001, Evanston, Illinois.
4. Sarma L. Rani, and S. P. Vanka, "Two-way coupling effects in a particle-laden turbulent pipe flow," American Physical Society 54th Annual Meeting of the Division of Fluid Dynamics, Nov. 18-20 2001, San Diego.
5. Sarma L. Rani, C. M. Winkler, and S. P. Vanka, "Preferential concentration of particles in a fully developed turbulent square duct flow," American Physical Society 55th Annual Meeting of the Division of Fluid Dynamics, Nov. 24-26 2002, Dallas.
6. Sarma L. Rani, C. M. Winkler, and S. P. Vanka, "Large eddy simulations of particle deposition in a fully developed turbulent square duct flow," American Physical Society 55th Annual Meeting of the Division of Fluid Dynamics, Nov. 24-26 2002, Dallas.
7. Sarma L. Rani, C. M. Winkler, and S. P. Vanka, "Large eddy simulations of particle deposition in a turbulent square duct flow," The Third International Symposium on Turbulence and Shear Flow Phenomena, June 24-27 2003, Sendai, Japan.
8. Sarma L. Rani, and C. M. Winkler, "Forces on particles in a turbulent square duct flow," American Physical Society 56th Annual Meeting of the Division of Fluid Dynamics, Nov. 23-25 2003, NJ.
9. Sarma L. Rani, and Donald L. Koch, "On Pair Diffusion and Preferential Concentration of High Stokes Number Particles in Isotropic Turbulence," American Physical Society 65th Annual Meeting of the Division of Fluid Dynamics, Nov. 18-20, 2012, San Diego.
10. Sarma L. Rani, "A Stochastic Model for High Stokes Number Particle Pair Dynamics in Isotropic Turbulence," ASME-AMD Summer Meeting, Society of Engineering Science 50th Annual Technical Meeting, Brown University, July 28-31, 2013, Providence.
11. Rohit Dhariwal, Sarma L. Rani, and Donald L. Koch, "A Stochastic Model for the Relative Motion of High Stokes Number Particles in Isotropic Turbulence," American Physical Society 67th Annual Meeting of the Division of Fluid Dynamics, Nov. 23-25, 2014, San Francisco.
12. Vijaya Krishna Rani, and Sarma L. Rani, "An Acoustically Consistent Investigation of Combustion Instabilities in a Dump Combustor," American Physical Society 67th Annual Meeting of the Division of Fluid Dynamics, Nov. 23-25, 2014, San Francisco.

Current and Past Funded Projects

1. **Status:** Principal Investigator
Proposal Title: The Role of Microphysical Processes and Turbulence Intermittency in Droplet Coalescence in Warm Cumulus Clouds

Funding Amount: \$173,642
Funding Agency: NSF
Performance Period: 09/01/2014 – 08/31/2017

2. **Status:** Principal Investigator
Proposal Title: Investigating the Role of Turbulence in Warm-Cloud Precipitation
Funding Amount: \$28,552
Funding Agency: NSF
Performance Period: 08/01/2015 – 07/31/2018

3. **Status:** Principal Investigator
Proposal Title: Prediction of Combustion Dynamics in Rocket Engines through Computational Enhancements in Loci-CHEM
Funding Amount: \$43,048
Funding Agency: NASA/GSFC
Performance Period: 02/01/2015 – 09/17/2015

4. **Status:** Co-Principal Investigator
Proposal Title: Optimal Feedback Control of Flow-Induced Instabilities Using Large Eddy Simulations
Funding Amount: \$5,000
Funding Agency: UAH
Performance Period: 01/01/2015 – 12/31/2015

5. **Status:** Co-Principal Investigator
Proposal Title: Understanding Precipitation Formation in Warm Cumulus Clouds
Funding Amount: \$5,000
Funding Agency: UAH
Performance Period: 01/01/2015 – 12/31/2015

6. **Status:** Principal Investigator
Proposal Title: Prediction of Combustion Dynamics in Rocket Engines through Computational Enhancements in Loci-CHEM
Funding Amount: \$41,367
Funding Agency: NASA/GSFC
Performance Period: 02/01/2014 – 01/31/2015

7. **Status:** Principal Investigator
Proposal Title: Combustion Instability Prediction in Rocket Engines through Computational Enhancements in Loci-Chem
Funding Amount Requested: \$33,089

Funding Agency: University of Alabama in Huntsville (Internal IIDR Solicitation)
Performance Period: 04/01/2013 – 03/31/2015

8. **Status:** Principal Investigator
Proposal Title: Prediction of Combustion Dynamics in Rocket Engines through Computational Enhancements in Loci-CHEM
Funding Amount: \$41,106
Funding Agency: NASA/GSFC
Performance Period: 02/01/2013 – 01/31/2014

Invited Seminars

1. Seminar titled, “A Stochastic Model for High Stokes Number Particle Pair Dynamics in Isotropic Turbulence,” Cornell University, January 22nd, 2013.
2. Seminar titled, “Stochastic Theories for Particle Pair Dynamics in Isotropic Turbulence,” Atmospheric Science Department, University of Alabama in Huntsville.

Research Grants at CFD Research Corporation

1. PI; Computational Tool for Coupled Simulation of Nonequilibrium Hypersonic Flows with Ablation; Funding Amount: \$700,000; Co-PI: Prof. Iain D. Boyd, University of Michigan; Funding Agency: NASA/Ames
2. Co-PI; Efficient Computational Tool for Comprehensive Thermal Analysis of Military Ground Vehicles; Funding Amount: \$100,000; Funding Agency: U.S. Army
3. Co-PI; A Mesoscale Modeling Tool for Heterogeneous Explosives with Accurate Multi-Physics Models and Detailed Chemical Kinetics; Funding Amount: \$100,000; Funding Agency: U.S. Air Force, Eglin, FL
4. PI; Hybrid Approach for Multi-Scale Modeling of Radiation Transfer in Three-Dimensional Non-gray Media; Funding Amount: \$100,000; Co-PI: Prof. Sandip Mazumder, Ohio State University; Funding Agency: AFOSR, Arlington, VA
5. PI; Fuel/Oxidizer Injector Modeling for Deep Throttling Cryogenic Engines; Funding Amount: \$165,000 Co-PI: Prof. Edward Luke, Mississippi State University; Funding Agency: NASA MSFC, Huntsville, AL
6. PI; Advanced Non-Gray Radiation Module in the LOCI Framework for Combustion CFD; Funding Amount: \$600,000 Co-PI: Prof. Edward Luke, Mississippi State University; Funding Agency: NASA MSFC, Huntsville, AL
7. PI; Advanced Non-Gray Radiation Module in the LOCI Framework for Combustion CFD; Funding Amount: \$100,000 Co-PI: Prof. Edward Luke, Mississippi State University; Funding Agency: NASA MSFC, Huntsville, AL

8. PI; Combined Linear/Nonlinear Reduced-Order Analysis Tool for Predicting Dynamic and Static Instabilities in Gas Turbine Augmentors Funding; Funding Amount: \$100,000; Co-PI: Prof. Tim Lieuwen, Georgia Tech; Funding Agency: AFRL, Wright-Patterson AFB, Dayton, OH