

M. Razi Nalim

Associate Professor and Chair of Graduate Education and Research Committee

Education

- 1994, Ph.D., Aerospace Engineering, Cornell University, Ithaca, NY.
- 1985, M.S., Mechanical Engineering, Cornell University, Ithaca, NY.
- 1983, B. Tech., Mechanical Engineering, Indian Institute of Technology, Kanpur, India.

Positions and Ranks Held at IUPUI

- 2004-present, Graduate Chair of Mechanical Engineering.
- 2003-present, Associate Professor of Mechanical Engineering.
- 1997-2003, Assistant Professor of Mechanical Engineering.

Other Related Experience

- 1994-1997, Research Associate, NASA Lewis Research Center, Cleveland, OH.
- 1994, Project Engineer, CFD Research Corporation, Huntsville, AL.
- 1989-1994, Research Associate, Aerospace Engineering, Cornell University, Ithaca, NY.
- 1989, Manager - Research Programs, Diesel and Gas Engineering Co., Beaver Dams, NY.
- 1985-1989, Research Staff Engineer, Diesel and Gas Engineering Co., Beaver Dams, NY.

Consulting, Patents, Etc.

1. 2002, Consultant, Lewis & Kappes, attorneys, Indianapolis, IN.
2. 1992-1993, Consultant, in combustor design and emissions data acquisition, Ithaca, NY.
3. M.R. Nalim, "Rotary Ejector Enhanced Pulsed Detonation System", U.S. patent 6,845,620, September 2004.
4. M.R. Nalim, "Partitioned Multi-Channel Combustor", U.S. patent 6,526,936, March 2003.
5. M.R. Nalim, "Wave Rotor Detonation Engine", U.S. patent 6,460,342, October 2002.
6. M.R. Nalim & D.E. Paxson, "Method and Apparatus for Cold-Gas Reinjection in Through-Flow and Reverse-Flow Wave Rotors", U.S. Patent 5,894,719, April 1999.

Professional Registration

Professional Engineer License (P.E.), States of New York (1992), Indiana (2002, currently registered).

Teaching Interests

Thermodynamics, Heat & Mass Transfer, Power Engineering, Combustion, Gas Dynamics, Computational Fluid Dynamics.

Courses Taught at IUPUI

ME 200 Thermodynamics; ME 314 Heat and Mass Transfer; ME 430 Principles of Power Engineering; ME 525/597 Combustion; ME 510/597 Gas Dynamics.

Research Interests

Unsteady flows, combustion, propulsion and power, non-steady flow devices, wave rotors, pulsed detonation engines, internal combustion engines, air pollution control, biofluid mechanics, computational fluid dynamics.

General Summary

Dr. Razi Nalim has over 20 years of practical and analytical experience in combustion engines and non-steady flow related areas in industry, academia, and government. His career began in internal combustion engine emissions control, cogeneration systems, and engine testing. After his doctorate, Dr. Nalim was a member of the wave rotor research team at the NASA Glenn Research Center, where he investigated non-steady combustion and flow devices for gas turbine enhancement. He has received four patents for non-steady flow devices, and has established a pioneering research program in non-steady flow and combustion processes. Since 2000, Dr. Nalim has led a consortium of university and industry researchers to establish the Indiana Propulsion and Power Center of Excellence. He has also initiated research in biological fluid non-steady flows related to joint and bone mechanics. Dr. Nalim was awarded the Abraham Max Distinguished Professorship in 2002, and the Frank Burley Distinguished Professorship in 2004 – the highest honors of the Purdue School of Engineering and Technology for research and service accomplishments, respectively. He has made invited presentations at major companies and institutions worldwide on the development of novel wave devices utilizing unsteady flow, and on engine emissions.

Principal Publications (recent)

Journal Papers

1. P. Akbari, M. R. Nalim, and N. Müller, “Performance Enhancement of Microturbine Engines Topped with Wave Rotors,” *ASME Journal of Engineering for Gas Turbines and Power*, in print 2005.
2. R. Nalim, K. Pekkan, H. B. Sun, and H. Yokota, “Oscillating Couette Flow for In Vitro Cell Loading,” *Journal of Biomechanics*, Vol. 37, No. 6, pp. 939-942, Jun 2004.
3. K. Pekkan and M.R. Nalim, “Two-Dimensional Flow and NO_x Emissions In Deflagrative Internal Combustion Wave Rotor Configurations”, *ASME Journal of Engineering for Gas Turbines and Power*, vol. 125, no, 3, pp. 720-733, Jul 2003.

4. Hui Bin Sun, Razi Nalim, and Hiroki Yokota "Expression and Activities of Matrix Metalloproteinases under Oscillatory Shear in IL-1-Stimulated Synovial Cells", *Connective Tissue Research*, 44: 42-99, 2003.
5. M.R. Nalim, "Thermodynamic Limits of Work and Pressure Gain in Combustion and Evaporation Processes," *AIAA J. of Propulsion & Power*, Vol. 18, No. 6, pp. 1176-1182, Nov-Dec 2002.
6. M. R. Nalim, "Longitudinally-Stratified Combustion in Wave Rotors", *AIAA J. of Propulsion & Power AIAA Journal of Propulsion and Power*, vol. 16, no. 6, pp. 1060-1068, Nov-Dec 2000.
7. D.E. Paxson and M.R. Nalim, "Modified Through-Flow Wave-Rotor Cycle with Combustor Bypass Ducts". *AIAA J. of Propulsion & Power*, v.15, No. 3, May-June 1999.
8. M.R. Nalim, "Assessment of Combustion Modes for Internal Combustion Wave Rotors", *ASME J. of Engineering for Gas Turbines & Power*, v.121, April 1999.

Conference Proceedings

1. J. P. Bowman, M. R. Nalim, and S. S. Krishnan, "Cooling Challenges of Modern Truck Diesel Engines," ASME Internal Combustion Engine Division 2005 Spring Technical Conference, ASME Paper ICES2005-1093, Apr 2005.
2. Akbari, P., Nalim, M. R., and Müller, N., "A Review of Wave Rotor Technology and Recent Developments" 2004 International Mechanical Engineering Congress, ASME Paper IMECE2004-60082, Nov 2004.
3. B. Alparslan, M. R. Nalim, and P. H. Snyder, "Wave Rotor Combustor Test Rig Preliminary Design" 2004 International Mechanical Engineering Congress, ASME Paper IMECE2004-61795, Nov 2004.
4. P. Akbari, N. Müller, and M. R. Nalim, "Performance Improvement of Recuperated and Unrecuperated Microturbines Using Wave Rotor Machines," 2004 CIMAC Congress, Kyoto, Japan, Jun 2004.
5. T. Geng and R. Nalim, "Statistical Design-of-Experiments for Wave Ejector Performance Improvement," AIAA paper 2004-1211, Aerospace Sciences Conference, Reno, Nevada, Jan 2004.
6. R. Nalim and K. Pekkan, "Internal Combustion Wave Rotors for Gas Turbine Engine Enhancement", International Gas Turbine Conference, IGTC2003-ABS-146, Tokyo, Japan, Nov 2003.
7. S. Chowdhury and R. Nalim, "Computational Study of Fuel Injection in a Large-Bore Gas Engine," ICEF2003-755, ASME Internal Combustion Engine Division and Rail Transportation Division 2003 Fall Technical Conference, Sep 2003.
8. M.R. Nalim and K. Pekkan, "A Review of Rotary Pressure-Gain Combustion Systems for Gas Turbine Applications," ASME GT-2003-38349, Turbo Expo 2003, Atlanta, Georgia, Jun 2003.
9. K. Pekkan, R. Nalim and H. Yokota, "Computed Synovial Fluid Flow in a Simple Knee Joint Model," FEDSM2003-45430, 4th ASME_JSME Joint Fluids Engineering Conference. Honolulu, July, 2003.

10. K. Pekkan and M.R. Nalim, "Two-Dimensional Flow and NO_x Emissions In Deflagrative Internal Combustion Wave Rotor Configurations", ASME Turbo Expo Amsterdam, Netherlands, Jun 2002.
11. C.F. Smith, P.H. Snyder, C.W. Emmerson, & M.R. Nalim, "Impact of the Constant Volume Combustor on a Supersonic Turbofan Engine," AIAA paper 2002-3916, 38th Joint Propulsion Conference, Indianapolis, IN, Jul 2002.
12. P. Snyder, B. Alparslan, and R. Nalim, "Gas Dynamic Analysis of the Constant Volume Combustor, A Novel Detonation Cycle," AIAA paper 2002-4069, 38th Joint Propulsion Conference, Indianapolis, IN, Jul 2002.
13. K. Pekkan and R. Nalim, "Control of Fuel and Hot-Gas Leakage in a Stratified Internal Combustion Wave Rotor," AIAA paper 2002-4067, 38th Joint Propulsion Conference, Indianapolis, IN, Jul 2002.
14. Z. Izzy and R. Nalim, "Wave-Fan and Rotary-Ejector Pulse Detonation Performance Prediction," AIAA paper 2002-4068, 38th Joint Propulsion Conference, Indianapolis, IN, Jul 2002.
15. K. Pekkan and R. Nalim, "Comparisons of Combustion Models for Wave Rotor Combustion Simulation," Spring Technical Meeting, Combustion Institute - Central States Section, Knoxville, TN, Apr 2002.
16. Nalim, M.R., and Izzy, Z.A., "Simulation of a Wave Rotor Pulse Detonation Engine with Integrated Ejector", International Symposium on Airbreathing Engines, September 2001, Bangalore, India.
17. Gunter, L.A., and Nalim, M.R., "Dynamic Performance of Conventional and Electrically Activated Engine Thermostats", ASME Internal Combustion Engine Division Spring Technical Conference, April 2001, Philadelphia, PA.
18. Q.Z. Jackson, T.H. Jackson, A. Ugan, R.M. Pidaparti, M.R. Nalim, "Numerical Study of Crack Detection Based on Microwave-Induced Heating and Thermography," Proc. of the International Society for Optical Engineering (SPIE) v. 4335, pp. 392-398, *Advanced Nondestructive Evaluation for Structural and Biological Health Monitoring*, Tribikram Kundu, (ed.), Jul 2001.
19. M.R. Nalim and Z.A. Izzy, "Rotary Ejector Enhanced Pulsed Detonation System," AIAA paper 2001-3613, 37th Joint Propulsion Conference, Salt Lake City, UT, Jul 2001.
20. K.K. Fong and M.R. Nalim, "Gas Dynamic Limits and Optimization of Pulsed Detonation Static Thrust," AIAA paper 2000-3471, 36th Joint Propulsion Conference, Huntsville, AL, Jul 2000.
21. Z. Izzy, K.K. Fong and M.R. Nalim, "Valved Pulsed Combustor Performance with Detonative and Deflagrative Combustion," Spring Technical Meeting, Central States Section, Combustion Institute, Indianapolis, IN, Apr 2000.
22. M.R. Nalim and K. Jules, "Pulse Combustion and Wave Rotors for High-speed Propulsion Engines," AIAA paper 98-1614, 8th International Space Planes & Hypersonics Conf., Norfolk, VA, Apr 1998.
23. M.R. Nalim, "Thermodynamic Limits of Pressure Gain and Work Production in Combustion and Evaporation Processes," AIAA paper 98-3398, 34th Joint Propulsion Conference, Cleveland, OH, Jul 1998.

Invited Lectures

1. "Combustion Engines using Non-Steady Flows: Pulsed Detonation Engines and Wave Rotors," California Institute of Technology, Pasadena, CA, Nov 2004.
2. "Exploiting Unsteady Flow using the Wave Rotor," 10th Asian Conference of Fluid Mechanics, Peradeniya, Sri Lanka, May 2004.
3. "Wave Ejector Parametric Study Using D.O.E. Statistics", NASA Glenn Research Center, Cleveland, OH, Apr 2003.
4. "Large Bore IC Engine Flow Simulation for Emission Control", University of Moratuwa, Sri Lanka, May 2003.
5. "Propulsion Engines using Non-Steady Flows: Pulsed Detonation Engines and Wave Rotors," Michigan State University, Feb 2003.
6. "Wave Rotor Propulsion Engine", Blue Operations, LLC, Seattle, WA, Sep 2002.
7. "Wave Ejector Pulse Detonation Engine Research," NASA Glenn Research Center, Cleveland, OH, Mar 2001 and Aug 2001.
8. "Computational Fluid Mechanics for Innovation and Advancement of Combustion Engines," University of Moratuwa, Sri Lanka, Aug 2001.
9. "Computational Fluid Mechanics for Innovation and Advancement of Combustion Engines," Anna University, Chennai, India, Aug 2001.
10. "Research in Innovative Propulsion and Thermal Power Engines: Pulsed Detonation Engine Simulation using CFD," University of Moratuwa, Sri Lanka, Aug 2001.
11. "2D Flow and Combustion in Internal Combustor Wave Rotor Channels," (with K. Pekkan), Star-CD North American User Conf., Detroit, MI, May 2001.
12. "Biofluid Transport Research," Purdue School of Engineering and Technology Research Symposium, Indianapolis, IN, Apr 2001.
13. "Gas Dynamics and Thermodynamics of Pulsed Detonation Engines and Wave Rotors," General Electric Global Corporate Research and Development Center, Niskayuna, NY, Apr 2001.
14. "Fundamentals of Pulsed Detonation Engines and Wave Rotors," National Aerospace Laboratory, Bangalore, India, Jan 2001.
15. "Fundamentals of Pulsed Detonation Engines and Wave Rotors," Indian Institute of Technology, Madras, India, Jan 2001.
16. "Fundamentals of Pulsed Detonation Engines and Wave Rotors," Regional Engineering College, Tiruchchirappalli, India, Jan 2001.
17. "Gas Dynamics and Thermodynamics of Pulse Detonation Engines," School of Aeronautics & Astronautics, Purdue University, West Lafayette, IN, Oct 2000.
18. "Wave Fan Concept and Hybrid Pulse Detonation Engine" NASA Glenn Research Center, Cleveland, OH, Jul 2000.
19. "Wave Rotor Detonation Engine," Allison Advanced Development Co., Indianapolis, IN, Mar 1999.
20. "Wave Rotor Detonation Engine," NASA Glenn Research Center, Cleveland, OH, May 1999.

Graduate Students Supervised (recent)

1. Viktor Kilchyk, PhD thesis in progress.
2. Hongwei Li, PhD thesis in progress.
3. Dhruv Baronia, MSME thesis in progress.
4. John Bowman, MSME thesis in progress. Bowman has one conference paper with Dr. Nalim
5. Arnab Bannerjee, MSME thesis in progress
6. Tao Geng, "Parametric Study of Rotary Ejector Wave Rotor Detonation Engine using a Design-of-Experiments Approach," MSME thesis, May 2004. Geng has one conference paper with Dr. Nalim.
7. Snehaunshu Chowdhury, "Geometry Design Evaluation of High-Pressure Fuel Injection Transient Jets," MSME thesis, May 2004.
8. Berrak Alparslan, "Performance Analysis of Novel Wave Rotor Pulsed Detonation Engine Cycles," MSME, Dec. 2002. Alparslan has three conference papers, two with Dr. Nalim, and one as sole author.
9. Kok Kee Fong, MSME thesis, "Parametric Study of a Pulse Detonation Engine," Dec 2000. Fong has two conference papers with Dr. Nalim.
10. Additionally, supervised 10 completed non-thesis graduate student research projects in past 6 years.

Principal Research Projects (recent)

1. "*CVCCE Technology Utilizing Wave-Rotor Configurations - Seals Development*," NASA Glenn Research Center (subcontract via Allison Advanced Development Co.), PI, \$68,197, Oct 2004 – Sep 2005.
2. "*Mechanical Response of Osteoblasts in 3D Matrix*," National Institutes of Health, co-PI, \$928K, Apr 2004 – Mar 2008. Share as Co-PI, \$9K.
3. "*Expansion of propulsion and power center of excellence*," State of Indiana 21st Century Research and Technology Fund, co-PI, \$1,608,881 total award, PI for IUPUI \$341,524 award, Apr 2004 - Mar 2006.
4. "*Engine Cooling System Design and Evaluation*", Cummins Inc., PI, \$101,877, Oct 2003 – Sep 2005.
5. "*Wave Fan and Hybrid Pulse Detonation Engine*," National Aeronautics and Space Administration (NASA) Glenn Research Center, PI, \$60,333, Mar 2002 - Dec 2002.
6. "*Advanced Propulsion and Power Institute: Innovative Propulsion and Systems and High-Fidelity Computer Simulation*," State of Indiana 21st Century Research & Technology Fund, \$2,000,000 total award, PI for IUPUI share of \$252,832, Jan 2001 - Dec 2002.
7. "*Two-Stroke Engine Flow Simulation, Phase II*," Dresser-Rand, \$59,260, PI, Apr 2001 - Apr 2002.

8. “*Wave Rotor Detonation Engine Performance*,” Allison Advanced Development Co., lead contractor to Defense Advanced Research Projects Agency (DARPA), \$50,812, PI, Sep 2001 - Feb 2002.
9. “*Wave Rotor Detonation Engine Performance*,” Allison Advanced Development Co., lead contractor to Defense Advanced Research Projects Agency (DARPA), \$28,762, PI, Apr 2001 - Jun 2001.
10. “*Wave Rotor Engine for Space Propulsion*,” Blue Operations-LLC, \$14,943, PI, Oct 2001 - Apr 2002.
11. Dresser-Rand, “Two-Stroke Engine Flow Simulation,” \$19,100, PI, Sep-Dec 2000.
12. “*Wave Fan and Hybrid Pulse Detonation Engine*,” National Aeronautics and Space Administration (NASA) Glenn Research Center, \$61,426, PI, Dec 1999 - Oct 2000.
13. “*Pulse Detonation Engine Model Subroutine*,” Allison Advanced Development Company, \$24,787, PI, Oct-Dec 1999.
14. “*Low-Emission Self-Cooled Combustion Wave Rotor*,” National Aeronautics and Space Administration (NASA) Lewis Research Center, \$53,078, PI, Nov 1998 - Nov 1999.

Membership in Scientific and Professional Societies

1. Member, American Society of Mechanical Engineers (ASME).
2. Senior Member, American Institute of Aeronautics and Astronautics (AIAA).
3. Member, The Combustion Institute.
4. Member, American Society for Engineering Education (ASEE).
5. Member, Society of Automotive Engineers (SAE).

Honors and Awards

1. 2004-05 Fulbright Senior Scholar Award for Lecturing and Research in Sri Lanka, U.S. Department of State, Washington, DC.
2. 2004 Frank Burley Distinguished Professorship award for excellence in service, Purdue School of Engineering and Technology.
3. 2002 Abraham Max Distinguished Professorship award for excellence in research, Purdue School of Engineering and Technology.
4. 1994-1997 National Research Council Associateship award for research at NASA.

Significant Institutional Service (recent)

Campus

2000-2004 Associate Director (IUPUI), Indiana Space Grant Consortium.

School

1. Member and Department representative, Faculty Senate, 2000-2004.
2. Faculty Advisor, IUPUI student section of American Institute of Aeronautics and Astronautics, 1998-2003.

3. Member, search and screen committee for three faculty positions in Biomedical Engineering, 2003-2004.
4. Member, search and screen committee for two faculty positions in Electrical and Computer Engineering.
5. Member and Department representative, Assessment Committee, 1998-2000.
6. Member, administrative review committee for CNT chair, 2003.

Department

1. Member, Assessment & Accreditation Committee, 200-present.
2. Chair, Graduate Education and Research Committee. 2004-present.
3. Member, Graduate Committee, 2001-2004.
4. Member, search and screen committee for thermal science faculty position, 2002.
5. Chair, Awards Committee, 2003-2004.
6. Co-advisor, NASA Moonbuggy race team.
7. Member, search and screen committee for thermal science faculty position, 1999.
8. Chairperson, Assessment Committee, 1998-2000.
9. Member, Search and Screen Committee for Department Chairperson, 1998-1999.

Significant Professional Service (recent)

Journal Reviews

1. AIAA Journal of Propulsion and Power.
2. ASME Journal of Engineering for Gas Turbines and Power.
3. The International Journal of Engine Research.

Conferences

1. Session Organizer & Chair, "In Cylinder Flows and Sprays", ASME IC Engine Division Spring 2002 Conference, Rockford, IL, May 2002.
2. Session Organizer & Chair, "Combustion and Emissions", International Council of Combustion Engines (CIMAC) and ASME IC Engine Division Spring 2003 Conference, Sallzburg, Austria, May 2003.
3. Session Chair, ASME International Mechanical Engineering Congress, Anaheim, CA, Nov 2004.

Others

1. Member, ASME International Gas Turbine Institute, Small and Vehicular Engine Committee, 1999-present.
2. Member and ASEE representative, Local liaison and planning committee for 2002 AIAA Joint Propulsion Conference.
3. Division Associate, ASME IC Engine Division, 2000-present.
4. Member, Local liaison committee, 1999 ASME International Gas Turbine Congress.
5. Reviewer, NASA Technical Memoranda, 1995-present.

Significant Professional Development Activities (recent)

1. Colloquium on Undergraduate Learning at IUPUI, Indianapolis, IN, Apr 2002.
2. IUPUI Assessment Institute Workshop, Indianapolis, IN, Nov 2000.
3. Student-Industry Projects Conf., Rose-Hulman Institute of Technology, Terre Haute, IN, Mar 2000.
4. Assessment Institute, Indianapolis, IN, Nov 1999.
5. Attended IUPUI workshop on Principles of Undergraduate Learning, 2002.
6. About ten conferences and workshops related to research and service per year for the last six years.