PROMOTION RECOMMENDATION
The University of Michigan
College of Engineering
Department of Aerospace Engineering

Venkatramanan Raman associate professor of aerospace engineering, with tenure, Department of Aerospace Engineering, College of Engineering, is recommended for promotion to professor of aerospace engineering, with tenure, Department of Aerospace Engineering, College of Engineering.

Academic Degrees:

Ph.D.   2003   Iowa State University, Chemical Engineering, Ames, Iowa
B.S.   1998   Madurai Kamaraj University, Chemical and Electrochemical Engineering, India

Professional Record:

2014 – present   Associate Professor (with tenure), Department of Aerospace Engineering, University of Michigan
2011 – 2014   Associate Professor (with tenure), Department of Aerospace and Engineering Mechanics, University of Texas, Austin, TX
2005 – 2011   Assistant Professor, Department of Aerospace and Engineering Mechanics, University of Texas, Austin, TX
2004 – 2005   Research Associate, Center for Turbulence Research, Stanford University, Palo Alto, CA
2003 – 2004   Post-doctoral Fellow, Center for Turbulence Research, Stanford University, Palo Alto, CA

Summary of Evaluation:

Teaching: Professor Raman has made substantial contributions to the teaching mission of the department. Since arriving at Michigan, Professor Raman revamped the existing AE633 course, Advanced Combustion to introduce computational modeling of combustion processes. His overall Q1/Q2 scores have averaged 4.33/4.51, respectively. Professor Raman has graduated eight Ph.D. students and has another seven in progress. He has also been active with advising undergraduate and M.S. students as well as post-doctoral researchers. Student letters include many positive comments on his mentoring.

Research: Professor Raman's post-doctoral research at Stanford University and his work as an assistant/associate professor at the University of Texas produced highly cited and creative papers that describe a new computational fluid dynamics (CFD) approach that he developed to simulate turbulent combustion. The approach that he developed is called the Hybrid LES/FDF method (Large Eddy Simulations using Filtered Density Functions). His method is recognized as one of the world's best because it allows for complex chemistry to be included into a model of a turbulent flow field. Many researchers currently use his approach. One of his 2005 papers has been cited 95 times while a 2007 paper was cited 87 times. For this work, he was awarded the

prestigious NSF CAREER award in 2008 and the Distinguished Paper Award at the International Combustion Symposium in Warsaw in 2014. New areas in which he is taking a leadership role are: 1) rare events in complex nonlinear systems; and 2) uncertainty quantification (UQ). He is recognized as one of the world leaders in the simulation and prediction of rare events in aerospace propulsion. He has significant funding for his research ($900K/year) and has published numerous high quality papers.

Recent and Significant Publications:

Kaul, C. M., V. Raman, E. Knudsen, E. S. Richardson and J. H. Chen (2013), "Large eddy simulation of a lifted ethylene flame using a dynamic nonequilibrium model for subfilter scalar variance and dissipation rate," *Proceedings of the Combustion Institute*, 34, 1289– 1297.

Donde, P., H. Koo and V. Raman (2012), "A multivariate quadrature based moment method for LES Based modeling of supersonic combustion," *Journal of Computational Physics*, 231 (17), 5805– 5821.

Braman, K., T. A. Oliver and V. Raman, (2015), "Adjoint-based sensitivity analysis of flames," *Combustion Theory and Modelling*, 19 (1), 29–56.

Heye, C., V. Raman and A. R. Masri, (2015), "Influence of spray/combustion interactions on auto- ignition of methanol spray flames," *Proceedings of the Combustion Institute*, 35 (2), 1639–1648.

Voelkel, S., V. Raman and P. L. Varghese, (2016), "Effect of Thermal Nonequilibrium on Reactions in Hydrogen Combustion," *Shock Waves*, to be assigned, 1–11.

Service: Since arriving at Michigan, Professor Raman has served as the chair of the Strategic Planning Committee and the Search Committee, which he continues to serve on. At the University of Texas, he served on similar committees as well as several college-level committees. He serves the profession on several technical committees and as an associate editor for major journals in his area. Professor Raman has also been very active in mentoring junior faculty members both here and at Texas.

External Reviewers:

Reviewer A: "He is performing fundamental, highly-regarded work in combustion modeling and has established himself as one of the pre-eminent researchers in this field."

Reviewer B: "…he is widely recognized as a 'superstar' in my research field: modeling and simulation of turbulent reacting flows. This is not just my opinion, as his visibility is recognized by anyone including those not working in his field."

Reviewer C: "Dr. Raman is clearly accepted as a leader [in his cohort] in the fields of computational fluid dynamics and computational combustion as applied to gas turbine engines particularly focusing on two phase flows including desirable and undesirable particle formation"

Reviewer D: "…he is one of the most promising and creative computational fluid dynamicists of his generation. …Venkat's determination to get the right answers for the right reasons is a breath of fresh air. …certainly he has the qualities of someone ultimately headed for a chaired Professorship at [my institution]."

Reviewer E: "Dr. Raman's significant contributions in computational turbulent combustion are widely recognized internationally."

Reviewer F: "He is an outstanding scientist [in his cohort] with considerable international standing and an excellent educator."

Reviewer G: "Dr. Raman has been making many original contributions to the field of turbulent combustion modeling throughout his career. …I would consider him in the top 5% of faculty at the same stage of achievements. I also believe he will have no problem in getting promoted to full Professor [at my institution] at this stage of his career."

Reviewer H: "…he appears to be fearless in venturing into new areas. …I rate the quality of Venkat's research to be outstanding. He understands the problems well, develops effective tools, and applies them carefully and imaginatively. …at [my institution] this would be a straightforward case; he would be promoted without difficulty."

Reviewer I: "Dr. V. Raman is also well recognized through the quality of his activities in direct relation with his Academic position (mentoring and advising of PhD graduates…)."

<u>Summary of Recommendation</u>: Professor Raman is well recognized by his peers as a leading expert in turbulent combustion modeling. He is an engaging educator with a variety of teaching at both the undergraduate and graduate level. His service to his institutions and to his profession is exemplary. It is with the support of the College of Engineering Executive Committee that I recommend Venkatramanan Raman for promotion to professor of aerospace engineering, with tenure, Department of Aerospace Engineering, College of Engineering.

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Alec D. Gallimore, Ph.D.
Robert J. Vlasic Dean of Engineering
College of Engineering

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