Curriculum Vitae

NAME Phillip Meredith Ligrani

TITLES Eminent Scholar in Propulsion, Professor of Mechanical and Aerospace Engineering, Department of Mechanical and Aerospace Engineering, Propulsion Research Center, 5000 Technology Drive, University of Alabama at Huntsville, Huntsville, AL 35899 USA. TELEPHONE: 1 (256) 824-5173 (work), 1 (256) 533-9179 (home), 1 (314) 800-5382 (mobile). E-MAIL: pml0006@uah.edu.
WEBSITE: http://www.ligrani.com.
WEBSITE: http://www.uah.edu/eng/departments/mae/faculty-staff/19-main/engineering/mechanical-and-aerospace/9046-mae-ligrani.

EDUCATION

Ph. D. Stanford University. Department of Mechanical Engineering, Thermosciences Division. June 1975-June 1979. Degree conferred: January 1980. Principal thesis advisor: Professor Robert J. Moffat. Second thesis advisor: Professor William M. Kays. Thesis topic: experimental study of thick, rough-wall turbulent boundary layers.

M. S. Stanford University. Department of Mechanical Engineering, Thermosciences Division. September 1974-June 1975. Degree conferred: June 1975.

B. S. University of Texas at Austin. Department of Mechanical Engineering. January 1971-May 1974. Degree conferred: May 1974. Course specialization in mechanical and energy systems.

ACADEMIC EMPLOYMENT HISTORY

Eminent Scholar in Propulsion, Professor of Mechanical and Aerospace Engineering. August 2014 – Present. Department of Mechanical and Aerospace Engineering, Propulsion Research Center, 5000 Technology Drive, University of Alabama at Huntsville, Huntsville, AL 35899 USA. Tenured position. Instructing convective heat transfer, thermodynamics.

Professor of Aerospace and Mechanical Engineering, Oliver L. Parks Endowed Chair, Director of Graduate Programs (July 2010 - July 2013). July 2010 – August 2014. Department of Aerospace and Mechanical Engineering, Professor of Aviation Science (Secondary Appointment 2012-2014), Department of Aviation Science, Parks College of Engineering, Aviation and Technology, Saint Louis University, 3450 Lindell Blvd., St. Louis, MO 63103, USA. Tenured position. Instructing convective heat transfer, applied thermodynamics, fluid mechanics, thermal systems design.

Donald Schultz Professor of Turbomachinery, Department of Engineering Science, University of Oxford, Oxford OX1 3PJ, England, United Kingdom. June 2006 to May 2009. The Donald Schultz Professorship of Turbomachinery is one of eight Statutory - Chair Professorships in the Department of Engineering Science. Professorial Fellow at St. Catherine's College. Director of the Rolls-Royce UTC (University Technology Centre) in Heat Transfer and Aerodynamics. Research on gas turbine heat transfer problems, convective heat transfer phenomena, heat transfer augmentation, film cooling, internal cooling, turbine aerodynamic losses, macro-scale pumping devices, micro-fluidic separation and analysis of nano-particles – including sub-cellular bio-particles, and millimeter scale and micro-scale pumping devices. Instructing A5 Thermodynamic Machines, C1A Turbomachinery, C1A Advanced Convection Heat Transfer. Tenured position.

Professor, Department of Mechanical Engineering, University of Utah. August 1992 to August 2006. Director, Convective Heat Transfer Laboratory. TFES (Thermal-Fluids Energy Systems) Division Chair, September 2005-May 2006. Research on gas turbine heat transfer problems, convective heat transfer phenomena, transition from laminar to turbulent flow in channels, turbulent boundary layers, macro-scale pumping devices, millimeter scale and micro-scale pumping devices, and Continuous SPLITT Fractionation. Instructing heat transfer, convective heat transfer, engineering thermodynamics, power thermodynamics, thermal systems design, and gas dynamics. Academic tenure awarded July 1, 1996. Promotion from Associate Professor to Professor July 1, 1997. Adjunct Professor, Department of Bioengineering, from September, 2003.

Associate Professor, Department of Mechanical Engineering, U. S. Naval Postgraduate School. September 1984-August 1992. Research on gas turbine heat transfer problems, convective heat transfer phenomena, transition from laminar to turbulent flow in channels, turbulent boundary layers, and subminiature instrumentation. Instructing mechanical engineering laboratory, fluid mechanics, convective heat transfer, turbomachinery, applied thermodynamics, and thermodynamics of steam power plants, refrigeration processes, and turbomachinery components. Academic tenure awarded July 1989.

Visiting Senior Research Fellow, Department of Aeronautics, Imperial College of Science and Technology, University of London. November 1982-August 1984. Supported by the Science and Engineering Research Council (SERC) of Great Britain, and by the U. S. Office of Naval Research (ONR). Subminiature hot-wire probe development and use to study the near-wall structure of turbulent boundary layers.

Assistant Professor, Turbomachinery Department, von Karman Institute for Fluid Dynamics. June 1979-November 1982. Institute von Karman de Dynamique des Fluides, Rhode-St-Genese, Belgium. Temporary

position. Gas turbine heat transfer research supervisor (from January 1980). Data acquisition systems center head (from April 1981). Research and consulting on pumps, compressors, turbines. Instructing measurement techniques, introductory turbomachinery, boundary layer theory, turbine blade convective heat transfer, turbulence, data acquisition fundamentals.

ACADEMIC DISTINCTIONS

Cited in Marquis Who's Who in the World, Marquis Who's Who in the USA, Marquis Who's Who in America, Marquis Who's Who in the American West, the International Directory of Distinguished Leadership, Who's Who in the International Gas Turbine Institute, Strathmore's Who's Who, Marquis Who's Who, Marquis Who's Who in Science and Engineering, A. C. Black Who's Who, and Academic Keys Who's Who in Engineering Higher Education.

Commendation letters for outstanding teaching - ranked in top 15% of the University of Utah College of Engineering course instructors. (i) ME EN 7660-Advanced Convection Heat Transfer, Spring Semester of 2004. (ii) ME EN 5810 / ME EN 6810-Thermal Systems Design, Autumn Semester of 2003. (iii) ME EN 7660-Advanced Convection Heat Transfer, Spring Semester of 2003. (iv) ME EN 7660-Advanced Convection Heat Transfer, Spring Semester of 2002. (v) ME EN 3600-Thermodynamics II, Autumn Semester of 2001. (vi) ME EN 3600-Thermodynamics II, Spring Semester of 2001. (vii) ME EN 3600-Thermodynamics II, Autumn Semester of 1999. (viii) ME562-Thermal Systems Design, Spring Quarter of 1998. (ix) ME665-Advanced Heat Transfer II, Winter Quarter of 1997. (x) ME562-Thermal Systems Design, Spring Quarter of 1996. (xi) ME360-Engineering Thermodynamics, Fall Quarter of 1995. (xii) ME362-Power Thermodynamics, Winter Quarter of 1995. (xiii) ME362-Power Thermodynamics, Spring Quarter of 1994.

July 2016, Invited Lecture, "Turbine Component Aerodynamic Losses Within Gas Turbine Engines" for the "China-Germany Workshop on Gas Turbine Technologies: Aerodynamics, Heat Transfer, and Combustion," ITLR-Institute of Aerospace Thermodynamics, University of Stuttgart, Stuttgart, Germany, and Shanghai Jiao Tong University, Shanghai, P. R. China.

March 2016, Invited Article for Heat Transfer Research, Special Issue: Heat Transfer Advances for Energy Conservation and Pollution Control (IWHT2013), "Jet Array Impingement Cooling Local Nusselt Number Variations: Effects of Hole Array Spacing, Jet-to-Target Plate Distance, and Reynolds Number."

February 2016 Outstanding Mechanical Engineer of the Year Award 2016, ASME – American Society of Mechanical Engineers, NAS - North Alabama Section, Huntsville, Alabama, USA.

February 2016, Panelist to review proposals for the Thermal Transport Processes Program of the National Science Foundation.

January 2016 - Present, Associate Fellow, AIAA – American Institute of Aeronautics and Astronautics.

January 2016, Invited to contribute a chapter on "Forced Convection – External Flow" to the Handbook of Thermal Science and Engineering, Springer Publishing Corporation, Editor: Francis A. Kulacki.

January 2016 Invited as Lead Editor of Special Issue of "Recent Advances in Enhanced Heat Transfer and Engineering Applications," Cogent Engineering Journal, CRC Press, Taylor and Francis Group.

January 2016, Invited Paper, "Onset and Transition to Elastic Turbulence: Effects of Rheological Property Variations for Polyacrylamide-Water Solutions," B. Lund, P. M. Ligrani, and A. Fatemi, 20th International Colloquium Tribology - Industrial and Automotive Lubrication, Stuttgart / Ostfildern, Germany.

December 2015, Certificate of Excellence. Propulsion Research Center. With recognition of the sustained and dedicated efforts of faculty and staff for their roles as mentors, educators, and leaders. Office of the Vice President for Research and Economic Development (OVPRED), University of Alabama in Huntsville, Huntsville, Alabama, USA.

November 2015 to Present, Editorial Board Member, Power and Thermal Engineering Processes and Equipment Journal, ISSN: 2078-774X, Published by the National Technical University "Kharkov Polytechnic Institute", Russia and Ukraine.

October 2015 to Present, Editorial Board Member, International Journal of Innovative Works in Engineering and Technology (IJIWET), ISSN: 2455-5797, Published by NAANJIL, India.

October 2015, Invited Plenary Paper, ICHHFF5, Fifth International Conference "Heat and Mass Transfer and Hydrodynamics in Swirled Flows," National Committee of the Russian Academy of Sciences, Kazan, Russia.

October 2015, Invited Plenary Paper, ICTE 2015, International Conference: "IX Workshop on Thermophysics and Power Engineering for Higher Education Institutions," Ministry of Education and Science of the Russian Federation, Kazan State Power Engineering University, Kazan, Russia.

August 2015 to Present, Associate Editor, Journal of Propulsion Technology (JPT), ISSN: 1001-4055, Published by CNPIEC, P. R. China.

July 2015, Distinguished Visiting Scholar, School of Energy and Power, Dalian University of Technology, Dalian, P. R. China.

March 4, 2015, Sponsored Representative, CVD – Congressional Visits Day, U. S. Senate and House of Representatives, Washington, D. C. Sponsored by Greater Huntsville Section of the AIAA – American Institute of Aeronautics and Astronautics.

January 23, 2015, Eminent Scholar Inaugural Seminar, "Heat Transfer and Aerodynamics Research For Gas Turbines and Other Propulsion Systems," Eminent Scholar in Propulsion, College of Engineering, University of Alabama in Huntsville, Huntsville, Alabama, USA.

October 1, 2014 to September 30, 2016, Distinguished Advisory Professor, School of Mechanical and Automotive Engineering, Inje University, Gimhae, South Korea.

September 2014, Distinguished Visiting Professor, School of Energy and Power Engineering, Beihang University, BUAA - Beijing University of Aeronautics and Astronautics, Beijing, P. R. China.

September 2014, Keynote Lecture at the ISJPPE 2014 – International Symposium on Jet Propulsion and Power Engineering, Beijing, P. R. China.

March 2014, Member of the Scientific Committee, ICHHFF5, Fifth International Conference "Heat and Mass Transfer and Hydrodynamics in Swirled Flows," National Committee of the Russian Academy of Sciences, Kazan, Russia, October 19-21, 2015.

March 2014, Panelist to review proposals for the Thermal Transport Processes Program of the National Science Foundation.

February 2014, Vice-Chairman of the Heat Transfer Committee of the ASME International Gas Turbine Institute (term of appointment is July 1, 2014 to June 30, 2016).

February 2014, Invited Lecture, Academic Forum on Gas Turbine Technology, Opening Ceremony for the Institute of Gas Turbines, Beijing Tsinghua University, Beijing, P. R. China.

February 2014-February 2017. Vice-Chairman and Member, Academic Committee, Institute of Gas Turbines, Beijing Tsinghua University, Beijing, P. R. China.

January 2014, Elected to be a member of the Scientific Council of the ICHMT – International Center for Heat and Mass Transfer. Nominated for membership by Professor Richard Goldstein of the University of Minnesota.

January 2014, Panelist, "Educating Today's and Tomorrow's Propulsion Engineers" Panel, "Continuing Education and Professional Development" Program of the AIAA Science and Technology Forum and Exposition - SCITECH 2014, Washington, D.C.

October 2013, Invited Lecture, Evolution of Secondary Dean Vortices in Spiral Microchannels for Cell Separations, Miniaturized Systems for Chemistry and Life Sciences MicroTAS 2013, University of Freiburg, Freiburg, Germany.

October 2013, Plenary Lecture as an Invited Keynote Speaker, Recent Developments in Impingement Array Cooling, Including Consideration of the Separate Effects of Mach Number, Reynolds Number, Temperature Ratio, Hole Spacing, and Jet-to-Target Plate Distance, IWHT2013, 2nd International Workshop on Heat Transfer Advances for Energy Conservation and Pollution Control, Northwestern Polytechnical University (NPU), Xi'an, P. R. China.

October 2013, Distinguished Visiting Professor, School of Energy and Power Engineering, Institute of Turbomachinery, Xi'an Jiaotong University, Xi'an, P. R. China.

November 2012, Invited Plenary Keynote Paper, New Developments in Surface Heat Transfer Augmentation Technologies as Applied to Internal Flow Environments, ISTP-23, The 23rd International Symposium on Transport Phenomena, The University of Auckland, Auckland, New Zealand.

October 1, 2012 to September 30, 2014, Distinguished Advisory Professor, School of Mechanical and Automotive Engineering, Inje University, Gimhae, South Korea.

September 2012-present. Distinguished Technical Committee, Advising on Gas Turbine Development for Utility Power Generation, Department of Thermal Engineering, Tsinghua University, Beijing, P. R. China.

September 2012, Invited Keynote Paper, Invited Expert, Heat Transfer Augmentation Technologies for Internal Cooling of Turbine Components of Gas Turbine Engines, Fourth International Symposium on Jet Propulsion and Power Engineering, 4th ISJPPE Meeting, Northwestern Polytechnical University, Xi'an, P. R. China.

September 2012, Invited Lecture, Turbine Research at Saint Louis University, Turbine Engine Technology Symposium (TETS), Dayton Convention Center, Dayton, Ohio, USA.

September 2012, Nominated by Parks College of Engineering, Aviation, and Technology for the 2012 Saint Louis University Annual Grant Winner Award for senior faculty.

January 2012, Invited Paper, Spiral Inertial Microfluidic Devices For Continuous Blood Cell Separation, MOEMS-MEMS Conference on Micro- and Nano-Fabricated Electromechanical and Optical Components, SPIE – International Society for Optics and Photonics, San Francico, California, USA.

November 2011, Invited Keynote Paper, Aerodynamic Loss Determination and Evaluation in Turbine Components, 11th Asian International Conference on Fluid Machinery, and 3rd Fluid Power Technology Exhibition, Indian Institute of Technology Madras, Chennai, India.

November 2011, Invited Keynote Paper, Aerodynamic Losses in Turbines With and Without Film Cooling, IGTC'11 Osaka, International Gas Turbine Congress 2011 Osaka, 10th Congress in Japan, Gas Turbine Society of Japan, Osaka, Japan.

September 2011, Nominated by Parks College of Engineering, Aviation, and Technology for the 2011 Saint Louis University Annual Grant Winner Award for senior faculty.

June 2011, Silver Winner – Annual 26th Educational Advertising Awards, for Brochure – Graduate Program Profile – Saint Louis University – Parks College, Higher Ed Marketing, Higher Education Marketing Report.

May 2011, Invited Lecture, New Developments in Continuous SPLITT Fractionation, 15th International Symposium on Field- and Flow-Based Separations (FFF2011), CASSS – International Separation

Science Society, South San Francisco Conference Center, South San Francisco, California, USA.

April 2011, Distinguished Lecture Award, Over-Tip Shock Wave Structure and Its Impact on Turbine Blade Tip Heat Transfer Including the Effects of Varying Tip Gap, CEAS Distinguished Lecture Series, Department of Mechanical Engineering, College of Engineering, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin, USA.

November 2010, Invited Lecture, Fluid Mechanics Research at Saint Louis University, Air Mobility Command (AMC) – Air Force Research Laboratory (AFRL) Symposium, Innovative Aerodynamics: Potential Solutions for Improving Mobility Efficiency, Fairview Heights, Illinois, USA.

October 1, 2010 to September 30, 2012, Distinguished Advisory Professor, School of Mechanical and Automotive Engineering, Inje University, Gimhae, South Korea.

September 16, 2010, Invested as Oliver L. Parks Endowed Chair (July 2010-present), Saint Louis University, St. Louis, Missouri, USA.

July 1, 2010 – June 30, 2014, Associate Technical Editor, ASME Transactions-Journal of Heat Transfer.

August 2009, International Scientific Committee, International Symposium on "Heat Transfer in Gas Turbine Systems," Antalya, Turkey, August 9-14, 2009.

October 2008, Technology Trends in the Gas Turbine Industry, Invited Keynote Paper - 4th International Conference on the Future of Gas Turbine Technology, European Turbine Network Conference, Brussels, Belgium.

November 2007, Smart Materials and Smart Structures for Aerodynamicists: Benefits, Challenges, Opportunities, Visions. Invited Lecture - Aerospace 2030 – The Role of Smart Materials, Begbroke Centre for Innovation and Enterprise, Department of Engineering Science, Oxford University, Oxford, England, United Kingdom.

August 2007, Executive Vice President's Award 2007 Nomination. Innovation and Investment Program. Rolls Royce PLC, Derby, England, United Kingdom. "Investigation into the Root Cause of Cabin Bleed Non-Return Valve Failures on the Trent 500, Trent 700, and RB211-524G, H&-T". Award Nominees: M. Potter, M. Bacic, P. M. Ligrani, P. Ireland, M. Plackett.

Degree of Master of Arts by Resolution, Register of Congregation, University of Oxford, High Street, Oxford OX1 4BG, United Kingdom

Member, Distinguished Editorial Review Board, Advances in Transport Phenomena, Book Series, Springer Publishing Corporation, 2006-present.

September 25-29, 2006, Dimple Array Effects on Turbulent Heat Transfer and Flow Structure, Invited Keynote Lecture, Fifth International Symposium on Turbulence, Heat, and Mass Transfer, Dubrovnik, Croatia.

July 1, 2005 – December 31, 2008, Associate Technical Editor, ASME Transactions-Journal of Fluids Engineering.

December, 2004, Co-Editor, Special Issue "Gas Turbine Heat Transfer," ASME Transactions-Journal of Heat Transfer.

March 2003, Invited Review Paper, "Comparison of Heat Transfer Augmentation Techniques," AIAA Journal, Vol. 41, No. 3, pp. 337-362.

July 1, 2003 – June 30, 2007, Associate Technical Editor, ASME Transactions-Journal of Heat Transfer.

September 2002, Recognition for highest ranked course taught in Department of Mechanical Engineering. Ranking provided by seniors graduating in Spring Semester of 2002.

May 2001, June 2002, June 2004, Invited Visiting Scholar, National Academy of Sciences of Ukraine, Institute of Engineering Thermophysics, Kiev-57, 252057, Ukraine.

May 2001, Invited Speaker, Ukraine-USA Workshop, "Innovative Aerothermal and Combustion Technologies in Energy and Power Systems."

December 2000, Elected to Fellow Grade in American Society of Mechanical Engineers (ASME).

April 2000-June 2000, Guest Professor, Institut fuer Thermische Stroemungs-maschinen, Universitaet Karlsruhe, Kaiserstrasse 12, 76128 Karlsruhe, Germany.

June 1999-August 1999, AGTSR Faculty Fellowship at General Electric Corp.-Corporate Research and Development. Funded by the SCERDC, South Carolina Energy Research and Development Center.

June 1998-December 2000, Guest Editor, Special Topical Issue on "Measuring Techniques for Turbomachinery," Measurement Science and Technology.

June 1995, Professor of the Year Award, presented by the undergraduates of the Department of Mechanical Engineering, University of Utah for exceptional teaching.

June-July 1993, Invited Speaker, Second Colloquium on Turbomachinery, TPMRC-Turbo and Power Machinery Research Center, Seoul National University, Seoul, Korea.

November 1991, NASA Space Act Tech Brief Award, ARC-12228-1, "Development of Subminiature Multi-Sensor Hot-Wire Probes."

October 1991, October 1990, October 1989, Naval Postgraduate School Faculty Performance Awards.

December 1990, Carl E. and Jessie W. Menneken Faculty Award for Excellence in Scientific Research.

November 1982-November 1983, Visiting Senior Research Fellowship, Department of Aeronautics, Imperial College of Science and Technology. Nomination by Professor Peter Bradshaw, Head, Aerodynamics, Department of Aeronautics.

September 1978, Miller Research Fellowship Nomination (Adolph C. and Mary Sprague Miller Institute for Basic Research in Science, 2334 Bowditch Street, Berkeley, California 94720). Nomination by Professor William M. Kays, Stanford University.

September 1974-June 1975, Stanford University Fellowship.
May 1974, Bachelor of Science Degree with Highest Honors, Department of Mechanical Engineering, University of Texas at Austin.
March 1973, Pi Tau Sigma, Tau Beta Pi memberships.
April 1970, Moody Foundation Scholar (The Moody Foundation, 704 Moody National Bank Building, Galveston, Texas, 77550, U.S.A.).

Research

RESEARCH FUNDING AWARDS

Dr. Ligrani has a strong past and present record of performing sponsored, fundamental and applied research for a variety of funding agencies, including ones in the USA and Europe. As such, he has successfully managed a wide variety of research programs, for different industrial, foundation, and government sponsors. **As of January 2016, research funding awards have been received from the following organizations**: Alabama State Innovation Program Fund, University of Alabama in Huntsville Endowment for Eminent Scholar in Propulsion, University of Alabama in Huntsville Start-Up Funds, AEDC – Arnold Engineering Development Center of Arnold Air Force Base, National Science Foundation, Honeywell Aerospace Corp., The Boeing Company, IHI Corporation, the Henry Luce Foundation, South Carolina Institute for Energy Studies (SCIES-AGTSR) of the Department of Energy, U. S. Army Aviation Research and Technology Activity-AVSCOM, NASA-Ames Research Center, NASA-Lewis Research Center, Hispanic Research Center-Arizona State University, Turbo and Power Machinery Research Center-Seoul National University, Solar Turbines Incorporated, UCON U.S.-Japan Center-Weber State University, General Electric Corporate Research and Development Center, Pratt & Whitney Corporation-Florida, the North Atlantic Treaty Organization (NATO), Pratt & Whitney Corporation-Canada Corp., the Gas Technology Institute, Intel Corporation, HEET-High Efficiency Engines and Turbines Program - South Carolina Energy Research and Development Center, Invesys Corp. - Foxboro Company, Ceramatec Advanced Materials and Electrochemical Technologies Corp., CISCO Systems Inc., SEEDA-South East England Development Agency, EPSRC – Engineering and Physical Sciences Research Council of Great Britain, ISIS Innovation, John Fell Fund, European Community Sixth Framework Programme, Korea Institute of Geoscience and Mineral Resources - KIGAM, Lockheed Martin UK, The Royal Academy of Engineering, Rolls Royce PLC, Science and Engineering Research Council (SERC) Engineering Board of Great Britain, Office of Naval Research, Naval Postgraduate School Research Foundation, Aero-Propulsion Laboratory-Wright-Patterson Air Force Base, and Naval Postgraduate School Direct Funding.

CURRENT AND RECENT RESEARCH FUNDING AWARDS

Total award amount at the University of Alabama in Huntsville as of February 2016 (and since August of 2014) is approximately $2,076,000.

1. Full Coverage Effusion Cooling: Performance Improvement Using Augmentation Devices and Impingement Jet Arrays. Agency: Solar Turbines, Inc., San Diego, California. Period of Research: October 1, 2014 - September 30, 2016. Principal Investigator: P. M. Ligrani.
2. Improvement of Impingement Array Cooling Effectiveness Using Surface Roughness Treatments – Phase II Effort. Agency: IHI Corp. (Ishikawajma Harima Heavy Industries), Advanced Technology Department, Research and Engineering Division, Tokyo, Japan. Period of Research: October 1, 2014 – August 31, 2015. Principal Investigator: P. M. Ligrani.
3. Collaborative Research: Thermal Transport in Elastic Turbulence. Agency: National Science Foundation, CBET Thermal Transport Processes, Division of Chemical, Bioengineering, Environmental, and Transport (CBET) Systems, Arlington, Virginia, USA. Period of Research: October 1, 2013 – September 30, 2017. Principal Investigators: P. M. Ligrani, R. H. Handler.
4. Development of the UAH TS/SS/WT (TranSonic/SuperSonic/WindTunnel) for Advanced Aerospace and Aeropropulsion Research, The Alabama Innovation Fund, Research Program, Montgomery, Alabama, USA. Period of Research: October 1, 2015 – September 30, 2016.

Principal Investigator: P. M. Ligrani. Co-Investigators: K. Frendi, K. Hollingsworth, R. Frederick, R. Tyson, W. Seidler.

5. Donation of Air Storage Tanks (Indefinite Loan). Agency: AEDC – Arnold Engineering Development Center, Arnold Air Force Base, CRADA – Cooperative Research and Development Agreement, Tullahoma, Tennessee, USA. Period of Research: September 1, 2015 - December 30, 2016. Principal Investigator: P. M. Ligrani.

6. REU (Research Experiences for Undergraduates) - Collaborative Research: Thermal Transport in Elastic Turbulence. Agency: National Science Foundation, CBET Thermal Transport Processes, Division of Chemical, Bioengineering, Environmental, and Transport (CBET) Systems, Arlington, Virginia, USA. Period of Research: January 1, 2016 – December 31, 2016. Principal Investigator: P. M. Ligrani.

RESEARCH AREAS AND EXPERTISE.

Dr. Ligrani has a strong past and present record of working with many different collaborators and co-workers, from many locations throughout the world.

(i) Traditional Heat Transfer and Fluid Mechanics Investigations involving electronics cooling, heat transfer augmentation, drag reduction, turbulent boundary layers, flows in channels with dimpled surfaces, flows in curved channels, elastic turbulence, slot impingement cooling, and macro-scale pumps and pump flows. Also included are **aerodynamics investigations with *high-speed, compressible flows at transonic and supersonic Mach numbers***, including SWBLI – Shock Wave Boundary Layer Interactions. Related projects involve **transonic and supersonic experimental testing**. Research interests also include experimental diagnostics in high speed flows, and air breathing propulsion.

(ii) Air Breathing Engines - Gas Turbine Heat Transfer, Cooling, and Aerodynamics Losses, including internal cooling, film cooling, impingement cooling, cooling of extremities, aerodynamic performance including aerodynamic losses, and transonic turbine flows and heat transfer. This subject area includes the effects of uses of bio-fuels, synthetic fuels, and renewable energy sources in relation to gas turbines and gas turbine heat transfer and cooling technologies. Note that an important area of turbomachinery research interest involves heat transfer and aerodynamics investigations with *high-speed, compressible flows at transonic and supersonic Mach numbers*, including linear cascade studies.

(iii) Micro-Fluidics and Millimeter-Scale-Fluidics, including micro-pump flows, and the effects of slip phenomena on gas and liquid flows in micro-scale passage flows with and without surface roughness, including the effects of hydrophobic surfaces and elastic turbulence.

(iv) Experimental Techniques, including development of millimeter-scale multiple-hole pressure probes, subminiature hot-wire anemometry, and infrared thermography.

Scholarship

ARCHIVAL JOURNAL PUBLICATIONS.

1979 1. Artificially Thickening a Smooth-Wall Turbulent Boundary Layer (P. M. Ligrani and R. J. Moffat), American Institute of Aeronautics and Astronautics Journal, Vol. 17, No. 8, pp. 907-910, August 1979.

1981 2. A Heat Transfer Prediction Method for Turbulent Boundary Layers Developing Over Rough Surfaces with Transpiration (P. M. Ligrani, W. M. Kays and R. J. Moffat), International Journal of Heat and Mass Transfer, Vol. 24, No. 4, pp. 774-778, April 1981.

1983 3. A Sensor for Flow Measurements Near the Surface of a Compressor Blade (P. M. Ligrani, B. R. Gyles, K. Matioudakis and F. A. E. Breugelmans), Journal of Physics E-Scientific Instruments, Vol. 16, No. 5, pp. 431-437, May 1983.

4. Artificially Thickened Turbulent Boundary Layers for Studying Heat Transfer and Skin Friction on Rough Surfaces (P. M. Ligrani, R. J. Moffat and W. M. Kays), ASME Transactions-Journal of Fluids Engineering, Vol. 105, No. 2, pp. 146-153, June 1983.

5. Measurements in the Vaneless Diffuser of a Radial Flow Compressor (P. M. Ligrani, R. Van den Braembussche and M. Roustan), The International Journal of Heat and Fluid Flow, Vol. 4, No. 2, pp. 103-106, June 1983.

1984 6. Reply to 'Comments on a Heat Transfer Prediction Method for Turbulent Boundary Layers Developing Over Rough Surfaces with Transpiration' (P. M. Ligrani, W. M. Kays and R. J. Moffat), International Journal of Heat and Mass Transfer, Vol. 27, No. 6, pp. 950-951, June 1984.

1985 7. Thermal Boundary Layers on a Rough surface Downstream of Steps in Wall Temperature (P. M. Ligrani and R. J. Moffat), Boundary Layer Meteorology, Vol. 31, No. 2, pp. 127-147, February 1985.

8. Adiabatic Film Cooling Effectiveness from Heat Transfer Measurements in Compressible, Variable Property Flow (P. M. Ligrani and C. Camci), ASME Transactions-Journal of Heat Transfer, Vol. 107, No. 2, pp. 313-320, May 1985.

1986 9. The Structure of Transitionally Rough and Fully Rough Turbulent Boundary Layers (P. M. Ligrani and R. J. Moffat), Journal of Fluid Mechanics, Vol. 162, pp. 69-98, January 1986.

10. Development of Customized Shear Layers on Smooth and Rough Surfaces (P. M. Ligrani), International Journal of Heat and Fluid Flow, Vol. 7, No. 4, pp. 266-277, December 1986.

1987 11. Subminiature Hot-Wire Sensors: Development and Use (P. M. Ligrani and P. Bradshaw), Journal of Physics E-Scientific Instruments, Vol. 20, No. 3, pp. 323-332, March 1987.

12. Spatial Resolution and Measurement of Small-Scale Turbulence in the Viscous Sublayer Using Subminiature Hot-Wire Probes (P. M. Ligrani and P. Bradshaw), Experiments in Fluids, Vol. 5, No. 6, pp. 407-417, August 1987.

1988 13. Heat Transfer in Film-Cooled Turbulent Boundary Layers at Different Blowing Ratios as Affected by Longitudinal Vortices (P. M. Ligrani, S. L. Joseph, A. Ortiz, and D. L. Evans), Experimental Thermal and Fluid Science, Vol. 1, No. 4, pp. 347-362, 1988.

14. Flow Visualization of Dean Vortices in a Curved Channel with 40 to 1 Aspect Ratio (P. M. Ligrani and R. D. Niver), Physics of Fluids, Vol. 31, No. 12, pp. 3605-3617, December 1988.

1989 15. Effects of Embedded Vortices on Film-Cooled Turbulent Boundary Layers (P. M. Ligrani, A. Ortiz, S. L. Joseph, and D. L. Evans), ASME Transactions-Journal of Turbomachinery, Vol. 111, No. 1, pp. 71-77, January 1989.

16. Spatial Resolution and Downwash Velocity Corrections for Multiple-Hole Pressure Probes in Complex Flows (P. M. Ligrani, B. A. Singer and L. R. Baun), Experiments in Fluids, Vol. 7, No. 6, pp. 424-426, 1989.

17. Fabrication and Testing of Subminiature Multi-Sensor Hot-Wire Probes (P. M. Ligrani, R. V. Westphal and F. R. Lemos), Journal of Physics E-Scientific Instruments, Vol. 22, No. 4, pp. 262-268, April 1989.

18. Miniature Five-Hole Pressure Probe for Measurement of Three Mean Velocity Components in Low Speed Flow (P. M. Ligrani, B. A. Singer and L. R. Baun), Journal of Physics E-Scientific Instruments, Vol. 22, No. 10, pp. 868-876, October 1989.

19. Subminiature Hot-Wire Probes (R. V. Westphal, P. M. Ligrani and F. R. Lemos), NASA Tech Briefs Journal, Vol. 13, No. 10, pp. 40-41, October 1989.

1990 20. Effects of an Embedded Vortex on Injectant from a Single Film-Cooling Hole in a Turbulent Boundary Layer (P. M. Ligrani and W. W. Williams), ASME Transactions-Journal of Turbomachinery, Vol. 112, No. 3, pp. 428-436, July 1990.

21. Comment on 'Behavior of a Two Rows of Holes Coolant Film along the Pressure Side of a High Pressure Nozzle Guide Vane' (P. M. Ligrani), ASME Transactions-Journal of Turbomachinery, Vol. 112, No. 3, pp. 520-521, July 1990.

22. Control of Embedded Longitudinal Vortices Using a Wall Jet (P. M. Ligrani and G. E. Schwartz), International Journal of Heat and Fluid Flow, Vol. 11, No. 4, pp. 274-283, December 1990.

1991 23. Effects of Vortices with Different Circulations on Heat Transfer and Injectant Downstream of a Row of Film-Cooling Holes in a Turbulent Boundary Layer (P. M. Ligrani, C. S. Subramanian, D. W. Craig and P. Kaisuwan), ASME Transactions-Journal of Heat Transfer, Vol. 113, No. 1, pp. 79-90, February 1991.

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1999 43. Local Swirl Chamber Heat Transfer and Flow Structure at Different Reynolds Numbers (C. R. Hedlund, and P. M. Ligrani), Paper 99-GT-164, 44th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Indianapolis, Indiana, June 7-10, 1999.

44. Transonic Aerodynamic Losses Due to Turbine Airfoil, Suction Surface Film Cooling (D. J. Jackson, K. L. Lee, P. M. Ligrani, P. D. Johnson, and F. O. Soechting), Paper 99-GT-260, 44th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Indianapolis, Indiana, June 7-10, 1999.

2000 45. Local Heat Transfer and Flow Structure On and Above a Dimpled Surface in a Channel (G. I. Mahmood, M. L. Hill, D. L. Nelson, P. M. Ligrani, H.-K. Moon, and B. Glezer), Paper 2000-GT-230, 45th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Munich, Germany, May 8-11, 2000.

46. Rotating and Stationary Rectangular Cooling Passages Heat Transfer and Friction With Turbulators and Dimples, (J. C. Han, P. M. Ligrani, H. C. Chen), Advanced Gas Turbine Systems Research, Aero-Heat Transfer

Workshop IV, University of Minnesota, Minneapolis, Minnesota, October 11-13, 2000.

47. Rotating and Stationary Heat Transfer and Friction in Rectangular Cooling Channels With Turbulators and Dimples, (J. C. Han, P. M. Ligrani, H. C. Chen), Advanced Gas Turbine Industry Meeting, U. S. Department of Energy, Alexandria, Virginia, December 4-6, 2000.

2001

48. Experimental Validation of an Inverse Heat Conduction Problem Using Thermocouple and Infrared Data, (R. H. Smith, E. P. Scott, P. M. Ligrani), Paper AIAA 2001-0507, 39th AIAA Aerospace Sciences Meeting and Exhibit, Reno, Nevada, January 8-11, 2001.
49. Interactions and Influences of Different Physical Effects With Film Cooling, (P. M. Ligrani), US-Ukraine Workshop on Innovative Combustion and Aerothermal Technologies in Energy and Power Systems, Kiev, Ukraine, May 20-26, 2001.
50. Shock Wave - Film Cooling Interactions In Transonic Flows, (P. M. Ligrani, C. Saumweber, A. Schulz, S. Wittig), Paper 2001-GT-0133, 46th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, New Orleans, Louisiana, June 4-7, 2001.
51. Effects of Bulk Flow Pulsations on Film Cooling With Compound Angle Holes: Heat Transfer Coefficient Ratio and Heat Flux Ratio, (I. S. Jung, J. S. Lee, P. M. Ligrani), Paper 2001-GT-0129, 46th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, New Orleans, Louisiana, June 4-7, 2001.

2002

52. Rotating and Stationary Rectangular Cooling Passaages - Heat Transfer and Friction With Turbulators, Pins, and Dimples, (J. C. Han, P. M. Ligrani, H. C. Chen), Turbine Power Systems Conference and Condition Monitoring Workshop, Galveston, Texas, February 25-27, 2002.
53. Enhanced Heat Exchangers for Process Heaters, (H. Kurek, P. M. Ligrani), AIChE 2002 Spring National Meeting, American Institute of Chemical Engineers (AIChE), New Orleans, Louisiana, March 10-14, 2002.
54. Spatially-Resolved Heat Transfer and Flow Structure in a Rectangular Channel with 45^{o} Angled Rib Turbulators, (G. I. Mahmood, P. M. Ligrani, S. Y. Won), Paper GT-2002-30215, 47th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Amsterdam, The Netherlands, June 3-6, 2002.
55. Rotating and Stationary Rectangular Cooling Passage Heat Transfer and Friction With Turbulators and Dimples, (J. C. Han, and P. M. Ligrani), Aero-Heat Transfer Workshop, SCIES-South Carolina Institute for Energy Studies, Baton Rouge, Louisiana, November 11-13, 2002.
56. Nusselt Number Behavior on Deep Dimpled Surfaces Within a Channel, (N. K. Burgess, M. M. Oliveira, and P. M. Ligrani), Paper IMECE2002-32941, 2002 International Mechanical Engineering Congress and Exhibition (IMECE), New Orleans, Louisiana, November 17-22, 2002.
57. Numerical Simulation of Flow and Heat Transfer Inside a Micro-Channel With One Dimpled Surface, (X. J. Wei, Y. K. Joshi, P. M. Ligrani), Paper IMECE2002-21633, 2002 International Mechanical

Engineering Congress and Exhibition (IMECE), New Orleans, Louisiana, November 17-22, 2002.

2003 58. Experimental Surface Heat Transfer and Flow Structure in a Curved Channel With Laminar, Transitional, and Turbulent Flows, (P. M. Ligrani, and C. R. Hedlund), Paper 2003-GT-38734, 48th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Atlanta, Georgia, June 16-19, 2003.

59. Effects of Surface Roughness and Turbulence Intensity on the Aerodynamic Losses Produced by the Suction Surface of a Simulated Turbine Airfoil, (Q. Zhang, S. W. Lee, and P. M. Ligrani), Paper IMECE2003-41687, 2003 International Mechanical Engineering Congress and Exhibition (IMECE), Washington, D.C., November 16-21, 2003.

2004 60. Nusselt Numbers and Flow Structure On and Above a Shallow Dimpled Surface Within a Channel Including Effects of Inlet Turbulence Intensity Level, (P. M. Ligrani, N. K. Burgess, and S. Y. Won), Paper Number GT2004-54231, 49th ASME TURBO EXPO Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Vienna, Austria, June 14-17, 2004.

61. Effects of Dimple Depth on Nusselt Numbers and Friction Factors for Internal Cooling in a Channel, (N. K. Burgess, and P. M. Ligrani), Paper Number GT2004-54232, 49th ASME TURBO EXPO Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Vienna, Austria, June 14-17, 2004.

62. Development and Testing of the Single-Disk and Double-Disk Viscous Micropump, (D. B. Blanchard, P. M. Ligrani, and B. K. Gale), Paper Number IMECE 2004-61705, 2004 International Mechanical Engineering Congress and Exhibition (IMECE), Anaheim, California, November 13-19, 2004.

63. Performance and Development of a Miniature Rotating Shaft Pump (RSP), (D. B. Blanchard, P. M. Ligrani, and B. K. Gale), Paper Number IMECE 2004-61695, 2004 International Mechanical Engineering Congress and Exhibition (IMECE), Anaheim, California, November 13-19, 2004.

2005 64. Osmotically-Driven Dispense Pump (P. M. Ligrani), ARUP Institute for Clinical and Experimental Pathology, March 23, 2005.

65. Influence of Surface Roughness On the Aerodynamic Losses of a Turbine Vane (Q. Zhang, M. Goodro, P. M. Ligrani, R. Trindade, S. Sreekanth), Paper Number GT2005-68832, 50th ASME TURBO EXPO Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Reno, Nevada, June 6-9, 2005.

66. Aerodynamic Losses of a Cambered Turbine Vane: Influences of Surface Roughness and Freestream Turbulence Intensity (Q. Zhang, and P. M. Ligrani), Paper Number IMECE 2005-81657, 2005 International Mechanical Engineering Congress and Exhibition (IMECE), Orlando, Florida, November 5-11, 2005.

67. Aero Losses, Heat Transfer, and Discharge Coefficients for Different Vane Trailing Edge Configurations, UTSR Peer Review Workshop III,

Madren Conference Center and Inn, Clemson University, Clemson, South Carolina, October 19-21, 2005.

2006 68. Separate Effects of Mach Number and Reynolds Number on Jet Array Impingement Heat Transfer (J. Park, M. Goodro, P. M. Ligrani, M. Fox, and H.-K. Moon), Paper Number GT2006-90628, 51st ASME TURBO EXPO Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Barcelona, Spain May 8-11, 2006.

69. Dimple Array Effects on Turbulent Heat Transfer and Flow Structure (P. M. Ligrani), Keynote Lecture, Fifth International Symposium on Turbulence, Heat, and Mass Transfer, Dubrovnik, Croatia, September 25-29, 2006.

70. Oxford Rotor Group CFD - Oxford Aerodynamics and Heat Transfer UTC – Turbomachinery Laboratory (N. Atkins, G. Thomas, R. W. Ainsworth, P. M. Ligrani), Rolls-Royce CFD Annual Review, Rolls-Royce PLC, Morley, Derbyshire, United Kingdom, October 5-6, 2006.

2007 71. Oxford Rotor Group CFD Work on Tip Flow and Heat Transfer (N. Atkins, P. M. Ligrani, R. W. Ainsworth, Q. Zhang, G. Thomas), Rolls-Royce Annual Blade Tip Cooling Forum, Rolls Royce PLC, Bristol, England, United Kingdom, February 6, 2007.

72. Effect of Temperature Ratio on Jet Array Impingement Heat Transfer (M. Goodro, J. Park, P. M. Ligrani, M. Fox, and H.-K. Moon), Paper Number GT2007-28293, 52nd ASME TURBO EXPO Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Montreal, Canada, May 14-17, 2007.

73. Effect of Hole Spacing on Jet Array Impingement Heat Transfer (M. Goodro, J. Park, P. M. Ligrani, M. Fox, and H.-K. Moon), Paper Number GT2007-28292, 52nd ASME TURBO EXPO Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Montreal, Canada, May 14-17, 2007.

74. Oxford Rotor Group CFD Work (A. Wheeler, Q. Zhang, N. Atkins, G. Thomas, P. M. Ligrani, R. W. Ainsworth), Rolls-Royce CFD Annual Review, Rolls-Royce PLC, Morley, Derbyshire, United Kingdom, October 1-2, 2007.

75. Smart Materials and Smart Structures for Aerodynamicists: Benefits, Challenges, Opportunities, Visions. Invited Lecture - Aerospace 2030 – The Role of Smart Materials, Begbroke Centre for Innovation and Enterprise, Department of Engineering Science, Oxford University, Oxford, England, United Kingdom, November 27, 2007.

2008 76. Suction Side Gill Region Film Cooling: Effects of Hole Shape and Orientation on Adiabatic Effectiveness and Heat Transfer Coefficient (J. C. Chappell, P. M. Ligrani, S. Sreekanth, T. Lucas), Paper Number GT2008-50798, 53rd ASME TURBO EXPO Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Berlin, Germany, June 9-13, 2008.

77. Aerodynamic Performance of Suction-Side Gill Region Film Cooling (J. C. Chappell, P. M. Ligrani, S. Sreekanth, T. Lucas, E. Vlasic), Paper Number GT2008-50799, 53rd ASME TURBO EXPO Gas Turbine and

Aeroengine Technical Congress, Exposition, and Users Symposium, Berlin, Germany, June 9-13, 2008.

78. Instabilities in Check Valve Operation in Air Systems (M. Potter, M. Bacic, P. M. Ligrani, M. Plackett), Tenth NRC/ASME Symposium on Valves, Pumps, and Inservice Testing, American Society of Mechanical Engineering, Washington, D. C., U.S.A., July 14-16, 2008.
79. Technology Trends in the Gas Turbine Industry (P. M. Ligrani), Invited Keynote Paper - 4th International Conference on the Future of Gas Turbine Technology, European Turbine Network Conference, Brussels, Belgium, October 15, 2008.

2009

80. Comparison of Heat Transfer Measurement Techniques on a Transonic Turbine Blade Tip (D. O'Dowd, Q. Zhang, P. M. Ligrani, L. He, S. Friedrichs), Paper Number GT2009-59376, 54th ASME TURBO EXPO Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Orlando, Florida, June 8-12, 2009.
81. Effects of Mach Number, Reynolds Number, and Jet Spacing on Surface Heat Transfer for a Full Array of Impinging Jets (M. Goodro, P. M. Ligrani, M. Fox, H.-K. Moon), TURBINE09 – International Symposium on Heat Transfer in Gas Turbine Systems, Antalya, Turkey, August 9-14, 2009.
82. Over-Tip Shock Wave Structure and Its Impact on Turbine Blade Tip Heat Transfer, (Q. Zhang, D. O'Dowd, P. M. Ligrani, A. P. S. Wheeler, L. He, and B. C. Y. Cheong), TURBINE09 – International Symposium on Heat Transfer in Gas Turbine Systems, Antalya, Turkey, August 9-14, 2009.

2010

83. Aero-Thermal Performance of a Winglet at Engine Representative Mach and Reynolds Numbers (D. O. O'Dowd, Q. Zhang, L. He, M. L. G. Oldfield, P. M. Ligrani, B. C. Y. Cheong, and I. Tibbott), Paper Number GT2010-22794, TURBO EXPO 2010 – 55th ASME Gas Turbine Technical Congress and Exposition, Glasgow, Scotland, UK, June 14-18, 2010.
84. Transonic Turbine Blade Tip Aero-Thermal Performance with Different Tip Gaps: Part I-Tip Heat Transfer (Q. Zhang, D. O. O'Dowd, L. He, M. L. G. Oldfield, and P. M. Ligrani), Paper Number GT2010-22779, TURBO EXPO 2010 – 55th ASME Gas Turbine Technical Congress and Exposition, Glasgow, Scotland, UK, June 14-18, 2010.
85. Transonic Turbine Blade Tip Aero-Thermal Performance with Different Tip Gaps: Part II-Tip Aerodynamic Loss (D. O. O'Dowd, Q. Zhang, I. Usandizaga, L. He, and P. M. Ligrani), Paper Number GT2010-22780, TURBO EXPO 2010 – 55th ASME Gas Turbine Technical Congress and Exposition, Glasgow, Scotland, UK, June 14-18, 2010.
86. Fluid Mechanics Research at Saint Louis University (M. McQuilling, R. LeBeau, P. M. Ligrani), Invited Lecture, Air Mobility Command (AMC) – Air Force Research Laboratory (AFRL) Symposium, Innovative Aerodynamics: Potential Solutions for Improving Mobility Efficiency, Fairview Heights, Illinois, USA, November 30, 2010.

2011

87. Slip Due to Rarefaction, Surface Roughness, and Intermolecular Interactions for Gases and Liquids (P. M. Ligrani), ASME/JSME 2011

8th Thermal Engineering Joint Conference, AJTEC2011, Honolulu, Hawaii, USA, March 13-17,2011.

88. New Developments in Continuous SPLITT Fractionation (P. M. Ligrani), Invited Lecture, 15th International Symposium on Field- and Flow-Based Separations (FFF2011), CASSS – International Separation Science Society, South San Francisco Conference Center, South San Francisco, California, USA, May 23-25,2011.
89. Full-Coverage Film Cooling: Film Effectiveness and Heat Transfer Coefficients for Dense and Sparse Hole Arrays at Different Blowing Ratios (M. Goodro, P. M. Ligrani, M. Fox, and H.-K. Moon), Paper Number GT2011-45389, TURBO EXPO 2011 – 56th TURBO EXPO Turbine Technical Conference and Exposition, Vancouver, Canada, June 6-10, 2011.
90. Aerodynamic Losses in Turbines With and Without Film Cooling (P. M. Ligrani), Invited Keynote Paper, IGTC'11 Osaka, International Gas Turbine Congress 2011 Osaka, 10th Congress in Japan, Gas Turbine Society of Japan, Osaka, Japan, November 13-18, 2011.
91. Aerodynamic Loss Determination and Evaluation in Turbine Components (P. M. Ligrani), Invited Keynote Paper, 11th Asian International Conference on Fluid Machinery, and 3rd Fluid Power Technology Exhibition, Indian Institute of Technology, Madras, Chennai, India, November 21-23, 2011.

2012

92. Spiral Inertial Microfluidic Devices For Continuous Blood Cell Separation (N. Nivedita, P. M. Ligrani, and I. Papautsky), Invited Paper, Paper Number 8251-26, MOEMS-MEMS Conference on Micro- and Nano-Fabricated Electromechanical and Optical Components, SPIE – International Society for Optics and Photonics, San Francico, California, USA, January 21-26, 2012.
93. Second Law Analysis of Aerodynamic Losses: Results for a Cambered Vane With and Without Film Cooling (P. M. Ligrani, and J. S. Jin), Paper Number GT2012-70021, TURBO EXPO 2012 – 57th TURBO EXPO Turbine Technical Conference and Exposition, Copenhagen, Denmark, June 11-15, 2012.
94. Full-Coverage Film Cooling: Film Effectiveness and Heat Transfer Coefficients For Dense Hole Arrays at Different Hole Angles, Contraction Ratios, and Blowing Ratios (M. Goodro, P. M. Ligrani, M. Fox, and H.-K. Moon), Paper Number GT2012-70014, TURBO EXPO 2012 – 57th TURBO EXPO Turbine Technical Conference and Exposition, Copenhagen, Denmark, June 11-15, 2012.
95. Heat Transfer Augmentation Technologies for Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), Invited Keynote Paper, Invited Expert, Fourth International Symposium on Jet Propulsion and Power Engineering, 4th ISJPPE Meeting, Northwestern Polytechnical University (NPU), Xi'an, P. R. China, September 10-12, 2012.
96. Turbine Research at Saint Louis University (M. McQuilling, and P. M. Ligrani), Invited Lecture, Turbine Engine Technology Symposium

(TETS), Dayton Convention Center, Dayton, Ohio, USA, September 10-13, 2012.

97. New Developments in Surface Heat Transfer Augmentation Technologies as Applied to Internal Flow Environments (P. M. Ligrani), Invited Plenary Keynote Paper, ISTP-23, The 23rd International Symposium on Transport Phenomena, The University of Auckland, Auckland, New Zealand, November 19-22, 2012.

2013

98. Effects of Jet-To-Target Plate Distance and Reynolds Number on Jet Array Impingement Heat Transfer (J. Lee, Z. Ren, J. Haegele, G. Potts, J. S. Jin, P. M. Ligrani, M. Fox, and H.-K. Moon), Paper Number GT2013-94651, TURBO EXPO 2013 – 58th TURBO EXPO Turbine Technical Conference and Exposition, San Antonio, Texas, USA, June 3-7, 2013.
99. Full-Coverage Film Cooling: Heat Transfer Coefficients and Film Effectiveness For a Sparse Hole Array at Different Blowing Ratios and Contraction Ratios, (P. M. Ligrani, M. Goodro, M. Fox, and H.-K. Moon), Paper Number GT2013-94649, TURBO EXPO 2013 – 58th TURBO EXPO Turbine Technical Conference and Exposition, San Antonio, Texas, USA, June 3-7, 2013.
100. Microfluidic Inertial, Continuous SPLITT, and Field-Flow Fractionation Developments for Separation of Whole Blood Components, (M. Jennerjohn, N. Nivedita, L. Carlson, P. M. Ligrani, I. Papautsky, J. Eslick, R. Sprague, and E. Bowles), 16th International Symposium on Field- and Flow-Based Separations, FFF2013 - PAU, University de Pau et des Pays de l'Adour, IPREM and Faculty of Sciences Pau, France, June 30-July 4, 2013.
101. Recent Developments in Impingement Array Cooling, Including Consideration of the Separate Effects of Mach Number, Reynolds Number, Temperature Ratio, Hole Spacing, and Jet-to-Target Plate Distance (P. M. Ligrani), Plenary Lecture as an Invited Keynote Speaker, IWHT2013, 2nd International Workshop on Heat Transfer Advances for Energy Conservation and Pollution Control, Northwestern Polytechnical University (NPU), Xi'an, P. R. China, October 18-21, 2013.
102. Evolution of Secondary Dean Vortices in Spiral Microchannels for Cell Separations (N. Nivedita, P. M. Ligrani, and I. Papautsky), Invited Lecture, Miniaturized Systems for Chemistry and Life Sciences MicroTAS 2013, University of Freiburg, Freiburg, Germany, October 27-31, 2013.

2014

103. Investigation of Shock Wave – Boundary Layer Interactions in a 3.57 Aspect Ratio Wind Tunnel (S. W. Warning, M. Turlin, L. Carlson, P. M. Ligrani, and M. McQuilling), 52nd AIAA Aerospace Sciences Meeting, American Institute of Aeronautics and Astronautics, National Harbor, Maryland, USA, January 13-17, 2014.
104. Recent Heat Transfer and Aerodynamics Research Developments For Application to Turbine Components of Gas Turbine Engines (P. M. Ligrani), Invited Lecture, Academic Forum on Gas Turbine Technology,

Opening Ceremony for the Institute of Gas Turbines, Beijing Tsinghua University, Beijing, P. R. China, February 27-28, 2014.

105. Experimental and Computational Investigations of Shock Wave – Boundary Layer Interactions in a Wide Aspect Ratio Wind Tunnel (M. McQuilling, P. M. Ligrani, S. Warning, M. Turlin, L. Carlson), 7th Annual Shock Wave Boundary Layer Interaction Workshop, Cleveland, Ohio, USA, May 6-7, 2014.
106. Crossflows From Jet Array Impingement Cooling: Effects of Hole Array Spacing, Jet-To-Target Plate Distance, and Reynolds Number (J. Lee, Z. Ren, P. M. Ligrani, M. D. Fox, and H.-K. Moon), Paper Number GT2014-26426, ASME TURBO EXPO 2014 – 59th TURBO EXPO Turbine Technical Conference and Exposition, Dusseldorf, Germany, June 16-20, 2014.
107. Heat Transfer Measurements From Concave and Convex Surfaces With a Fully Developed Confined Impinging Slot Jet (S. J. Kim, Y. H. Kim, H. J. Park, D. H. Lee, and P. M. Ligrani), The 15th International Heat Transfer Conference, IHTC2014, Kyoto, Japan, August 10-15, 2014.
108. Aerodynamics Losses From Turbine Components Within Gas Turbine Engines (P. M. Ligrani, A. Fatemi, and G. Potts), Invited Keynote Paper, Fifth International Symposium on Jet Propulsion and Power Engineering, 5th ISJPPE Meeting, Beihang University, Beijing, P. R. China, September 15-19, 2014.

2015

109. Unsteady Structure and Development of a Row of Impingement Jets, Including Shear Layer and Vortex Development, Part 1: Turbulent Jets, (L. Yang, P. M. Ligrani, J. Ren, and H. Jiang), Paper Number GT2015-43070, GT2015, ASME TURBO EXPO 2015: Turbine Technical Conference and Exposition, Montreal, Canada, June 15-19, 2015.
110. Unsteady Structure and Development of a Row of Impingement Jets, Including Shear Layer and Vortex Development, Part 2: Laminar Jets, (L. Yang, J. Ren, H. Jiang, and P. M. Ligrani), Paper Number GT2015-43074, GT2015, ASME TURBO EXPO 2015: Turbine Technical Conference and Exposition, Montreal, Canada, June 15-19, 2015.
111. Swirl Chambers: Flow Structure and Surface Heat Transfer (P. M. Ligrani), Invited Plenary Paper, ICHHFF5, Fifth International Conference "Heat and Mass Transfer and Hydrodynamics in Swirled Flows," National Committee of the Russian Academy of Sciences, Kazan, Russia, October 19-21, 2015.
112. Arrays of Surface Dimples: Flow Structure and Surface Heat Transfer (P. M. Ligrani), Invited Plenary Paper, ICTE 2015, International Conference: "IX Workshop on Thermophysics and Power Engineering for Higher Education Institutions," Ministry of Education and Science of the Russian Federation, Kazan State Power Engineering University, Kazan, Russia, October 21-24, 2015.
113. Elastic Turbulence Effects on the Performance of a Miniature Viscous Disk Pump (B. Lund, M. Brown, M. Jennerjohn, P. M. Ligrani, and A. Fatemi), Paper Number IMECE2015-52596, IMECE 2015, International Mechanical Engineering Congress and Exposition, Houston, Texas, USA, November 13-19, 2015.

2016

114., Onset and Transition to Elastic Turbulence: Effects of Rheological Property Variations For Polyacrylamide-Water Solutions (B. Lund, P. M. Ligrani, and A. Fatemi), Invited Paper, 20th International Colloquium Tribology – Industrial and Automotive Lubrication, Stuttgart / Ostfildern, Germany, 12-14 January 2016.

115. Influences of Target Surface Roughness on Impingement Jet Array Heat Transfer, Part 1: Effects of Roughness Pattern, Roughness Height, and Reynolds Number, (W. Buzzard, Z. Ren, P. M. Ligrani, C. Nakamata, and S. Ueguchi), Paper Number GT2016-56354, ASME TURBO EXPO 2016: Turbomachinery Technical Conference and Exposition, Seoul, South Korea, June 13-17, 2016.

116. Influences of Target Surface Roughness on Impingement Jet Array Heat Transfer, Part 2: Effects of Roughness Shape, and Reynolds Number, (W. Buzzard, Z. Ren, P. M. Ligrani, C. Nakamata, and S. Ueguchi), Paper Number GT2016-56355, ASME TURBO EXPO 2016: Turbomachinery Technical Conference and Exposition, Seoul, South Korea, June 13-17, 2016.

117. Effects of Double Wall Cooling Configuration and Conditions on Performance of Full Coverage Effusion Cooling, (N. Rogers, Z. Ren, W. Buzzard, B. Sweeney, N. Tinker, P. M. Ligrani, K. D. Hollingsworth, F. X. Liberatore, R. Patel, and H.-K. Moon), Paper Number GT2016-56515, ASME TURBO EXPO 2016: Turbomachinery Technical Conference and Exposition, Seoul, South Korea, June 13-17, 2016.

118. Effect of Reynolds Number, Hole Patterns, and Hole Inclination on Cooling Performance of an Impinging Jet Array, Part 1: Convective Heat Transfer Results and Optimization (W. Li, L. Yang, X. Li, J. Ren, H. Jiang, and P. M. Ligrani), Paper Number GT2016-56205, ASME TURBO EXPO 2016: Turbomachinery Technical Conference and Exposition, Seoul, South Korea, June 13-17, 2016.

119. Turbine Component Aerodynamic Losses Within Gas Turbine Engines (P. M. Ligrani), Invited Lecture, "China-Germany Workshop on Gas Turbine Technologies: Aerodynamics, Heat Transfer, and Combustion," ITLR-Institute of Aerospace Thermodynamics, University of Stuttgart, Stuttgart, Germany, and Shanghai Jiao Tong University, Shanghai, P. R. China, July 18-20, 2016.

RECENT LECTURES, INCLUDING INVITED LECTURES.

1. Recent Developments in Field Flow Fractionation and Continuous SPLITT Fractionation, FFF (Field Flow Fractionation) Research Center, Chemistry Department, University of Utah, Salt Lake City, Utah, USA, October 21, 1994.
2. Recent Developments in Field Flow Fractionation and Continuous SPLITT Fractionation, Dow Chemical Corporation, Midland, Michigan, USA, October 25, 1994.
3. Recent Gas Turbine Heat Transfer Research at the University of Utah, Solar Turbines Inc., San Diego, California, USA, April 7, 1995

4. Flow and Heat Transfer in a Curved Channel Including Development and Characteristics of Dean Vortices, Nagoya Institute of Technology, Nagoya, Japan, July 11, 1995.
5. Flow and Heat Transfer in a Curved Channel Including Development and Characteristics of Dean Vortices, Kyoto University, Kyoto, Japan, July 14, 1995.
6. Effects of Bulk Flow Pulsations on Film Cooling, Mitsubishi Heavy Industries Ltd., Takasago Research and Development Center, Takasago, Japan, July 19, 1995.
7. Effects of Bulk Flow Pulsations on Film Cooling, Kyushu University, Fukuoka, Japan, July 21, 1995.
8. Study of Vortices in Turbulent Flow to Augment Surface Heat Transfer, Solar Turbines Inc., San Diego, California, USA, November 13, 1996.
9. Heat Transfer in Curved and Straight Channels, Idaho State University, Pocatello, Idaho, USA, January 17, 1997.
10. Gas Turbine Heat Transfer Research at the University of Utah, Department of Mechanical Engineering, Undergraduate Seminar, University of Utah, Salt Lake City, Utah, USA, March 4, 1997.
11. Heat Transfer and Fluid Mechanics Research at the University of Utah Convective Heat Transfer Laboratory, Rocketdyne Corporation, Canoga Park, California, USA, July 17, 1998.
12. Gas Turbine Heat Transfer Research at the University of Utah, Department of Mechanical Engineering, Undergraduate Seminar, University of Utah, Salt Lake City, Utah, USA, November 10, 1998.
13. Swirl Chamber Heat Transfer and Flow Characteristics, General Electric Corporate Research and Development Center, Schenectady, New York, USA, August 5, 1999.
14. Innovative Schemes for Convective Heat Transfer Augmentation, Darmstadt Technical University, Darmstadt, Germany, May 30, 2000.
15. Effects of Roughness on the Development and Structure of Turbulent Boundary Layers, Department of Mechanical Engineering, Louisiana State University, Baton Rouge, Louisiana, USA, September 8, 2000.
16. Transonic Aerodynamic Losses Due to Turbine Airfoil, Suction Surface Film Cooling, Department of Mechanical Engineering, Louisiana State University, Baton Rouge, Louisiana, USA, October 25, 2000.
17. Heat Transfer and Flow Structure On and Above a Dimpled Surface in a Channel, Department of Mechanical Engineering, North Carolina State University, Raleigh, North Carolina, USA, November 28, 2000.
18. Heat Transfer and Flow Structure On and Above a Dimpled Surface in a Channel, Department of Mechanical Engineering, University of Massachusetts, Amherst, Massachusetts, USA, March 12, 2001.
19. Heat Transfer and Flow Structure On and Above a Dimpled Surface in a Channel, National Science Foundation, Chemical and Transport Systems Division, Arlington, Virginia, USA, March 24, 2001.
20. Heat Transfer and Flow Structure On and Above a Dimpled Surface in a Channel, Pratt & Whitney – Canada Corporation, Longueille, Quebec, Canada, September 7, 2001.

21. The Influences and Effects of Different Physical Phenomena on Film Cooling, Pratt & Whitney – Canada Corporation, Longueille, Quebec, Canada, September 7, 2001.
22. Dimpled Tube Development, Gas Technology Institute, Des Plaines, Illinois, USA, February 22, 2002.
23. Heat Transfer and Flow Structure On and Above a Dimpled Surface in a Channel, Department of Mechanical Engineering, Ohio University, Athens, Ohio, USA, February 25, 2002.
24. Heat Transfer and Flow Structure On and Above a Dimpled Surface in a Channel, Department of Mechanical Engineering, University of Akron, Akron, Ohio, USA, February 26, 2002.
25. Heat Transfer and Flow Structure On and Above a Dimpled Surface in a Channel, Department of Mechanical Engineering, Kansas State University, Manhattan, Kansas, USA, October 24, 2002.
26. Micropumps for Low-Volume Drug Delivery, Sorenson Medical Corp., Salt Lake City, Utah, USA, September 16, 2003.
27. Electrochemical Actuation of Micropumps, and Micropumps for Low-Volume Drug Delivery, Ceramatec Advanced Materials and Electrochemical Technologies Corp., Salt Lake City, Utah, USA, November 11, 2003.
28. Osmotic Dispense Pump, Foxboro-Invensys Corporation, Foxboro, Massachusetts, USA, December 15, 2004.
29. Research Underway in the Convective Heat Transfer Laboratory at the University of Utah, Foxboro-Invensys Corporation, Foxboro, Massachusetts, USA, December 15, 2004.
30. Osmotically-Driven Dispense Pump, ARUP Institute for Clinical and Experimental Pathology, Salt Lake City, Utah, USA, March 23, 2005.
31. Heat Transfer and Flow Structure On and Above Dimpled Surfaces in Macro- and Micro-Scale Channels, Department of Mechanical and Industrial Engineering, University of Illinois at Chicago, Chicago, Illinois, USA, March 28, 2005.
32. Vision Seminar: Future Directions in Macro-Fluid Mechanics, Micro-Fluid Mechanics, and Heat Transfer, Department of Mechanical and Industrial Engineering, University of Illinois at Chicago, Chicago, Illinois, USA, March 29, 2005.
33. Miniature-Scale and Millimeter-Scale Rotating Shaft Pumps (RSP), Price Pump Company, Sonoma, California, USA, May 31, 2005.
34. Research Projects – Convective Heat Transfer Laboratory – University of Utah, Intel Corporation – Visit and Discussions, Department of Mechanical Engineering, University of Utah, Salt Lake City, Utah, September 8, 2005.
35. Convective Heat Transfer Laboratory – Future Directions in Macro-Fluid Mechanics, Micro-Fluidics, and Heat Transfer, Department of Mechanical Engineering, University of Utah, Salt Lake City, Utah, September 23, 2005.
36. A Vision for Turbomachinery and Related Research in the Osney Laboratory, Department of Engineering Science, Oxford University, Oxfordshire, England, United Kingdom, October 28, 2005.

37. Aero Losses, Heat Transfer, and Discharge Coefficients for Different Vane Trailing Edge Configurations, UTSR Peer Review Workshop III, Madren Conference Center and Inn, Clemson University, Clemson, South Carolina, October 19-21, 2005.
38. Dimple Array Effects on Heat Transfer and Turbulent Flow Structure, Keynote Lecture, Fifth International Symposium on Turbulence, Heat, and Mass Transfer, Dubrovnik, Croatia, September 25-29, 2006.
39. Oxford Rotor Group CFD - Oxford Aerodynamics and Heat Transfer UTC – Turbomachinery Laboratory (N. Atkins, G. Thomas, R. W. Ainsworth, P. M. Ligrani), Rolls-Royce CFD Annual Review, Rolls-Royce PLC, Morley, Derbyshire, England, United Kingdom, October 5-6, 2006.
40. Future Research and Development Directions in Fluid Mechanics and Heat Transfer, QinetiQ PLC, Cody Technology Park, Farnborough, England, United Kingdom, November 13, 2006.
41. Dimple Array Effects on Turbulent Heat Transfer and Flow Structure, Aeronautics Department, Prince Consort Road, Imperial College of Science, Technology, and Medicine, University of London, London, England, United Kingdom,, December 6, 2006.
42. Turbomachinery Laboratory – Review of Laboratory Activities - Aerodynamics, Heat Transfer, and Turbomachinery Group, Presentation to Dr. Dr. Bauer and Dr. Schulz of ITS - Institut fuer Thermische Stroemungsmaschinen - Universitaet Karlsruhe, Thermo-Fluids Laboratory, Oxford University, Oxford, England, United Kingdon, January 8, 2007.
43. Thermo-Fluids Laboratory–Aerodynamics, Heat Transfer, and Turbomachinery Group, Institut fuer Thermische Stroemungsmaschinen, Universitaet Karlsruhe, Germany, January 22, 2007.
44. Turbine Vane Aerodynamic Losses With and Without Surface Roughness Augmentations, Fachgebiet Stromungslehre und Aerodynamik Technische Universitat, Technical University of Darmstadt, Darmstadt, Germany, January 29, 2007.
45. Oxford Rotor Group CFD Work on Tip Flow and Heat Transfer, Rolls-Royce Annual Tip Cooling Forum, Rolls Royce PLC, Bristol, England, United Kingdom, February 6, 2007.
46. Current State-of-the-Art Research on Heat Transfer and Cooling of Gas Turbine Engine Components Including Future Directions, Siemens Corporation, Ruston House, Lincoln, England, United Kingdom, April 24, 2007.
47. Microfluidic Separation of Biological Nano-Particles (with Dr. Karl Morten), John Fell Fund Program, Oxford University, Oxford, England, United Kingdom, May 9, 2007.
48. The Impetus for Nano-Technology and Micro-Science Research in the Department of Engineering Science at Oxford University (with Dr. Yiannis Ventikos), Engineering Program Visit, EPSRC-Engineering and Physical Sciences Research Council, Department of Engineering

Science, Oxford University, Oxford, England, United Kingdom, June 11, 2007.

49. Microfluidic Separation of Biological Nano-Particles (with Dr. Karl Morten), UCSF / IUIF / ISIS Innovation Funding Program, Oxford University, Oxford, England, United Kingdom, July 5, 2007.
50. Microfluidic Separation of Biological Nano-Particles (with Dr. Karl Morten), Becton, Dickinson, and Company Visit, Department of Engineering Science, Begbroke Centre for Innovation and Enterprise, Oxford University, Oxford, England, United Kingdom, July 17, 2007.
51. Current State-of-the-Art Research on Heat Transfer and Cooling of Gas Turbine Engine Components Including Future Directions, Rolls Royce PLC, Thermo-Fluids Laboratory, Department of Engineering Science, Oxford University, Oxford, England, United Kingdom, August 21, 2007.
52. Oxford Rotor Group CFD Work (A. Wheeler, Q. Zhang, N. Atkins, G. Thomas, P. M. Ligrani, R. W. Ainsworth), Rolls-Royce CFD Annual Review, Rolls-Royce PLC, Morley, Derbyshire, United Kingdom, October 1-2, 2007.
53. Effects of a Casing Step on the Over-Tip Aerothermodynamics of a Transonic HP Turbine Stage, Institute for Energy Technologies, Swiss Federal Institute of Technology, ETH Zurich, Switzerland, October 24, 2007.
54. Smart Materials and Smart Structures for Aerodynamicists: Benefits, Challenges, Opportunities, Visions. Invited Lecture - Aerospace 2030 – The Role of Smart Materials, Begbroke Centre for Innovation and Enterprise, Department of Engineering Science, Oxford University, Oxford, England, United Kingdom, November 27, 2007.
55. Technology Trends in the Gas Turbine Industry, Invited Keynote Paper - 4th International Conference on the Future of Gas Turbine Technology, European Turbine Network Conference, Brussels, Belgium, October 15, 2008.
56. Suction-Side Gill-Region Film Cooling: Effects of Hole Shape and Orientation on Adiabatic Effectiveness, Heat Transfer Coefficient, and Aerodynamic Performance, Siemens Energy Inc., Muelheim an der Ruhr, Germany, November 19, 2008.
57. Suction-Side Turbine Vane Film Cooling: Thermal and Aerodynamic Performance to Meet Energy and Environmental Challenges, Department of Mechanical and Aerospace Engineering, University of Notre Dame, Notre Dame, Indiana, December 15, 2008.
58. Suction-Side Turbine Vane Film Cooling: Thermal and Aerodynamic Performance to Meet Energy and Environmental Challenges, Department of Mechanical Engineering, The Petroleum Institute, Abu Dhabi, United Arab Emerites, December 23, 2008.
59. Current State-of-the-Art Research on Heat Transfer and Cooling of Gas Turbine Engine Components Including Future Directions, Heat Transfer Advance Technology Group, Siemens Energy Inc., Orlando, Florida, May 28, 2009 and June 18, 2009.

60. A Vision for the Oliver L. Parks Endowed Chair and Director of Graduate Programs at Saint Louis University, Parks College of Engineering, Aviation and Technology, Saint Louis University, St. Louis, Missouri, USA, January 25, 2010.
61. Flow and Heat Transfer on and Near a Transonic Turbine Blade Tip, Including Effects of a Varying Tip Gap, Department of Mechanical Engineering, Louisiana State University, Baton Rouge, Louisiana, USA, February 5, 2010.
62. Flow and Heat Transfer on and Near a Transonic Turbine Blade Tip, Including Effects of a Varying Tip Gap, Department of Mechanical and Aerospace Engineering, Florida Institute of Technology, Melbourne, Florida, USA, February 9, 2010.
63. Slip Phenomena in Gases and a Newtonian Liquid as Investigated Within a Micro-Scale Viscous Disk Pump, Department of Mechanical Engineering, University of Texas at Dallas, Dallas, Texas, USA, February 18, 2010.
64. Slip Phenomena in Gases and a Newtonian Liquid as Investigated Within a Micro-Scale Viscous Disk Pump, William Maxwell Reed Seminar, Department of Mechanical Engineering, University of Kentucky, Lexington, Kentucky, USA, March 23, 2010.
65. Slip Phenomena in Gases and a Newtonian Liquid as Investigated Within a Micro-Scale Viscous Disk Pump, Department of Aerospace and Mechanical Engineering, Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, September 9, 2010.
66. Current State-of-the-Art Research on Heat Transfer and Cooling of Gas Turbine Engine Components Including Future Directions, Advanced Technology Turbine, Mechanical Center of Excellence, Honeywell Engine and Air Management, Honeywell Aerospace Division, Honeywell International Corp., Phoenix, Arizona, USA, September 24, 2010.
67. Research on Heat Transfer and Cooling of Gas Turbine Engine Components Including Measurement Techniques, School of Mechanical and Automotive Engineering, Inje University, Gimhae, South Korea, October 4, 2010.
68. Flow and Heat Transfer On and Near a Transonic Turbine Blade Tip, Including Effects of a Varying Tip Gap, School of Mechanical and Automotive Engineering, Inje University, Gimhae, South Korea, October 5, 2010.
69. Research on Heat Transfer and Cooling of Gas Turbine Engine Components Including Measurement Techniques, Department of Mechanical Engineering, KAIST – Korea Advanced Institute of Science and Technology, Daejeon, South Korea, October 6, 2010.
70. Slip Phenomena in Gases and a Newtonian Liquid as Investigated Within a Micro-Scale Viscous Disk Pump, School of Mechanical and Aerospace Engineering, College of Engineering, SNU – Seoul National University, Seoul, South Korea, October 7, 2010.

71. Research on Heat Transfer and Cooling of Gas Turbine Engine Components Including Measurement Techniques, Aero Propulsion Systems Department, Aeronautics Technology Division, KARI – Korea Aerospace Research Institute, Daejeon, South Korea, October 8, 2010.
72. Slip Phenomena in Gases and a Newtonian Liquid as Investigated Within a Micro-Scale Viscous Disk Pump, Mechanical Engineering and Materials Science Department, School of Engineering and Applied Science, Washington University in St. Louis, St. Louis, Missouri, USA, December 2, 2010.
73. Parks College of Engineering, Aviation, and Technology - Research Discussions at Scott Air Force Base, Air Mobility Command (AMC) - Scott Air Force Base, Scott Air Force Base, Illinois, USA, December 17, 2010.
74. Parks College of Engineering, Aviation, and Technology – Research Activities, Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, February 18, 2011.
75. Parks College of Engineering, Aviation, and Technology – Graduate School Research Opportunities, Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, February 23, 2011.
76. Slip Phenomena in Gases and a Newtonian Liquid as Investigated Within a Micro-Scale Viscous Disk Pump, Distinguished Seminar Series, Department of Mechanical Engineering, Dwight Look College of Engineering, TAMU – Texas A&M University, College Station, Texas, USA, March 30, 2011.
77. Over-Tip Shock Wave Structure and Its Impact on Turbine Blade Tip Heat Transfer, Including the Effects of Varying Tip Gap, CEAS Distinguished Lecture Series, Department of Mechanical Engineering, College of Engineering, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin, USA, April 21, 2011.
78. Science, Engineering, and Jet Engines, Physics Class, LaDue Horton Watkins High School, LaDue, Missouri, USA, May 11, 2011.
79. Over-Tip Shock Wave Structure and Its Impact on Turbine Blade Tip Heat Transfer, Including the Effects of Varying Tip Gap, Turbomachinery and Heat Transfer Branch, NASA Glenn Research Center, Cleveland, Ohio, USA, June 28, 2011.
80. Slip Phenomena in Gases and a Newtonian Liquid as Investigated Within a Micro-Scale Viscous Disk Pump, Department of Mechanical and Aerospace Engineering, U.S. Naval Postgraduate School, Monterey, California, USA, August 11, 2011.
81. An Overview of Parks College of Engineering, Aviation, and Technology (with K. Ravindra), The Boeing Company, St. Louis, Missouri, USA, September 12, 2011.
82. Saint Louis University – Parks College of Engineering, Aviation, and Technology - An Overview and Review of Research Opportunities, Department of Mechanical and Automotive Engineering, Inje University, Gimhae, Korea, October 31, 2011.

83. Experimental Investigations of Jet Array Impingement Heat Transfer and Full-Coverage Film Cooling, Department of Mechanical and Automotive Engineering, Inje University, Gimhae, Korea, November 1, 2011.
84. Experimental Investigations of Jet Array Impingement Heat Transfer and Full-Coverage Film Cooling, University of Science and Technology of China, Hefei, P. R. China, November 5, 2011.
85. Slip Phenomena in Gases and a Newtonian Liquid as Investigated Within a Micro-Scale Viscous Disk Pump, University of Michigan-Shanghai Jiao Tong University Joint Institute, Shanghai Jiao Tong University, Shanghai, P. R. China, November 7, 2011.
86. Experimental Investigations of Jet Array Impingement Heat Transfer and Heat Transfer and Flow Structure On and Above Dimpled Surfaces, Mechanical Engineering Department, Tokyo University of Science, Tokyo, Japan, November 8, 2011.
87. Experimental Investigations of Jet Array Impingement Heat Transfer and Heat Transfer and Flow Structure On and Above Dimpled Surfaces, DENSO Corporation, Nagoya, Japan. November 10, 2011.
88. Experimental Investigations of Jet Array Impingement Heat Transfer, Full-Coverage Film Cooling, and Over-Tip Shock Wave Structure and Its Impact on Turbine Blade Tip Heat Transfer, Mitsubishi Heavy Industries, Takasago, Japan, November 15, 2011.
89. Thermal-Fluid Sciences Research at Parks College of Engineering, Aviation, and Technology, The Boeing Company, St. Louis, Missouri, USA, October 21, 2011.
90. Influence of Corners (With and Without Fillets) on Turbulent Boundary Layers with Transonic Shock Waves in Channels, The Boeing Company, St. Louis, Missouri, USA, December 19, 2011.
91. Over-Tip Shock Wave Structure and Its Impact on Turbine Blade Tip Heat Transfer, Including the Effects of Varying Tip Gap, BEARS Seminar, Department of Mechanical Engineering, School of Engineering and Applied Science, Baylor University, Waco, Texas, USA, January 26, 2012.
92. Over-Tip Shock Wave Structure and Its Impact on Turbine Blade Tip Heat Transfer, Including the Effects of Varying Tip Gap, Mechanical Engineering Department, Virginia Tech, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, USA, February 10, 2012.
93. Parks College of Engineering, Aviation, and Technology – Status of Graduate Programs – February 21, 2012, Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, February 21, 2012.
94. Parks College of Engineering, Aviation, and Technology – Graduate School Research Opportunities, Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, March 28, 2012.
95. Parks College of Engineering, Aviation, and Technology – Status of Graduate Programs – May 8, 2012, Parks College of Engineering,

Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, May 8, 2012.

96. Experimental Investigations of Full-Coverage Film Cooling and Over-Tip Shock Wave Structure and Its Impact on Turbine Blade Tip Heat Transfer, Institute of Power Engineering, Department of Thermal Engineering, Tsinghua University, Beijing, P. R. China, May 24, 2012.
97. Experimental Investigations of Jet Array Impingement Heat Transfer and Full-Coverage Film Cooling, School of Energy and Power Engineering, Xi'an Jiaotong University, Xi'an, P. R. China, May 25, 2012.
98. Slip Phenomena in Gases and a Newtonian Liquid as Investigated Within a Micro-Scale Viscous Disk Pump, Department of Mechanical Engineering, Graduate School of Engineering, Osaka University, Osaka, Japan, May 29, 2012.
99. Investigations of Heat Transfer and Aerodynamic Phenomena as Applied to Turbine and Combustor Components of Gas Turbine Engines, IHI Corporation, Tokyo, Japan, May 30, 2012.
100. Aerodynamic Losses in Turbines With and Without Film Cooling, as Influenced by Mainstream Turbulence, Surface Roughness, Airfoil Shape, and Mach Number, Department of Mechanical and Automotive Engineering, Advanced Vehicle Core Parts Research Group, Inje University, Republic of Korea, May 31, 2012.
101. Slip Phenomena in Gases and a Newtonian Liquid as Investigated Within a Micro-Scale Viscous Disk Pump, Institute of Aerospace Thermodynamics (ITLR), Department of Aviation and Aerospace Engineering, University of Stuttgart, June 8, 2012.
102. Investigations of Heat Transfer and Aerodynamic Phenomena as Applied to Turbine and Combustor Components of Gas Turbine Engines, Technology Department of Research and Development Center, AVIC Commercial Aircraft Engine Co., Ltd., Shanghai, P. R. China, September 13, 2012.
103. Parks College of Engineering, Aviation, and Technology – Status of Graduate Programs – August 23, 2012, Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, August 23, 2012.
104. Parks College of Engineering, Aviation, and Technology – Status of Graduate Programs – September 25, 2012, Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, September 25, 2012.
105. Parks College of Engineering, Aviation, and Technology – Status of Graduate Programs – October 15, 2012, Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, October 15, 2012.
106. International Grants and Interdisciplinary Grant Workshops (with D. Carlin, P. Turner), Frost Campus, Saint Louis University, St. Louis, Missouri, USA, November 30, 2012.

107. International Grants and Interdisciplinary Grant Workshops (with D. Carlin, P. Turner), South Campus, Saint Louis University, St. Louis, Missouri, USA, November 30, 2012.
108. International Grants and Interdisciplinary Grant Workshops (with D. Carlin, P. Turner), Frost Campus, Saint Louis University, St. Louis, Missouri, USA, December 3, 2012.
109. International Grants and Interdisciplinary Grant Workshops (with D. Carlin, P. Turner), Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, January 30, 2013.
110. Thermal-Fluid Sciences – Some Recent Research Activities (P. M. Ligrani), Aerospace Engineering and Mechanical Engineering Department, Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, February 28, 2013.
111. Heat Transfer Augmentation Technologies for Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), School of Mechanical Engineering, Hanyang University, Seoul, Republic of Korea, March 27, 2013.
112. Saint Louis University – Parks College of Engineering, Aviation, and Technology - An Overview and Review of Research Opportunities (P. M. Ligrani), School of Mechanical Engineering, Hanyang University, Seoul, Republic of Korea, March 27, 2013.
113. Heat Transfer Augmentation Technologies for Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), Department of Mechanical and Automotive Engineering, Advanced Vehicle Core Parts Research Group, Inje University, Republic of Korea, March 29, 2013.
114. Heat Transfer Augmentation Technologies for Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), Institute of Power Engineering, Department of Thermal Engineering, Tsinghua University, Beijing, P. R. China, April 1, 2013.
115. Aerodynamic Losses in Turbines With and Without Film Cooling, as Influenced by Mainstream Turbulence, Surface Roughness, Airfoil Shape, and Mach Number (P. M. Ligrani), School of Mechanical Engineering, Northwestern Polytechnical University (NPU), Xi'an, P. R. China, April 3, 2013.
116. Heat Transfer Augmentation Technologies for Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), School of Energy and Power Engineering, Xi'an Jiaotong University, Xi'an, P. R. China, April 3, 2013.
117. New Developments in Surface Heat Transfer Augmentation Technologies as Applied to Internal Flow Environments (P. M. Ligrani), The George W. Woodruff School of Mechanical Engineering, College of Engineering, Georgia Institute of Technology, Atlanta, Georgia, USA, April 24, 2013.
118. Parks College of Engineering, Aviation, and Technology – Status of Graduate Programs – May 7, 2013 (P. M. Ligrani), Faculty Retreat -

Parks College of Engineering, Aviation, and Technology, Saint Louis University, St. Louis, Missouri, USA, May 7, 2013.

119. Jet Array Impingement Heat Transfer (P. M. Ligrani), School of Energy and Power Engineering, Institute of Turbomachinery, Xi'an Jiaotong University, Xi'an, P. R. China, October 14, 2013.
120. Full Coverage Film Cooling for Combustor Liner Applications (P. M. Ligrani), School of Energy and Power Engineering, Institute of Turbomachinery, Xi'an Jiaotong University, Xi'an, P. R. China, October 14, 2013.
121. Flow and Heat Transfer On and Near a Transonic Turbine Blade Tip (P. M. Ligrani), School of Energy and Power Engineering, Institute of Turbomachinery, Xi'an Jiaotong University, Xi'an, P. R. China, October 15, 2013.
122. Micro-Fluidic Slip Phenomena in Gases and Liquids (P. M. Ligrani), School of Energy and Power Engineering, Institute of Turbomachinery, Xi'an Jiaotong University, Xi'an, P. R. China, October 15, 2013.
123. Aerodynamic Losses In Turbines With and Without Film Cooling (P. M. Ligrani), School of Energy and Power Engineering, Institute of Turbomachinery, Xi'an Jiaotong University, Xi'an, P. R. China, October 16, 2013.
124. Heat Transfer and Flow Structure On and Above Dimpled Surfaces in Macro- and Micro-Scale Channels (P. M. Ligrani), School of Energy and Power Engineering, Institute of Turbomachinery, Xi'an Jiaotong University, Xi'an, P. R. China, October 16, 2013.
125. Heat Transfer and Flow Structure On and Above Dimpled Surfaces in Macro- and Micro-Scale Channels (P. M. Ligrani), School of Mechanical Engineering, Northwestern Polytechnical University (NPU), Xi'an, P. R. China, October 16, 2013.
126. Recent Heat Transfer and Aerodynamics Research Developments For Application to Turbine Components of Gas Turbine Engines (P. M. Ligrani), Invited Lecture at the Opening Ceremony for the Institute of Gas Turbines of Beijing Tsinghua University, Beijing, P. R. China, February 27, 2014.
127. Slip Phenomena in Gases and a Newtonian Liquid As Investigated Within a Micro-Scale Viscous Disk Pump (P. M. Ligrani), Department of Thermal Energy and Power Engineering, China University of Petroleum, Qingdao, P. R. China, March 3, 2014.
128. Experimental Investigations of Jet Array Impingement Heat Transfer (P. M. Ligrani), Department of Thermal Energy and Power Engineering, China University of Petroleum, Qingdao, P. R. China, March 3, 2014.
129. Slip Phenomena in Gases and a Newtonian Liquid As Investigated Within a Micro-Scale Viscous Disk Pump (P. M. Ligrani), Department of Mechanical Engineering, Yeungnam University, Republic of Korea, March 5, 2014.
130. Experimental Investigations of Jet Array Impingement Heat Transfer (P. M. Ligrani), Department of Mechanical and Automotive

Engineering, Advanced Vehicle Core Parts Research Group, Inje University, Republic of Korea, March 6, 2014.

131. Investigation of Shock Wave Boundary Layer Interactions in a Newly Developed 3.57 Aspect Ratio Wind Tunnel (P. M. Ligrani), Department of Aeronautics, Imperial College London, South Kensington, London, United Kingdom, June 13, 2014.
132. Heat Transfer Augmentation Technologies for Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), Institute of Particle Science and Engineering, School of Chemical and Process Engineering, University of Leeds, Leeds, England, United Kingdom, June 16, 2014.
133. Heat Transfer Augmentation Technologies for Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), B&B-AGEMA GmbH, Aachen, Germany, June 20, 2014.
134. Heat Transfer Augmentation Technologies for Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), Institut für Thermische Stroemungsmaschinen, Karlsruher Institut für Technologie (KIT), Karlsruhe, Germany, June 23, 2014.
135. Heat Transfer Augmentation Technologies for Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), ITLR-Institute of Aerospace Thermodynamics, University of Stuttgart, Stuttgart, Germany, June 25, 2014.
136. Aerodynamics Loss Investigations of Turbine Components, Including Aero-Thermodynamic and Film Cooling Influences (P. M. Ligrani), Institute of Power Engineering, Department of Thermal Engineering, Tsinghua University, Beijing, P. R. China, September 19, 2014.
137. Heat Transfer Augmentation Technologies For Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), School of Energy and Power Engineering, Beihang University, BUAA - Beijing University of Aeronautics and Astronautics, Beijing, P. R. China, September 20, 2014.
138. Heat Transfer and Flow Structure On and Above Dimpled Surfaces in Macro- and Micro-Scale Channels (P. M. Ligrani), School of Energy and Power Engineering, Beihang University, BUAA - Beijing University of Aeronautics and Astronautics, Beijing, P. R. China, September 20, 2014.
139. Aerodynamics Losses in Turbines With and Without Film Cooling, as Influenced by Mainstream Turbulence, Surface Roughness, Airfoil Shape, and Mach Number (P. M. Ligrani), School of Energy and Power Engineering, Beihang University, BUAA - Beijing University of Aeronautics and Astronautics, Beijing, P. R. China, September 21, 2014.
140. Jet Array Impingement Heat Transfer – Part 1: 1. Effects of Jet-to-Target Plate Distance and Reynolds Number, 2. Effects of Hole Spacing and Reynolds Number (P. M. Ligrani), School of Energy and Power Engineering, Beihang University, BUAA - Beijing University of

Aeronautics and Astronautics, Beijing, P. R. China, September 21, 2014.

141. Jet Array Impingement Heat Transfer – Part 2: 3. Separate Effects of Mach Number and Reynolds Number (P. M. Ligrani), School of Energy and Power Engineering, Beihang University, BUAA - Beijing University of Aeronautics and Astronautics, Beijing, P. R. China, September 22, 2014.
142. Flow and Heat Transfer On and Near a Transonic Turbine Blade Tip – Including Effects of a Varying Tip Gap (P. M. Ligrani), School of Energy and Power Engineering, Beihang University, BUAA - Beijing University of Aeronautics and Astronautics, Beijing, P. R. China, September 22, 2014.
143. Full Coverage Film Cooling for Combustor Liner Applications, Part 1 – Heat Transfer Coefficients and Film Effectiveness for a Sparse Hole Array at Different Blowing Ratios and Contraction Ratios (P. M. Ligrani), School of Energy and Power Engineering, Beihang University, BUAA - Beijing University of Aeronautics and Astronautics, Beijing, P. R. China, September 23, 2014.
144. Full Coverage Film Cooling for Combustor Liner Applications, Part 2 – Comparisons Between Sparse and Dense Hole Arrays at Different Blowing Ratios and Contraction Ratios (P. M. Ligrani), School of Energy and Power Engineering, Beihang University, BUAA - Beijing University of Aeronautics and Astronautics, Beijing, P. R. China, September 23, 2014.
145. Heat Transfer and Aerodynamics Research For Gas Turbines and Other Propulsion Systems (P. M. Ligrani), Eminent Scholar Inaugural Seminar, Eminent Scholar in Propulsion, College of Engineering, University of Alabama in Huntsville, Huntsville, Alabama, USA, January 23, 2015.
146. Heat Transfer and Aerodynamics Research For Gas Turbines and Other Propulsion Systems (P. M. Ligrani), Propulsion Systems Department, NASA – MSFC, NASA - Marshall Space Flight Center, Huntsville, Alabama, USA, April 9, 2015.
147. Supersonic Flow Research at the Propulsion Research Center (P. M. Ligrani), The Boeing Company Visit, Propulsion Research Center, College of Engineering, University of Alabama in Huntsville, Huntsville, Alabama, USA, April 21, 2015.
148. Supersonic Flow Research at the Propulsion Research Center (P. M. Ligrani), Northrop Grumman Corp. Visit, Propulsion Research Center, College of Engineering, University of Alabama in Huntsville, Huntsville, Alabama, USA, April 29, 2015.
149. Heat Transfer and Aerodynamics Research For Gas Turbines and Other Propulsion Systems (P. M. Ligrani), Propulsion and Structures Division, AMRDEC - Aviation and Missile Research, Development and Engineering Center, RDECOM – U. S. Army Research, Development, and Engineering Command, Redstone Arsenal, U. S. Army, Huntsville, Alabama, USA, May 7, 2015.

150. Welcome to the University of Alabama in Huntsville (P. M. Ligrani), Symposium on Gas Turbine Technology and Research, Beijing Tsinghua University Visit, Mechanical and Aerospace Engineering Department, College of Engineering, University of Alabama in Huntsville, Huntsville, Alabama, USA, May 11, 2015.
151. Recent Progress and Future Directions of Gas Turbine Research (P. M. Ligrani), Symposium on Gas Turbine Technology and Research, Beijing Tsinghua University Visit, Mechanical and Aerospace Engineering Department, College of Engineering, University of Alabama in Huntsville, Huntsville, Alabama, USA, May 11, 2015.
152. Heat Transfer Augmentation Technologies For Internal Cooling of Turbine Components of Gas Turbine Engines (P. M. Ligrani), School of Energy and Power, DLUT - Dalian University of Technology, Dalian, P. R. China, July 7, 2015.
153. Heat Transfer and Flow Structure On and Above Dimpled Surfaces in Macro- and Micro-Scale Channels (P. M. Ligrani), School of Energy and Power, DLUT - Dalian University of Technology, Dalian, P. R. China, July 7, 2015.
154. Aerodynamics Losses in Turbines With and Without Film Cooling, as Influenced by Mainstream Turbulence, Surface Roughness, Airfoil Shape, and Mach Number (P. M. Ligrani), School of Energy and Power, DLUT - Dalian University of Technology, Dalian, P. R. China, July 8, 2015.
155. Flow and Heat Transfer On and Near a Transonic Turbine Blade Tip – Including Effects of a Varying Tip Gap (P. M. Ligrani), School of Energy and Power, DLUT - Dalian University of Technology, Dalian, P. R. China, July 8, 2015.
156. Over-Tip Shock Wave Structure and Its Impact On Turbine Blade Tip Heat Transfer, Including the Effects of a Varying Tip Gap (P. M. Ligrani), Institute of Power Engineering, Department of Thermal Engineering, Beijing Tsinghua University, Beijing, P. R. China, July 9, 2015.
157. Heat Transfer and Aerodynamics Research for Gas Turbines and Other Propulsion Systems (P. M. Ligrani), National Gas Turbine Research Center, Beijing Tsinghua University, Beijing, P. R. China, July 10, 2015.
158. Effects of Target Surface Roughness on Jet Array Impingement Heat Transfer (P. M. Ligrani, Zhong Ren, and Warren Buzzard), IHI Corporation, Yokohama, Japan, July 15, 2015.
159. Thermal-Fluid Sciences Research Capabilities at the University of Alabama in Huntsville (P. M. Ligrani), IHI Corporation, Yokohama, Japan, July 15, 2015.
160. Microfluidics and Microplasmas for Space Micro-Propulsion (G. Xu, and P. M. Ligrani), NASA – Marshall Space Flight Center, Huntsville, Alabama, USA, May 29, 2015.
161. Microfluidics and Microplasmas for Space Micro-Propulsion (G. Xu, and P. M. Ligrani), The Boeing Company, Huntsville, Alabama, USA, June 12, 2015.

162. SS/TS/WT SuperSonic/TransSonic/WindTunnel for Advanced Aerospace and Aeropropulsion Research (P. M. Ligrani), Propulsion Research Center, University of Alabama in Huntsville, Huntsville, Alabama, USA, September 18, 2015.
163. Over-Tip Shock Wave Structure and Its Impact On Turbine Blade Tip Heat Transfer, Including the Effects of a Varying Tip Gap (P. M. Ligrani), Department of Mathematics, University of Texas at Arlington, Arlington, Texas, USA, November 6, 2015.
164. UAH PRC MAE SS/TS/WT Facility - SuperSonic/TransSonic/ WindTunnel Laboratory Capabilities (P. M. Ligrani), Propulsion Research Center, University of Alabama in Huntsville, Huntsville, Alabama, USA, January 29, 2016.
165. Research Highlights and New Developments at the Propulsion Research Center (P. M. Ligrani), Engineering Advisory Board Meeting, College of Engineering, University of Alabama in Huntsville, Huntsville, Alabama, USA, February 19, 2016.

INSTITUTION PUBLICATIONS-U. S. NAVAL POSTGRADUATE SCHOOL.

1. Subminiature Hot-Wire Sensor Construction (P. M. Ligrani), Naval Postgraduate School Report NPS-69-84-010, Naval Postgraduate School, Code 69, Monterey, Ca., November 1984.
2. Development of Subminiature Multi-Sensor Hot-Wire Probes (R. V. Westphal, P. M. Ligrani and F. R. Lemos), NASA Technical Memorandum 100052, NASA-Ames Research Center, Moffett Field, Ca., March 1988.
3. A Study of Dean Vortex Development and Structure in a Curved Rectangular Channel With Aspect Ratio of 40 at Dean Numbers Up to 430 (P. M. Ligrani), NASA Contract Report 4607, Army Research Laboratory Contractor Report ARL-CR-144, Vehicle Propulsion Directorate, U. S. Army Research Laboratory, and NASA-Lewis Research Center, Cleveland, Ohio, July 1994.

INSTITUTION PUBLICATIONS-VON KARMAN INSTITUTE FOR FLUID DYNAMICS.

1. Measurement Techniques, von Karman Institute Course Note No. 108 (P. M. Ligrani), von Karman Institute for Fluid Dynamics, Rhode-St-Genese, Belgium, October 1979.
2. Investigation of Heat Transfer rates on a Film Cooled Plate With and Without a Pressure Gradient (C. Camci, P. M. Ligrani and N. Hay), von Karman Institute Internal Note No. 68, von Karman Institute for Fluid Dynamics, Rhode-St-Genese, Belgium, July 1981.
3. Data Logger Hardware and Software Operation Details (M. Thiry, F. Thiry, A. Otte and P. M. Ligrani), von Karman Institute Manual 16, von Karman Institute for Fluid Dynamics, Rhode-St-Genese, Belgium, February 1982.
4. Some Hot-Wire Anemometer Measurement Details (P. M. Ligrani and D. Herbeaux), von Karman Institute Internal Note No. 71, von Karman Institute for Fluid Dynamics, Rhode-St-Genese, Belgium, March 1982.

5. Thin-Film Heat Transfer Gage Construction and Measurement Details (P. M. Ligrani, C. Camci and M. S. Grady), von Karman Institute Technical Memorandum No. 33 and von Karman Institute Internal Note No. 72, von Karman Institute for Fluid Dynamics, Rhode-St-Genese, Belgium, November 1982 and March 1982.
6. Rotating Stall in an Axial Flow Single Stage Compressor: On-Blade Measurements (B. R. Gyles, P. M. Ligrani and F. A. E. Breugelmans), AFOSR 80-0119B Grant Number Report, von Karman Institute for Fluid Dynamics, Rhode-St-Genese, Belgium, April 1982.

INSTITUTION PUBLICATION-STANFORD UNIVERSITY.

1. The Thermal and Hydrodynamic Behavior of Thick, Rough-Wall, Turbulent Boundary Layers (Ph. D. Thesis: P. M. Ligrani, R. J. Moffat and W. M. Kays), Report HMT-29, Thermosciences Division, Department of Mechanical Engineering, Stanford University, Stanford, Ca.

LECTURE SERIES-VON KARMAN INSTITUTE FOR FLUID DYNAMICS.

1. Separated Flows in Turbomachinery Components (lecture series co-directors: P. M. Ligrani and F. A. E. Breugelmans), von Karman Institute Lecture Series 1981-01, von Karman Institute for Fluid Dynamics, Rhode-St-Genese, Belgium, January 12-16, 1981.
2. Film Cooling and Turbine Blade Heat Transfer (lecture series director: P. M. Ligrani), von Karman Institute Lecture Series 1982-03, von Karman Institute for Fluid Dynamics, Rhode-St-Genese, Belgium, February 22-26, 1982.
3. Turbulent Shear Flows (lecture series director: P. M. Ligrani), von Karman Institute Lecture Series 1983-03, von Karman Institute for Fluid Dynamics, Rhode-St-Genese, Belgium, February 28-March 4, 1983.

U.S. PATENTS.

1. Rotary Centrifugal and Viscous Pumps. (D. B. Blanchard, P. M. Ligrani, B. Gale). U. S. Patent Office, Application Number PCT / US2004 / 028890, and Docket No. 23343.PCT.US. Final patent application filed March 4, 2006.
2. Aspherical Dimples For Heat Transfer Surfaces and Method. (T. Djeridane, T. Blaskovich, S. Sreekanth, R. Trindade, M. L. C. Papple, O. Bibor, L. Lebel, P. M. Ligrani). Patent disclosure submitted through Pratt & Whitney – Canada Corporation. U. S. Patent Office, publication date May 11, 2006. Patent publication number US 2006 / 0099073A1.
3. Osmotically-Driven Dispense Pump and Related Components For Use in High Pressure Applications. (T. H. Deem, P. M. Ligrani, B. Hansen). U. S. Patent Office, publication date February 1, 2007. Patent Application Number PCT/US06/28141 filed July 21, 2006. Attorney Docket No. 00846-24846.PCT. Patent publication number WO 2007 / 013957.

POST-DOCTORAL RESEARCH FELLOW - THERMAL-FLUID SCIENCES LABORATORY, SAINT LOUIS UNIVERSITY.

1. Dr. Jae Sik Jin, PDRF - Post-Doctoral Research Fellow, February 2011 – September 2011.
2. Dr. Krishnendu Saha, PDRF - Post-Doctoral Research Fellow, August 16, 2012 – December 31, 2012.
3. Dr. Arshia Fatemi, PDRF - Post-Doctoral Research Fellow, March 18, 2013 – December 31, 2014.

LONG-TERM ACADEMIC VISITORS - THERMO-FLUIDS LABORATORY, UNIVERSITY OF OXFORD.

1. Dr. Chi-Ho Yoon, Director of Geotechnical Engineering Division, Korea Institute of Geoscience and Mineral Resources (KIGAM), Daejeon, Korea. Sabbatical Visiting Scientist, September 2007 – August 2008.
2. Professor Mounir Ibrahim, Department of Mechanical Engineering, Cleveland State University, 2121 Euclid Avenue, SH 231, Cleveland, Ohio 44115-2214 USA. Short Visit: July 2008. Royal Academy of Engineering Visit: November-December 2008.

RRIF – ROLLS ROYCE INDUSTRIAL FELLOW - THERMO-FLUIDS LABORATORY, UNIVERSITY OF OXFORD.

1. Dr. Andrew Wheeler, RRIF – Rolls Royce Industrial Fellow, February 2007-August 2008.

SEEDA PROFESSORIAL FELLOW - THERMO-FLUIDS LABORATORY, UNIVERSITY OF OXFORD.

1. Dr. Helen Townley, SEEDA Professorial Fellow, September 2007-May 2009.

POST-DOCTORAL RESEARCH ASSISTANTS - THERMO-FLUIDS LABORATORY, UNIVERSITY OF OXFORD.

4. Dr. Qiang Zhang, PDRA-Post-Doctoral Research Assistant, October 2006 – May 2009.
2. Dr. Nicholas Atkins, PDRA-Post-Doctoral Research Assistant, June 2006 – July 2007.
3. Dr. John Williams, PDRA-Post-Doctoral Research Assistant, January 2007 – March 2008.
4. Dr. Brian Holley, Department of Mechanical Engineering, The University of Connecticut, Storrs, Connecticut, USA. U.S. National Science Foundation Supported Visit. PDRA-Post-Doctoral Research Assistant, January 2008 – June 2008.
5. Dr. Phil Douglas, PDRA-Post-Doctoral Research Assistant, February 2008 – January 2009.

TECHNICIANS (EXTERNAL) - THERMO-FLUIDS LABORATORY, UNIVERSITY OF OXFORD.

1. Mr. Nigel Brett, Technician, Oxford Rotor Facility – ORF, September 2007 – April 2008.

2. Mr. Berkan Sesen, Technician, Micro-Fluid-Dynamics Laboratory, November 2007 – December 2007.

LONG-TERM ACADEMIC VISITORS - CONVECTIVE HEAT TRANSFER LABORATORY, UNIVERSITY OF UTAH.

1. Professor Joon Sik Lee, Department of Mechanical Engineering, Turbo and Power Machinery Research Center, Seoul National University, Seoul 151-742, Korea. Sabbatical visitor, September 1994-September 1995.
2. Professor Hiromitsu Hamakawa, Department of Production System Engineering, Faculty of Engineering, Oita University, 700 Dannoharu, Oita 870-11, Japan. Sabbatical visitor, March 1998-January 1999.
3. Professor Sin Chul Bae, Department of Mechanical Engineering, Dankook University, #8, Hannam-Dong, Yongsan-Gu, Seoul, 140-714, Korea. Sabbatical visitor, February 7, 2000-February 28, 2001.
4. Professor Artem Khalatov, Institute of Engineering Thermophysics, National Academy of Sciences of Ukraine, Kiev-57, 252057, Ukraine. Visitor, June 2001.
5. Dr. Gazi Mahmood, Lecturer, Department of Mechanical Engineering, 220 S. W. Mudd, Mail Code 4703, 500 West 120th Street, Columbia University, New York, New York 10027, U.S.A. Post-Doctoral Fellow, June-August 2001, and January-March 2002.
6. Professor Sang Woo Lee, School of Mechanical Engineering, Kumo National Institutue of Technology, 188 Shinpyung, Gumi, Kyungbook 730-701, Korea. Sabbatical visitor, February 2002-January 2003.
7. Professor Hyung Ho Jung, Division of Mechanical and Information Engineering, Korea Maritime University, 1 Dongsam-dong, Yeongdo-gu, Pusan, 606-791, Korea. Sabbatical visitor, March 2002-August 2003.
8. Professor Artem Khalatov, Institute of Engineering Thermophysics, National Academy of Sciences of Ukraine, Kiev-57, 252057, Ukraine. W. W. Clyde Chair Visiting Professor, January 2004-May 2004.
9. Professor Edward D. Sergievsky, Department of Heat and Mass Transfer and Installations, Moscow Power Engineering Institute, 14 Krasnokazarmennaya Str., 111250 Moscow, Russia. Visiting Professor, November 2003.
10. Professor Victor I. Terekhov, Head - Thermal and Gas Dynamics Laboratory, Institute of Thermophysics SB RAS, Siberian Branch – Russian Academy of Sciences, Av. Ac. Lavrent'ev, 1, Novosibirisk 630090, Russia. Visiting Professor, December 2004.
11. Professor Dae Hee Lee, Professor, Dean of Research and International Affairs, Department of Mechanical and Automotive Engineering, Inje University, 607 Obang-Dong Kimhae, Kyongnam, 621-749 Korea. Visiting Professor, January 2005.

POST-DOCTORAL RESEEARCH FELLOWS - CONVECTIVE HEAT TRANSFER LABORATORY, UNIVERSITY OF UTAH.

1. Dr. Gazi Mahmood, Post-Doctoral Research Fellow, June-August 2001, and January-March 2002.
5. Dr. Qiang Zhang, Post-Doctoral Research Fellow, May-September 2005.

RESEARCH ASSISTANT PROFESSORS - CONVECTIVE HEAT TRANSFER LABORATORY, UNIVERSITY OF UTAH.

1. Dr. Qiang Zhang, Research Assistant Professor, September 2005-October 2006.

INTERNATIONAL SCIENTIFIC COMMITTEE MEMBERSHIPS.

1. International Conference on Mechanical Engineering-Algeria, Ministere de l'Enseignement Superieur et de la Recherche Scientifique, Oran, Algeria, April 28-29, 2002.
2. International Scientific Committee, International Symposium on "Heat Transfer in Gas Turbine Systems," Antalya, Turkey, August 9-14, 2009.
3. Member of the Scientific Committee, ICHHFF5, Fifth International Conference "Heat and Mass Transfer and Hydrodynamics in Swirled Flows," National Committee of the Russian Academy of Sciences, Kazan Russia, October 19-21, 2015.
4. Vice-Chairman and Member, Academic Committee, Institute of Gas Turbines, Beijing Tsinghua University, Beijing, P. R. China, February 2014 - February 2017.
5. ICHMT, Scientific Council Member, International Center for Heat and Mass Transfer. Nominated for membership by Professor Richard Goldstein of the University of Minnesota, January 2014 – Present.

Teaching Responsibilities/Assignments

COURSES TAUGHT, UNIVERSITY OF ALABAMA IN HUNTSILLE.

Fall Semester 2014, MAE 341-03 Thermodynamics I, 19 students.
Spring Semester 2015, MAE 341-01 Thermodynamics I, 47 students.
Fall Semester 2015, MAE 341-01 Thermodynamics I, 39 students.
Fall Semester 2015, MAE 746-01 Convective Heat Transfer, 8 students.
Spring Semester 2016, MAE 341-02 Thermodynamics I, 49 students.
Spring Semester 2016, MAE 341-03 Thermodynamics I, 44 students.

GRADUATE STUDENTS SUPERVISED, UNIVERSITY OF ALABAMA IN HUNTSILLE (COMPLETED DEGREES).

1. Zhong Ren, Master of Science – M.S., "Jet Array Impingement Heat Transfer: Effects of Target Plate Distance, Reynolds Number, and Hole Spacing." December 2015.
2. Warren Buzzard, Master of Science – M.S., "Effects of Target Surface Roughness on Impingement Jet Array Heat Transfer." December 2015.
3. Nathaniel D. Rogers, Master of Science – M.S., "Performance of Full Coverage Effusion Cooling With Cross Flow Supply." January 2016.

GRADUATE STUDENTS SUPERVISED, UNIVERSITY OF ALABAMA IN HUNTSILLE (DEGREES IN PROGRESS).

1. Benjamin Lund, Master of Science – M.S., "Investigations of the Effects of Elastic Turbulence on Heat Transfer and Flow Structure Within Rotating Couette Flows, Both With and Without Pressure Gradients."
2. Zhong Ren, Ph.D. – Doctor of Philosophy, "Investigations of Impingement and Effusion Cooling, Including Double Wall Cooling Arrangements."
3. Mengying Su, Ph.D. – Doctor of Philosophy, "Investigations of the Effects of Elastic Turbulence Within Internal Flows."
4. Benjamin Lund, Ph.D. – Doctor of Philosophy, "Investigations of Shock Wave Boundary Layer Interactions."
5. Sneha Reddy Vanga, Master of Science – M.S., "Investigations of Impingement and Effusion Cooling, Including Double Wall Cooling Arrangements."
6. Sneha Reddy Vanga, Ph.D. – Doctor of Philosophy, "Investigations of Shock Wave Boundary Layer Interactions."

GRADUATE STUDENTS SUPERVISORY COMMITTEE PARTICIPATION, UNIVERSITY OF ALABAMA IN HUNTSVILLE (DEGREES IN PROGRESS, and COMPLETED DEGREES).

1. Nivedita Nivedita, Doctor of Philosophy – Ph.D. "Fluid Dynamics and Inertial Focusing in Spiral Microchannels for Cell-Sorting." University of Cincinnati, Cincinnati, Ohio, USA. December 2015.
2. Jonathan Tay Chien Ming, Doctor of Philosophy – Ph.D. "Flow Past Dimple Surfaces." National University of Singapore, Singapore. March 2016.

3. Sven Winkler, Doctor of Philosophy – Ph.D. "Endwall Contouring Using Numerical Optimization in Combination With the Ice Formation Method." Institute of Aerospace Thermodynamics, University of Stuttgart, Stuttgart, Germany. March 2016.
4. Tyler Englestad, Doctor of Philosophy – Ph.D. "Investigations Related to Nuclear Fusion Propulsion," Propulsion Research Center, Department of Mechanical and Aerospace Engineering, University of Alabama in Huntsville, Huntsville, Alabama, USA.

UNDERGRADUATE STUDENT PROJECTS, UNIVERSITY OF ALABAMA IN HUNTSILLE.

1. Maria Brown, "Investigations of the Effects of Elastic Turbulence."
2. Daniel Copeland, "Development of a Plasma-Driven, Micro-Scale Thruster With Electrothermal Acceleration" and "Investigations of the Effects of Elastic Turbulence."
3. Masaaki Suzuki, "Development of a Plasma-Driven, Micro-Scale Thruster With Electrothermal Acceleration."
4. Chong Ren, "Investigations of the Effects of Elastic Turbulence" and "Development of a Plasma-Driven, Micro-Scale Thruster With Electrothermal Acceleration."
5. Carolyn Boos, "Development of the UAH Supersonic/Transonic Wind Tunnel Facility."
6. Patrick McInturff, "Development of the UAH Supersonic/Transonic Wind Tunnel Facility."
7. Daniel Corey, "Development of the UAH Supersonic/Transonic Wind Tunnel Facility."
8. Benjamin Shea, "Development of the UAH Supersonic/Transonic Wind Tunnel Facility."
9. Andrew Miller, "Development of the UAH Supersonic/Transonic Wind Tunnel Facility."
10. Matthew Lantigua, "Investigations of Impingement and Effusion Cooling, Including Double Wall Cooling Arrangements."
11. David Ritchie, "Investigations of Impingement and Effusion Cooling, Including Double Wall Cooling Arrangements."

HIGH SCHOOL STUDENT PROJECTS, UNIVERSITY OF ALABAMA IN HUNTSILLE.

1. Several students from Sparkman High School, under the supervision of Ms. Teresa Hodge, are participating in the National Science Foundation research project, "Collaborative Research: Thermal Transport in Elastic Turbulence."

COURSES TAUGHT, SAINT LOUIS UNIVERSITY.

Fall Semester 2010, MENG 501-01 Fluid Mechanics, 6 students.
Spring Semester 2011, MENG 235-01 Applied Thermodynamics, 47 students.
Fall Semester 2011, MENG 593-01 Advanced Convection Heat Transfer, 5 students.

Spring Semester 2012, MENG 235-01 Applied Thermodynamics, 30 students.
Fall Semester 2012, MENG 501-01 Fluid Mechanics, 9 students.
Spring Semester 2013, MENG 235-01 Applied Thermodynamics, 25 students.
Fall Semester 2013, MENG 593-01 Advanced Convection Heat Transfer, 6 students.
Fall Semester 2013, ESCI 322 Fluid Mechanics, 42 students.
Spring Semester 2014, MENG 235-01 Applied Thermodynamics, 23 students.
Spring Semester 2014, MENG 593-01 MENG 493-01 Thermal Systems Design, 14 students.

GRADUATE STUDENTS SUPERVISED, SAINT LOUIS UNIVERSITY (COMPLETED DEGREES).

1. Jacob Haegele, Master of Science – M.S., "Effects of Jet-Plate to Target Distance on Impingement Array Heat Transfer," May 2012.
2. Richard Steckel, Ph.D. – Doctor of Philosophy (Aviation Science), "Developing and Establishing the Validity and Reliability of the Perceptions Toward Aviation Safety Action Program (ASAP) and Line Operations Safety Audit (LOSA) Questionnaires," May 2014.
3. Junsik Lee, Ph.D. – Doctor of Philosophy, "Jet Array Impingement Heat Transfer: Effects of Jet-to-Target Plate Distance, Reynolds Number, Hole Spacing, and Surface Roughness," May 2014.
4. Geoffrey Potts, Master of Science – M.S., "Aerodynamic Loss Investigations of a Cambered Turbine Airfoil Cascade in Transonic Flow," May 2014.
5. Hui Jiang, Master of Science – M.S., "Development of Experimental Apparatus and Procedures For Investigation of Aerodynamics Losses Downstream of Cambered Turbine Vanes," August 2014.
6. Lyndel Carlson, Master of Science – M.S., "Boundary Layer and Inlet Flow Characterization," December 2014.

GRADUATE STUDENTS SUPERVISORY COMMITTEE PARTICIPATION, SAINT LOUIS UNIVERSITY (DEGREES IN PROGRESS, and COMPLETED DEGREES).

1. Carrie Pedone, Doctor of Philosophy – Ph.D. (Aviation Science), "Women Engineer Leadership Roles in the Aerospace and Aviation Sciences."
2. Nivedita Nivedita, Doctor of Philosophy – Ph.D. (University of Cincinnati), "Inertial Focusing in Microfluidic Spirals for Cell-Sorting."
3. Jian Zhou, Doctor of Philosophy – Ph.D. (University of Cincinnati), "Novel Approaches to Cell Isolation in Simple Inertial Microfluidic Devices."
4. Chen Yu, Doctor of Philosophy – Ph.D. (National University of Singapore), "Manipulation of Turbulent Flow For Drag Reduction and Enhanced Heat Transfer."
5. Richard Clabaugh, Master of Science – M.S. (Orthodontic Department, Saint Louis University), "Heat Generation and Heat Transfer During

Insertion of Orthodontic Mini-Screw Implants Into Synthetic and Real Bone."

6. Terry Kelly, Doctor of Philosophy – Ph.D. (Aviation Science), "Management Perceptions of Factors Underlying Organizational Safety Climate in an Aviation Organization."
7. Ashley Cox, Ph.D. – Doctor of Philosophy, "Shock Wave Boundary Layer Interactions (SWBLI) in Supersonic Ducts With Varying Cross-Section."
8. Miranda Turlin, Master of Science – M.S., "Shock Wave Boundary Layer Interactions (SWBLI) in Supersonic Ducts With Varying Cross-Section."
9. Miranda Turlin, Ph.D. – Doctor of Philosophy, "Shock Wave Boundary Layer Interactions (SWBLI) in Supersonic Ducts With Varying Cross-Section."
10. J. Nagesh Kumar, Doctor of Philosophy – Ph.D. (Anna University, Chennai, India), "Energy Efficient Approach to Inlet Air Cooling for Gas Turbines."

SURE (Summer Undergraduate Research Experience) STUDENT PROJECTS, SAINT LOUIS UNIVERSITY.

1. Geoffrey Potts, "Experimental Investigation of Impingement Cooling at High Mach Numbers for Gas Turbine Engine Application," Summer 2011.

UNDERGRADUATE STUDENT PROJECTS, SAINT LOUIS UNIVERSITY.

1. Benjamin Lund, "Development of a Micro-Scale Viscous Disk Pump for Investigation of Slip Phenomena," and "Airfoil Exit Mixing Loss Investigations."
2. Felix Tian, "Development of a Micro-Scale Pump for Investigation of Slip Phenomena."
3. Jacob Haegele, "Experimental Investigation of Impingement Cooling at High Mach Numbers for Gas Turbine Engine Application."
4. Geoffrey Potts, "Experimental Investigation of Impingement Cooling at High Mach Numbers for Gas Turbine Engine Application."
5. Hui Jiang, "Development of a Micro-Scale Viscous Disk Pump for Investigation of Slip Phenomena."
6. Craig Doerfler, "Development and Testing of a Spiral Inertial Fractionation System."
7. Josh Mandernach, "Development and Testing of a Spiral Inertial Fractionation System."
8. Thomas Moline, "Development and Testing of a Buoyancy Driven Continuous SPLITT Fractionation System."
9. Zhong Ren, "Effects of Jet-Plate to Target Distance, Hole Spacing, Reynolds Number, and Mach Number on Jet Array Impingement Heat Transfer."
10. Michael Weiler, "Development and Testing of a Buoyancy Driven Continuous SPLITT Fractionation System."

11. Mary Jennerjohn, "Development and Testing of a Buoyancy Driven Continuous SPLITT Fractionation System."
12. Lyndel Carlson, "Shock Wave Boundary Layer Interactions (SWBLI) in Supersonic Ducts With Varying Cross-Section."
13. Mary Jennerjohn, "Impingement Array Test Plate Conduction Analysis."
14. Lyndel Carlson, "Surface Roughness Analyses for Turbomachinery Applications."
15. Lyn Ratliff, "Surface Roughness Analyses for Turbomachinery Applications."
16. Benjamin Lund, "Airfoil Exit Mixing Loss Investigations."
17. John Lauber, "Impingement Cooling Heat Transfer Investigations."
18. Chi Doshi, "Airfoil Exit Mixing Loss Investigations."
19. Tony Bilbrey, "Shock Wave Boundary Layer Interactions (SWBLI) in Supersonic Ducts."
20. Graham Tait, "Shock Wave Boundary Layer Interactions (SWBLI) in Supersonic Ducts."

COURSES TAUGHT, UNIVERSITY OF UTAH.

Winter Quarter, 1993, ME562, Thermal Systems Design, 29 students.
Spring Quarter, 1993, ME665, Advanced Heat Transfer II, 11 students.
Fall Quarter, 1993, ME360, Engineering Thermodynamics, 34 students.
Winter Quarter, 1994, ME562, Thermal Systems Design, 17 students.
Winter Quarter, 1994, ME665, Advanced Heat Transfer II, 17 students.
Spring Quarter, 1994, ME362, Power Thermodynamics, 31 students.
Fall Quarter, 1994, ME360, Engineering Thermodynamics, 69 students.
Winter Quarter, 1995, ME362, Power Thermodynamics, 48 students.
Winter Quarter, 1995, ME665, Advanced Heat Transfer II, 18 students.
Spring Quarter, 1995, ME562, Thermal Systems Design, 8 students.
Fall Quarter, 1995, ME360, Engineering Thermodynamics, 46 students.
Winter Quarter, 1996, ME362, Power Thermodynamics, 26 students.
Winter Quarter, 1996, ME665, Advanced Heat Transfer II, 9 students.
Spring Quarter, 1996, ME562, Thermal Systems Design, 12 students.
Fall Quarter, 1996, ME360, Engineering Thermodynamics, 59 students.
Winter Quarter, 1997, ME362, Power Thermodynamics, 51 students.
Winter Quarter, 1997, ME665, Advanced Heat Transfer II, 12 students.
Spring Quarter, 1997, ME562, Thermal Systems Design, 13 students.
Fall Quarter, 1997, ME364, Heat Transfer, 47 students.
Winter Quarter, 1998, ME362, Power Thermodynamics, 40 students.
Winter Quarter, 1998, ME665, Advanced Convective Heat Transfer, 13 students.
Spring Quarter, 1998, ME562, Thermal Systems Design, 11 students.
Spring Quarter, 1998, ME652, Gas Dynamics, 9 students.
Autumn Semester, 1998, ME3600, Thermodynamics II, 23 students.
Spring Semester, 1999, ME7660, Advanced Convection Heat Transfer, 10 students.
Spring Semester, 1999, ME3600, Thermodynamics II, 40 students.
Autumn Semester, 1999, ME5810 / 6810, Thermal Systems Design, 9 students.

Autumn Semester, 1999, ME3600, Thermodynamics II, 39 students.
Autumn Semester, 2000, ME3600, Thermodynamics II, 41 students.
Spring Semester, 2001, ME7660, Advanced Convection Heat Transfer, 16 students.
Spring Semester, 2001, ME3600, Thermodynamics II, 24 students.
Autumn Semester, 2001, ME3600, Thermodynamics II, 35 students.
Autumn Semester, 2001, ME5810 / 6810, Thermal Systems Design, 6 students.
Spring Semester, 2002, ME7660, Advanced Convection Heat Transfer, 10 students.
Autumn Semester, 2002, ME3600, Thermodynamics II, 86 students.
Spring Semester, 2003, ME7660, Advanced Convection Heat Transfer, 10 students.
Spring Semester, 2003, ME2600, Thermodynamics I, 71 students.
Spring Semester, 2003, ME6950, Independent Study Class, Numerical Predictions of Complex, Unsteady Three-Dimensional Flows, 5 students.
Autumn Semester, 2003, ME5810 / 6810, Thermal Systems Design, 19 students.
Spring Semester, 2004, ME7660, Advanced Convection Heat Transfer, 17 students.
Spring Semester, 2004, ME5960 / 6960, Special Topics Class, Advanced Aerothermal Technologies in Engineering For Aerospace, Heat Transfer, and Combustion Applications, 10 students.
Autumn Semester, 2004, ME3600, Thermodynamics II, 108 students.
Spring Semester, 2005, ME 5830 / 6830, Aero-Propulsion, 34 students.
Spring Semester, 2005, ME7660, Advanced Convection Heat Transfer, 13 students.
Autumn Semester, 2005, ME5810 / 6810, Thermal Systems Design, 11 students.
Spring Semester, 2006, ME7660, Advanced Convection Heat Transfer, 10 students.
Spring Semester, 2006, ME2300, Thermodynamics I, 95 students.

UNDERGRADUATE HONORS THESES SUPERVISED, UNIVERSITY OF UTAH (COMPLETED DEGREES).

1. Craig M. Norton, Bachelor of Science (Honors Baccalaureate Degree), "Investigation of Heat Transfer and Film Effectiveness Beneath Film Cooled Boundary Layers," May 1996.
2. Wade A. Hull, Bachelor of Science (Honors Baccalaureate Degree), "Film Effectiveness and Heat Transfer Beneath Film Cooled Boundary Layers Subject to Bulk Flow Pulsations," April 1997.

GRADUATE STUDENTS SUPERVISED, UNIVERSITY OF UTAH (COMPLETED DEGREES).

1. Seunghyun Choi, Master of Science, "A Study of Surface Heat Transfer in a Curved Channel at Low Dean Numbers." March 1995.

2. John Michael Cuthrell, Master of Science, "A Study of the Effects of Bulk Flow Pulsations on Film Cooling." September 1995.
3. Ruoming Gong, Doctor of Philosophy, "Structure of Film Cooled Turbulent Boundary Layers Subject to Bulk Flow Pulsations." July 1996.
4. Carl Ragnar Hedlund, Master of Science, "Effects of Transition to Turbulence and Dean Vortex Pairs on Surface Heat Transfer at Moderate and High Dean Numbers." December 1996.
5. Troy Babinchak, Master of Science, "Flow Behavior, Including Development and Structure of Gortler Vortices, in a Simple Swirl Chamber." March 1997.
6. Rajan Thambu, Master of Science, "Flow Phenomena, Including Gortler Vortices, in a Simple Swirl Chamber With Controlled Inlet Forcing." June 1997.
7. Supriya Gupta, Doctor of Philosophy, "Investigation of Resolution Deteriorating Factors and New Applications in Continuous SPLITT Fractionation." Degree through Department of Chemical and Fuels Engineering. August 1997.
8. Donald Owen Brock, Master of Science, "Spatial Development of Splitting, Merging, and Spanwise Wave Number Selection of Dean Vortex Pairs." June 1998.
9. Scott Robert Sargent, Master of Science, "Investigations of Transonic Film Cooling With Shaped and Round Holes." July 1998.
10. Kyle Leon Lee, Master of Science, "Aerodynamic Losses and Discharge Coefficients for a Transonic Turbine Blade With Film Cooling." July 1998.
11. Dale Jay Jackson, Master of Science, "Aerodynamic Mixing Losses and Discharge Coefficients Due to Film Cooling From a Symmetric Turbine Airfoil in Transonic Flow." August 1998.
12. Carl Ragnar Hedlund, Doctor of Philosophy, "Heat Transfer and Flow Behavior in a Swirl Chamber With Helical Flow." September 1998.
13. Clint Bell, Master of Science, "Effects of Bulk Flow Pulsations on Film Cooling with Different Density Ratios." October 1998.
14. Dustin Birch, Master of Science, "Adiabatic Effectiveness and Shock Wave Effects for Conical Diffused Film Cooling Holes." January 2000.
15. Michael L. Hill, Master of Science, "The Effect of Spherically Shaped Surface Cavities on Internal Cooling of Gas Turbine Blades." October 2000.
16. Mounir Zaki Sabbagh, Master of Science, "The Effect of Dimple Surface Cavities on Heat Transfer Augmentation for the Internal Cooling of Gas Turbine Blades." June 2000.
17. Tetsuji Furukawa, Master of Science, "Transonic Film Cooling From Shaped Holes on the Suction Surface of a Turbine Blade." March 2001.
18. Gazi I. Mahmood, Doctor of Philosophy, "Heat Transfer and Flow Structure From Dimples in an Internal Cooling Passage." April 2001.
19. Jennifer Ann van Rij, Master of Science, "Analysis and Experiments on Three-Dimensional Irregular Surface Roughness," August 2001.

20. Brandon Belnap, Master of Science, "Experiments and Analysis on Three-Dimensional Irregular Surface Roughness," June 2001.
21. Donna Nelson, Master of Science, "Internal Cooling of Gas Turbine Engine Blades: Investigation of Flow Structure Through a Channel With Surface Concavities," June 2002.
22. Venkatta Krishnan, Master of Science, "Effects of Bulk Flow Pulsations on the Performance of Compound Angle, Shaped Film Cooling Holes," August 2002.
23. Mauro Oliveira, Master of Science, "Investigations of Dimples as Applied to Heat Transfer in an Internal Passage," September 2002.
24. Lester Sherrow, Master of Science, "Experimental Investigation of Exterior Surface Dimples Installed on Tubes of a Cross Flow Heat Exchanger," April 2003.
25. Brett Wagstaff, Master of Science, "Effects of Bulk Flow Pulsations on the Vortex Structures Produced by Shaped Film Cooling Holes," August 2003.
26. Nathan Burgess, Master of Science, "Investigations of Surface Heat Transfer Augmentations and Friction Factors in Channels With Rib Turbulators, Shallow Dimples, and Deep Dimples," April 2004.
27. Se Youl Won, Doctor of Philosophy, "Study of Flow Transport Mechanisms In Rectangular Channels With Different Heat Transfer Augmentation Devices," May 2004.
28. Qiang Zhang, Doctor of Philosophy, "Aerodynamic Performance of Transonic and Subsonic Airfoils: Effects of Surface Roughness, Turbulence Intensity, Mach Number, and Streamwise Curvature – Airfoil Shape," July 2005.
29. Danny Blanchard, Doctor of Philosophy, "Macroscale and Microscale Fluid Mechanics in Rotary Pumps," May 2006.
30. Donald Sandberg, Master of Science, "Influence of Mach Number and Freestream Turbulence on the Aerodynamic Losses of a Turbine Vane," August 2005.
31. Trebor Bowers, Master of Science, "Momentum and Heat Transfer of Surfaces With Three-Dimensional, Irregular Roughness at Low Roughness Reynolds Numbers," November 2005.
32. Trent Deem, Master of Science, "Osmotic Dispense Pump For High Temperature and High Pressure Applications," June 2006.
33. Hwabok Wee, Master of Engineering, "Use of Dimpled Surfaces and Rib Turbulators to Augment Cooling of Heat Sinks in Laminar Flow," May 2006.
34. Vijay Krishnan, Master of Engineering, "Design of Airfoils with Gill Slot and Pressure Side Film Cooling Hole Configurations," April 2006.
35. Matt Goodro, Master of Science, "Independent Effects of Mach Number and Reynolds Number on Impingement Heat Transfer," May 2006.
36. Mathew Clyde Williams, Master of Science, "Effects of Back Pressure on an Osmotic Dispense Pump," August 2006.
37. Jake Allen, Master of Science, "Optimization of a Rotary Shaft Pump," June 2006.

38. Jongmyung Park, Doctor of Philosophy, “Jet Array Impingement Heat Transfer: Separate Effects of Mach Number, Reynolds Number, Temperature Ratio, and Hole Spacings,” January 2007.
39. Justin Chappell, Master of Science, “Suction Side Gill Region Film Cooling-Effects of Hole Orientation,” September 2007.
40. Jonathan Hilton, Master of Science, “Development of a Viscous Disk Air Flow Displacement Device,” September 2009.

UNDERGRADUATE STUDENT PROJECTS, UNIVERSITY OF UTAH.

The undergraduate student projects are supported by funding from: (i) the U. of U. Undergraduate Research Opportunities Program (UROP), (ii) the National Science Foundation through the Coalition to Increase Minority Degrees (CIMD) Program administered through Arizona State University, and (iii) International Gas Turbine Institute (IGTI) Scholarships.

1. Johann Adam, "Development of a Heat Transfer Test Surface for Convective Heat Transfer Studies Applied to Gas Turbine Engines."
2. Hector Lora, "Continued Development of an Experimental Facility for Convective Heat Transfer Studies Applied to Gas Turbine Engines."
3. Johann Adam, "Documentation and Study of Imposed Flow Pulsations as Applied to Gas Turbine Engines."
4. Carl Hedlund, "Heat Transfer In a Curved Channel With Transitional and Turbulent Flows."
5. Chris Brown, "Investigation of Bulk Flow Pulsations and Film Cooling as Applied to Gas Turbine Engines."
6. Carl Hedlund, "Continued Study Of Heat Transfer In a Curved Channel With Transitional and Turbulent Flows."
7. Chris Brown, "Continued Investigation of Bulk Flow Pulsations and Film Cooling as Applied to Gas Turbine Engines."
8. Don Brock, "Local Heat Transfer and Flow Visualization in a Curved Channel With Dean Vortex Pairs."
9. Hector Lora, "Curved Channel Studies."
10. Don Brock, "Continued Study of Local Heat Transfer and Flow Visualization in a Curved Channel With Dean Vortex Pairs."
11. Axel Eduardo Soto, "Flow Studies in a Curved Channel."
12. Craig Kilbane, "Design and Development of a Device to Produce Large Amplitude Bulk Flow Pulsations in a Wind Tunnel."
13. Wade Hull, "Design, Construction, Instrumentation, and Qualification of a Test Surface to Measure Heat Transfer Coefficients and Local Magnitudes of Film Cooling Effectiveness."
14. Kameron Leang, "Design, Construction, Instrumentation, and Qualification of a Test Surface to Measure Heat Transfer Coefficients and Local Magnitudes of Film Cooling Effectiveness."
15. Anne Tracy, "Design, Construction, Instrumentation, and Qualification of a Test Surface to Measure Heat Transfer Coefficients and Local Magnitudes of Film Cooling Effectiveness."
16. Craig Norton, "Investigation of the Effects of Bulk Flow Pulsations on Heat Transfer and Film Cooling Effectiveness in a Film Cooled Boundary Layer."

17. Don Brock, "Continued Flow Visualization Investigations in a Curved Channel With Dean Vortex Pairs."
18. Axel Eduardo Soto, "Continued Curved Channel Studies."
19. Corona Ngatuvai, "Study of Surface Heat Transfer Produced by Vortex Pairs Using Liquid Crystal Thermography."
20. Wade Hull, "Continued Investigation of Bulk Flow Pulsations and Film Cooling as Applied to Gas Turbine Engines."
21. Paul McMullin, "Transonic Film Cooling Mixing Loss Investigations as Applied to Gas Turbine Engines."
22. Lance Richman, "Transonic Film Cooling Mixing Loss Investigations as Applied to Gas Turbine Engines."
23. Glen West, "20 Ton Preconditioned Air Unit Design."
24. Mauro Oliveira, "Development of an Experimental Facility to Measure Heat Transfer in a Swirl Chamber."
25. Corey Pascal, "Development of an Experimental Facility to Measure Heat Transfer in a Swirl Chamber."
26. Mike Hill, "Heat Transfer Augmentation On A Flat Surface With Dimples."
27. Scott Snider, "Development of Experimental Facilities and Data Acquisition Systems for Investigation of a Unique Internal Cooling Scheme for a Gas Turbine Blade."
28. Mounir Sabbagh, "Surface Adiabatic Film Effectiveness Measurements on a Film Cooled Turbine Blade in Transonic Flow."
29. Donna Nelson, "Investigation of Flow Structure Above a Flat Surface With Dimples."
30. Dale Clark, "Transonic Film Cooling Investigations."
31. Dustin Breuning, "Transonic Film Cooling Investigations."
32. Gary Kessler, "Effects of Pulsations on Film Cooling as Applied to Gas Turbine Engines."
33. Bill Trappett, "Effects of Pulsations and Shock Waves on Film Cooling as Applied to Gas Turbine Engines."
34. Dale Clarke, "Investigation of Film Cooling Effectiveness in Transonic Flow."
35. Ron Simonsen, "Investigation of Aerodynamic Losses Due to Turbine Airfoil, Film Cooling in Transonic Flow."
36. Jamie McCullough, "Investigation of Aerodynamic Losses Due to Turbine Airfoil, Film Cooling in Transonic Flow."
37. Blaine Hanson, "Adiabatic Film Cooling Effectiveness Investigations on Transonic Turbine Airfoils With Augmented Turbulence Intensity."
38. Curtis Cottrell, "Adiabatic Film Cooling Effectiveness Investigations on Transonic Turbine Airfoils With Augmented Turbulence Intensity."
39. Zed Kato, "Effects of Bulk Flow Pulsations on Vortex Structures Produced by Film Cooling."
40. Chris Clayton, "Investigations of Film Cooling on a Transonic Turbine Airfoil."
41. Erica Graves, "Analyses and Processing of Experimental Data From Film Cooling Investigations."

42. Ariel Fershtut, "Investigations of Film Cooling on a Transonic Turbine Airfoil."
43. Jacob Kingston, "Investigations of Internal Cooling Techniques for Turbine Airfoils."
44. Cordell Post, "Flow Visualization of Film Cooling Flows From Shaped Holes Subject to Bulk Flow Pulsations."
45. Bill Trappett, "Investigations of Internal Cooling Techniques for Turbine Airfoils."
46. Jeff Harrison, "Measurement of Flow Characteristics with a Miniature Five-Hole Pressure Probe."
47. Jeff Harrison, "Investigations of Cooling Schemes For Turbine Airfoils as Applied to Gas Turbine Engines."
48. Andrew L. Rosenberg, "Investigations of Internal Cooling Schemes for Turbine Airfoils in Gas Turbine Engines."
49. Chris Clayton, "Investigations of Cooling Schemes For Turbine Airfoils as Applied to Gas Turbine Engines."
50. Lester Sherrow, "Investigations of the Effects of Dimples on External Surfaces of Tube Bundles Used in Heat Exchangers."
51. Eli Comeau, "Investigations of Friction Coefficients and Pressure Drops in Passages Used for Internal Cooling of Turbine Airfoils in Gas Turbine Engines."
52. Arthur Fox, "Investigations of Flow Structure in Boundary Layers Film Cooled With Shaped Holes, and Subject to the Effects of Bulk Flow Pulsations."
53. Jim Hanson, "Investigations of Roughness on a Transonic Turbine Airfoil."
54. Arthur Fox, "Investigations of Flow Structure Associated With Internal Cooling Schemes for Turbine Airfoils As Applied to Gas Turbine Engines."
55. Michael Winter, "Investigations of Roughness and Aerodynamic Losses On a Transonic Turbine Airfoil."
56. Jim Hanson, "Investigations of the Effects of Dimples on External Surfaces of Tube Bundles Used in Heat Exchangers."
57. Nathan Burgess, "Investigations of the Effects of Dimples on External Surfaces of Tube Bundles Used in Heat Exchangers."
58. Nathan Burgess, "Investigations of Internal Cooling Schemes For Turbine Airfoils as Applied to Gas Turbine Engines."
59. Jim Hanson, "Performance Analyses, and Component Development of a Micro-Scale Pump."
60. Sarah Peddicord, "Use of ANSYS Code to Correct Experimental Data for Surface Conduction."
61. David Kenney, "Use of ANSYS Code to Correct Experimental Data for Surface Conduction."
62. Scot Waye, "Turbine Cascade – Shaped Hole Film Cooling Investigations."
63. Matt Goodro, "Turbine Cascade – Shaped Hole Film Cooling Investigations."

64. Matt Howe, “Turbine Cascade – Shaped Hole Film Cooling Investigations.”
65. Jon Angle, “Performance Analyses, and Component Development of a Micro-Scale Pump.”
66. Jennifer Gill, “Development of a Flow Regulating Device for Micro-Scale Passages Containing Peptides and Proteins.”
67. Matt Goodro, “Impingement Cooling of Internal Components of Turbine Airfoils Used in Gas Turbine Engines.”
68. Jon Angle, “Improved Cooling Methods for Heat Sinks Employed for Electronics Cooling.”
69. Jennifer Gill, “Development of an Osmotic Pumping Device for Biomedical Application.”
70. Trent Deem, “Development of an Osmotic Pumping Device for Biomedical Application.”
71. Jason Williams, “Effects of Surface Roughness and Turbulence Intensity on Turbine Airfoil Aerodynamic Losses.”
72. Jared Wood, "Investigations of Film Cooling, Internal Cooling, and Aerodynamic Losses for the Trailing Edge of a Turbine Vane Employed in Industrial Gas Turbine Engines."
73. Matt Lively, "Investigations of Film Cooling, Internal Cooling, and Aerodynamic Losses for the Trailing Edge of a Turbine Vane Employed in Industrial Gas Turbine Engines."
74. Brad Hansen, “Development of Osmotic Pumping Devices for Biomedical Applications.”
75. Ryan Dark, “Laminar Heat Transfer Augmentation Experments.”
76. Amit Amritkar, “Numerical Predictions of Laminar Heat Transfer Augmentation Results,”

GRADUATE STUDENTS SUPERVISED, U. S. NAVAL POSTGRADUATE SCHOOL.

All graduate degrees from the U. S. Naval Postgraduate School are ABET accredited from an ABET accredited graduate program in Mechanical Engineering.

1. A. Ramsey, Master of Science, "A Study of Film Cooling Downstream of One and Two Rows of Holes Oriented in Spanwise/Normal Planes," September 1992.
2. A. R. Schallert, Master of Science, "A Study of Nusselt Number Distributions In a Curved Channel," June 1992.
3. S. M. Jackson, Master of Science, "Heat Transfer, Adiabatic Effectiveness and Injectant Distributions Downstream of Single Rows and Two Staggered Rows of Film-Cooling Holes With Simple and Compound Angles," December 1991.
4. J. M. Wigle, Master of Science, "Heat Transfer, Adiabatic Effectiveness and Injectant Distributions Downstream of Single and Double Rows of Film-Cooling Holes With Compound Angles," December 1991.
5. B. W. Payne, Master of Science, "A Study of Spatially-Averaged Nusselt Number Distributions in a Curved Channel with 40 to 1 Aspect Ratio for Dean Numbers from 175 to 375," September 1991.

6. S. J. Fuqua, Master of Science, "Study of the Transition to Turbulence Within a Curved Rectangular Channel with 40 to 1 Aspect Ratio," September 1991.
7. M. R. Kendall, Mechanical Engineer, "Effects of Centrifugal Instabilities on Laminar/Turbulent Transition in Curved Channels With 40 to 1 Aspect Ratios," June 1991.
8. S. Ciriello, Master of Science, "Heat Transfer, Adiabatic Effectiveness and Injectant Distributions Downstream of Single and Double Rows of Film Cooling Holes With Simple and Compound Angles," March 1991.
9. B. J. Smith, Master of Science, "Study of Transition Phenomena in a Straight Channel With 40 to 1 Aspect Ratio With and Without Imposed Pulsations, Part Two: Reynolds Number Surveys," March 1991.
10. D. S. Morrow, Master of Science, "Transition Phenomena in a Straight Channel With a 40 to 1 Aspect Ratio With and Without Imposed Pulsations, Part One: Near-Wall and Central Region Profiles," March 1991.
11. W. A. Fields, Mechanical Engineer, "Study of the Effects of Centrifugal Instabilities on Flow in a 40 to 1 Aspect Ratio Rectangular Curved Channel for Dean Numbers from 35 to Fully Turbulent Conditions," December 1990.
12. D. T. Bishop, Master of Science, "Heat Transfer, Adiabatic Effectiveness and Injectant Distributions Downstream of Single and Double Rows of Film-Cooling Holes with Compound Angles," September 1990.
13. S. W. Mitchell, Master of Science, "The Effects of Embedded Vortices on Heat Transfer in a Turbulent Boundary Layer with Film Cooling from Holes with Compound Angles," September 1990.
14. H. E. Koth, Master of Science, "Effects of Imposed Bulk Flow Oscillations at 1, 2, 3 and 4 Hz on Transition in a Straight Channel with 40 to 1 Aspect Ratio," June 1990.
15. P. E. Skogerboe, Master of Science, "Local and Spatially Averaged Heat Transfer Distributions in a Curved Channel with 40 to 1 Aspect Ratio for Dean Numbers from 50 to 200," March 1990.
16. W. D. Doner, Master of Science, "Further Studies of Turbulence Structure Resulting from Interactions Between Embedded Vortices and Wall Jets at High Blowing Ratios," December 1989.
17. T. M. Coumes, Master of Science, "Effects of 1 Hz Imposed Bulk Flow Unsteadiness on Laminar/Turbulent Transition in a Straight Channel," December 1989.
18. F. J. Greco, Master of Science, "Effects of 2 Hz Imposed Bulk Flow Unsteadiness on Laminar/Turbulent Transition in a Straight Channel," December 1989.
19. P. Kaisuwan, Master of Science, "Effects of Vortex Circulation on Injectant from a Single Film-Cooling Hole and a Row of Film-Cooling Holes in a Turbulent Boundary Layer, Part 2: Injection Beneath the Vortex Upwash," December 1989.
20. R. E. Hughes, Master of Science, "Development, Qualification and Measurements in Two Curved Channels with 40 to 1 Aspect Ratio," September 1989.

21. M. F. Tuzzolo, Mechanical Engineer, "Study of Vortex Arrays Induced Artificially and from Centrifugal Instabilities," June 1989.
22. J. M. Longest, Master of Science, "Flow Visualization Studies in (1) a Curved Rectangular Channel with 40 to 1 Aspect ratio and (2) a Straight Channel with Bulk Flow Unsteadiness," June 1989.
23. J. G. Green, Master of Science, "Turbulence Structure Resulting from Interactions Between an Embedded Vortex and Wall Jet," June 1989.
24. D. W. Craig, Master of Science, "Effects of Vortex Circulation on Injectant from a Single Film-Cooling Hole and a Row of Film-Cooling Holes in a Turbulent Boundary Layer, Part 1: Injection Beneath the Vortex Downwash," June 1989.
25. D. W. Bella, Master of Science, "Flow Visualization of Time-Varying Structural Characteristics of Dean Vortices in a Curved Channel," December 1988.
26. G. E. Schwartz, Master of Science, "Control of Embedded Vortices Using Wall Jets," September 1988.
27. L. R. Baun, Mechanical Engineer, "Development and Structural Characteristics of Dean Vortices in a Curved Rectangular Channel with 40 to 1 Aspect Ratio," September 1988.
28. W. W. Williams, Master of Science, "Effects of an Embedded Vortex on a Single Film-Cooling Jet in a Turbulent Boundary Layer," June 1988.
29. A. Ortiz, Mechanical Engineer, "The Thermal Behavior of Film-Cooled Turbulent Boundary Layers as Affected by Longitudinal Vortices," September 1987.
30. R. D. Niver, Master of Science, "Structural Characteristics of Dean Vortices in a Curved Channel," June 1987.
31. D. L. Evans, Master of Science, "Study of Vortices Embedded in Boundary Layers with Film Cooling," March 1987.
32. M. A. Siedband, Master of Science, "A Flow Visualization Study of Laminar/Turbulent Transition in a Curved Channel," March 1987.
33. S. L. Joseph, Mechanical Engineer, "Effects of Embedded Vortices on Heat Transfer in Film-Cooled Turbulent Boundary Layers," December 1986.
34. A. F. Walz Jr., Master of Science, "Effects of Variable Properties in Film Cooled Turbulent Boundary Layers," March 1986.

GRADUATE STUDENTS SUPERVISED, VON KARMAN INSTITUTE FOR FLUID DYNAMICS.

1. M. Pezzani, Von Karman Institute Diploma, "Investigation of Heat Transfer Rates on a Film Cooled Flat Plate with One and Two Rows of Injection Holes," von Karman Institute Project No. 1982-24, June 1982.
2. J. Poco, Von Karman Institute Diploma, "Laser Doppler Velocity Measurements in the Radial Vaneless Diffuser of a Centrifugal Water Pump," von Karman Institute Project No. 1981-23, June 1981.
3. M. Lotzerich, Von Karman Institute Diploma, "Heat Transfer Measurements on a Gas Turbine Blade at Low Incidence Angles," von Karman Institute Project No. 1981-27, June 1981.

4. A. Ongoren, Von Karman Institute Diploma, "Heat Transfer on the Endwall of a Turbine Cascade with Film Cooling," von Karman Institute Project No. 1981-19, June 1981.
5. C. Camci, Von Karman Institute Diploma, "Investigation of Heat Transfer Rates on a Film Cooled Flat-Plate With and Without a Pressure Gradient," von Karman Institute Project No. 1980-12, June 1980.

University and Professional Service

INTERNATIONAL SCIENTIFIC COMMITTEE MEMBERSHIPS.

March 2014. Member of the Scientific Committee, ICHHFF5, Fifth International Conference "Heat and Mass Transfer and Hydrodynamics in Swirled Flows," National Committee of the Russian Academy of Sciences, Kazan Russia, October 19-21, 2015.

February 2014 - February 2017. Vice-Chairman and Member, Academic Committee, Institute of Gas Turbines, Beijing Tsinghua University, Beijing, P. R. China.

January 2014 – Present. ICHMT, Scientific Council Member, International Center for Heat and Mass Transfer. Nominated for membership by Professor Richard Goldstein of the University of Minnesota.

International Scientific Committee, International Symposium on "Heat Transfer in Gas Turbine Systems," Antalya, Turkey, August 9-14, 2009.

International Conference on Mechanical Engineering-Algeria, Ministere de l'Enseignement Superieur et de la Recherche Scientifique, Oran, Algeria, April 28-29, 2002.

U.S. NATIONAL SERVICE.

Panel Member, Thermal Transport Processes (Unsolicited) Panel, Thermal Transport Processes Program, Chemical, Bioengineering, Environmental and Transport Systems (CBET) Division, National Science Foundation, Arlington, Virginia, USA, 2016.

Sponsored Representative, CVD – Congressional Visits Day, U. S. Senate and House of Representatives, Washington, D. C. Sponsored by Greater Huntsville Section of the AIAA – American Institute of Aeronautics and Astronautics, March 4, 2015.

Panel Member, Convection (Unsolicited) Panel, Thermal Transport Processes Program, Chemical, Bioengineering, Environmental and Transport Systems (CBET) Division, National Science Foundation, Arlington, Virginia, USA, 2014.

Participation as Panelist, "Educating Today's and Tomorrow's Propulsion Engineers" Panel, "Continuing Education and Professional Development" Program of the AIAA Science and Technology Forum and Exposition - SCITECH 2014, Washington, D.C., January, 13-17, 2014.

Participant, Second Graduate Deans Workshop on Institutionalizing Interdisciplinary Graduate Education, Virginia Tech, Virginia Polytechnic Institute and State University, and National Science Foundation, Arlington, Virginia, USA, November 1-2, 2012.

Participant, Graduate Deans Workshop on Institutionalizing Interdisciplinary Graduate Education, Virginia Tech, Virginia Polytechnic Institute and State University, and National Science Foundation, Arlington, Virginia, USA, April 2-3, 2012.

Panel Member, Convection (Unsolicited) Panel, Thermal Transport Processes Program, Chemical, Bioengineering, Environmental and

Transport Systems (CBET) Division, National Science Foundation, Arlington, Virginia, USA, 2011.

Panel Member, Thermal Transport Processes Program (Unsolicited) Panel, Thermal Transport Processes Program, Chemical, Bioengineering, Environmental and Transport Systems (CBET) Division, National Science Foundation, Arlington, Virginia, USA, 2010.

Panel Member, Thermal Transport and Therma Processing (TTTP) Program, Chemical and Transport Systems (CTS) Division, National Science Foundation, Arlington, Virginia, USA, 2005.

Session Chair, External Turbine Cooling, Aero-Heat Transfer Workshop, SCIES-South Carolina Institute for Energy Studies, Baton Rouge, Louisiana, USA, November 11-13, 2002.

Prepreposal Panel Member, Science and Technology Centers (STC) Program, National Science Foundation, Arlington, Virginia, USA, November 16-17, 2000.

Career Panel Member, National Science Foundation, Division of Chemical & Thermal Systems, Dallas, Texas, USA, 1997.

COLLEGE AND UNIVERSITY COMMITTEES AND SERVICE ACTIVITIES – UNIVERSITY OF ALABAMA IN HUNTSVILLE.

COE (College of Engineering) Representative and Member, UAH Graduate Council, University of Alabama in Huntsville, August 2015 - Present.

Member, MAE Graduate Programs Committee, Department of Mechanical and Aerospace Engineering, College of Engineering, University of Alabama in Huntsville, August 2015 – Present.

Member, Task Force on Discussion of Immigration Matters Related to Hiring of Foreign Faculty, University of Alabama in Huntsville, July 2015 - Present.

Member, MAE PTAC, Mechanical and Aerospace Engineering Department - Promotion and Tenure Advisory Committee, Department of Mechanical and Aerospace Engineering, College of Engineering, University of Alabama in Huntsville, August 2014 – Present.

Representative Member and Alternate, CoE PTAC, College of Engineering - Promotion and Tenure Advisory Committee, College of Engineering, University of Alabama in Huntsville, September 2014 – August 2016.

Member, Search Committee, Eminent Scholar in Systems Engineering, College of Engineering, University of Alabama in Huntsville, September 2014 – May 2015.

Member and Chairman, Committee to consider Dr. Michael Anderson – Promotion to the Rank of Full Professor, College of Engineering, University of Alabama in Huntsville, November 2014 – January 2015.

COLLEGE AND UNIVERSITY - OTHER SERVICE ACTIVITIES – UNIVERSITY OF ALABAMA IN HUNTSVILLE.

Arranged Visit. Professor and Department Head, Karen A. Thole, Mechanical and Nuclear Engineering Department, Steady Thermal Aero Research Turbine (START) Laboratory, Pennsylvania State University, State College, Pennsylvania, USA. Department of Mechanical and

Aerospace Engineering, College of Engineering, University of Alabama in Huntsville. February 18-20, 2016.

Arranged Visit. Engineer, Fred X. Liberatore, Solar Turbines Inc., San Diego, California, USA. Department of Mechanical and Aerospace Engineering, College of Engineering, University of Alabama in Huntsville. October 26, 2015.

Arranged Visit. Commonwealth Professor and Associate Vice President for Research, Srinath Ekkad, Virginia Polytechnical and State University, Blacksburg, Virginia, USA. Department of Mechanical and Aerospace Engineering, College of Engineering, University of Alabama in Huntsville. October 1-2, 2015.

Organized Symposium. "Gas Turbine Technology and Research." College of Engineering, University of Alabama in Huntsville. May 11, 2015.

Arranged Visit. Academic Committee (Professor Hongde Jiang, Professor Jing Ren, Professor Ningsheng Cai, Profesor Wei Pan, Professor Peter R. N. Childs), Institute of Gas Turbines, Beijing Tsinghua University, Beijing, P. R. China. College of Engineering, University of Alabama in Huntsville. May 10-14, 2015.

Arranged Visit. Professor Peter R. N. Childs, Head of School, Dyson School of Design Engineering, Imperial College London, South Kensington, London, United Kingdom. College of Engineering, University of Alabama in Huntsville. May 10-12, 2015.

Arranged Visit. The Boeing Company (Dr. Mori Mani [Senior Tech Fellow], Dr. Richard K. Scharnhorst [Associate Tech Fellow], Dr. Luther Woodall [Lead Engineer], Dr. Darby Cooper [Senior Manager], Dr. Winston Wang [Lead Engineer], Dr. Bob Tramel [Subcontractor], Dr. Steven Snell [Senior Manager], Dr. William Seidler [Senior Research Scientist, UAH]). Propulsion Research Center, College of Engineering, University of Alabama in Huntsville. April 21, 2015.

Arranged Visit. Professor Jae-Sup Pak, Dean of International Affairs, Inje University, Gimhae, South Korea. Mechanical and Aerospace Engineering Department, Propulsion Research Center, College of Engineering, University of Alabama in Huntsville. October 23-28, 2014.

PARKS COLLEGE COMMITTEES AND SERVICE ACTIVITIES – SAINT LOUIS UNIVERSITY.

Director, Graduate Programs Committee, Parks College of Engineering, Aviation, and Technology, Saint Louis University, July 2010-July 2013.

Member, College Dean Search Committee, Parks College of Engineering, Aviation, and Technology, Saint Louis University, October 2010-April 2011.

Member, College Dean Search Committee, Parks College of Engineering, Aviation, and Technology, Saint Louis University, July 2011-November 2011.

Member, Parks College Scholarship Awards Committee, Parks College of Engineering, Aviation, and Technology, Saint Louis University, March 2012-August 2014.

Member, Parks College Graduate Research and Affairs Committee (GRAC) Committee, Parks College of Engineering, Aviation, and Technology, Saint Louis University, July 2012-August 2014.

UNIVERSITY COMMITTEES AND SERVICE ACTIVITIES – SAINT LOUIS UNIVERSITY.

Chairman, Clare Boothe Luce Program Fellowship Selection Committee, Saint Louis University, September 2012-May 2013.

Member, STEM-Plus Building Proposal Committee, Saint Louis University, August 2012-March 2013.

Member, STEM-Plus Building Proposal Steering Sub-Committee, Saint Louis University, September 2012-March 2013.

Member, GAAC – Graduate Academic Affairs Committee, Saint Louis University, July 2010-January 2013.

Member, GAAC – Graduate Academic Affairs Committee – Sub-Committees, Saint Louis University, (a) Graduate Student Annual Reviews, (b) Proprietary and Confidential Research Policy and Procedures, (c) Ph.D. Defense and Examination Catalog Information, July 2012-January 2013.

Member, Think Tank For Strategic Planning, Saint Louis University, September 2010-December 2010.

Member, STEM-Plus Building Proposal Committee, Saint Louis University, November 2010-January 2011.

Member, Associate Deans and Directors Committee, Saint Louis University, December 2010-July 2013.

Member, Research Productivity Committee – Committee for Faculty and Administrator Evaluation Systems, Saint Louis University, March 2011-November 2011.

Member, International Initiatives Committee (IIC), Saint Louis University, April 2011-August 2014.

Member, STEM Strategic Planning Task Force, Saint Louis University, September 2013-August 2014.

Member, Marketing Image Issues Focus Group, Saint Louis University, April 2014-August 2014.

UNIVERSITY COMMITTEES AND SERVICE ACTIVITIES – UNIVERSITY OF OXFORD.

Membership of Congregation and of the Faculty of Engineering (University Governing Body), Oxford University, Oxford, England, United Kingdom, May 2006 – May 2009.

Board of Electors - Rolls-Royce / Royal Academy of Engineering Professorship of Computational Aerothermal Engineering, Oxford University, Oxford, England, United Kingdom, April 2007 – September 2007.

ST. CATHERINE'S COLLEGE COMMITTEES AND SERVICE ACTIVITIES – UNIVERSITY OF OXFORD.

Governing Body of St. Catherine's College, Membership of Congregation, Oxford University, Oxford, England, United Kingdom, May 2006 – May 2009.

DEPARTMENT OF ENGINEERING SCIENCE COMMITTEES AND SERVICE ACTIVITIES - UNIVERSITY OF OXFORD.

Mechanical Engineering Panel, Department of Engineering Science, Oxford University, Oxford, England, United Kingdom, June 2006 – May 2009.

Faculty Search Committee – Lecturer in Micro-Fluidics, Department of Engineering Science, Oxford University, Oxford, England, United Kingdom, February 2007 – April 2007, November 2007-March 2008.

UNIVERSITY COMMITTEES AND SERVICE ACTIVITIES - UNIVERSITY OF UTAH.

Member, Goldwater Scholarship Selection Committee, University of Utah, September 1999-November 1999.

Member, Goldwater Scholarship Selection Committee, University of Utah, October 2002–December 2002.

Member, Goldwater Scholarship Selection Committee, University of Utah, November 2003–December 2003.

Member, Academic Evaluation and Standards Committee, University of Utah, August 1, 2000-September 30, 2003.

Member, UPTAC Committee (University Promotion and Tenure Advisory Committee), University of Utah, August 1, 2002–September 30, 2005. Elected by tenure-track faculty in the College of Engineering.

Member, Funding Incentive Seed Grant Program Committee, University of Utah, August 1, 2002-September 30, 2005. Chosen upon recommendation by the University of Utah Personnel and Elections Committee.

Member, University of Utah Technology Review Board, University of Utah, October 28, 2005–May 2006.

COLLEGE COMMITTEES AND SERVICE ACTIVITIES - UNIVERSITY OF UTAH.

Member, College Council, College of Engineering, University of Utah, October 1993-October 1996.

Member, College Scholarship Committee, College of Engineering, University of Utah, May 1999–May 2006.

Member, College Tenure Procedures Review Committee, College of Engineering, University of Utah, November 2002–May 2004.

DEPARTMENTAL COMMITTEES AND SERVICE ACTIVITIES - UNIVERSITY OF UTAH.

Graduate Seminar Coordinator, Department of Mechanical Engineering, University of Utah, September 1992-June 1993

Member, Mechanical Engineering Design Search Committee, Department of Mechanical Engineering, University of Utah, September 1992-April 1993

Member, Graduate Committee, Department of Mechanical Engineering, University of Utah, September 1994-May 1999.

Faculty Advisor, Pi Tau Sigma Honorary Fraternity, December 1994-May 2006.

Chairman, Mechanical Engineering Thermal Fluids and Energy Systems Search Committee, Department of Mechanical Engineering, University of Utah, October 1995-May 1996.

Director-Graduate Admissions, and Chairman-Graduate Committee, Department of Mechanical Engineering, University of Utah, June 1996-September 1997.

RPT Alumni Surveys and Survey Evaluations, Department of Mechanical Engineering, University of Utah, June 1997-December 1997.

Member, Tenured Faculty Review Committees, Department of Mechanical Engineering, University of Utah, February 1998-April 1998.

Chairman and Member, Fellowship, Scholarship, and Honors Committee, Department of Mechanical Engineering, May 1999-May 2006.

RPT Alumni Surveys and Survey Evaluations, Department of Mechanical Engineering, University of Utah, June 1999-December 1999.

Chairman, Thermal, Fluids, and Energy Sciences (TFES) Division, Department of Mechanical Engineering, September 2005–May 2006. Appointed by Department Chairman.

Member, Departmental Executive Committee, Department of Mechanical Engineering, September 2005–May 2006. Appointed by Department Chairman.

PROFESSIONAL SOCIETIES.

ASME, Member, American Society of Mechanical Engineering, July 1985 - Present.

ASME, Fellow, American Society of Mechanical Engineering, December 2000 - Present.

ASEE, Member, American Society for Engineering Education, September 2010 - Present.

AIAA, Member, American Institute of Aeronautics and Astronautics, January 1988 - December 1991, December 2013 - Present.

AIAA, Associate Fellow, American Institute of Aeronautics and Astronautics, January 2016 - Present.

APS, American Physical Society, Fluid Dynamics Division. August 1988 - July 1993.

ICHMT, Scientific Council Member, International Center for Heat and Mass Transfer. Nominated for membership by Professor Richard Goldstein of the University of Minnesota. January 2014 – Present.

PROFESSIONAL SOCIETY COMMITTEES AND CHAIRMANSHIPS.

ASME, American Society of Mechanical Engineering, K-14 Gas Turbine Heat Transfer Committee. December 1986 - Present

IGTI, International Gas Turbine Institute Heat Transfer Committee. December 1986 - Present.

Chairman, Honors and Awards Sub-Committee, ASME, American Society of Mechanical Engineering, K-14 Gas Turbine Heat Transfer Committee. July 1, 2012 – June 30, 2014.

Vice-Chairman, Heat Transfer Committee of the ASME International Gas Turbine Institute, July 1, 2014 to June 30, 2016.

SESSIONS ORGANIZED, SESSION CHAIR ACTIVITIES, INTERNATIONAL MEETINGS.

ASME TURBO EXPO 2016: Turbomachinery Technical Conference and Exposition, Seoul, South Korea, June 13-17, 2016. Session organizer. Session 10-2: Conjugate Analysis of Film Cooling/Internal Flows.

ASME TURBO EXPO 2015: Turbine Technical Conference and Exposition, Montreal, Canada, June 15-19, 2015. Session co-organizer. Session 12-13: Film Cooling.

Academic Forum on Gas Turbine Technology, Opening Ceremony for the Institute of Gas Turbines, Beijing Tsinghua University, Beijing, P. R. China, February 27-28, 2014. Forum Session Chairman.

IWHT2013, 2nd International Workshop on Heat Transfer Advances for Energy Conservation and Pollution Control, Northwestern Polytechnical University (NPU), Xi'an, P. R. China, October 18-21, 2013. Session Chair, Technical Session 2C, Heat/Mass Transfer and Enhancement Techniques.

TURBO EXPO 2013 – 58th TURBO EXPO Turbine Technical Conference and Exposition, San Antonio, Texas, USA, June 3-7, 2013. Session organizer. Session 14-6: Experimental Test Techniques II.

ISTP-23, The 23rd International Symposium on Transport Phenomena, The University of Auckland, Auckland, New Zealand, November 19-22, 2012. Session Chair, Technical Session 1, Stream C: Air Conditioning.

ISTP-23, The 23rd International Symposium on Transport Phenomena, The University of Auckland, Auckland, New Zealand, November 19-22, 2012. Session Chair, Technical Session 8, Stream D: Turbomachinery I.

ISTP-23, The 23rd International Symposium on Transport Phenomena, The University of Auckland, Auckland, New Zealand, November 19-22, 2012. Session Chair, Technical Session 9, Stream D: Turbomachinery II.

Fourth International Symposium on Jet Propulsion and Power Engineering, 4th ISJPPE Meeting, Northwestern Polytechnical University (NPU), Xi'an, China, September 10-12, 2012. Session Chair. Technical Session: Heat Transfer.

International Mechanical Engineering Congress & Exposition 2012, IMECE 2012, Houston, Texas, USA, November 9-15, 2012. Session organizer. Session: Film Cooling Over Gas Turbine Blades-1.

TURBO EXPO 2012 – 57th TURBO EXPO Turbine Technical Conference and Exposition, Copenhagen, Denmark, June 11-15, 2012. Session organizer. Session 11-3: Shaped Hole Film Cooling.

IGTC'11 Osaka, International Gas Turbine Congress 2011 Osaka, 10th Congress in Japan, Gas Turbine Society of Japan, Osaka, Japan,

November 13-18, 2011. Session Chair. Session HT(7): Heat Transfer on Film Cooling III.

11th Asian International Conference on Fluid Machinery, and 3rd Fluid Power Technology Exhibition, Indian Institute of Technology, Madras, Chennai, India, November 21-23, 2011. Session Chair. Session 2: Fluid Mechanics-FM-1.

TURBO EXPO 2011 – 56th TURBO EXPO Turbine Technical Conference and Exposition, Vancouver, Canada, June 6-10, 2011. Session organizer. Session 11-8: Innovative Film Cooling Approaches.

TURBO EXPO 2010 – 55th ASME Gas Turbine Technical Congress and Exposition, Glasgow, Scotland, June 2010. Session organizer. Session 10-12: Innovative Film Cooling Concepts.

TURBO EXPO 2010 – 55th ASME Gas Turbine Technical Congress and Exposition, Glasgow, Scotland, June 2010. Session organizer. Session 12-2: Transition.

49th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Vienna, Austria, June 2004. Session co-organizer. Session 11-25: Internal Channels VIII.

46th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, New Orleans, June 2001. Session organizer. Session M-10: Film Cooling I.

45th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Munich, May 2000. Vanguard chair for session W-35: Film Cooling Flow Characteristics I.

45th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Munich, May 2000. Session organizer. Session W-35: Film Cooling Flow Characteristics I.

44th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Indianapolis, June 1999. Session co-organizer. Session THP02: Film Cooling V.

43rd ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Stockholm, June 1998. Session organizer. Session THP07: Film Cooling V.

42nd ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Orlando, June 1997. Session organizer. Session 6: Film Cooling III (Large and Small Turbulence Effects).

40th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Houston, June 1995. Session organizer. Session 104: Film Cooling IV.

38th ASME Gas Turbine and Aeroengine Technical Congress, Exposition, and Users Symposium, Cincinnati, June 1993. Session organizer. Session: Film Cooling.

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