

Tianshu Liu

ADDRESS:

Department of Mechanical and Aerospace Engineering
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Western Michigan University
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EDUCATION:

PhD (1996), Aeronautics & Astronautics, specializing in Aerodynamics, Purdue University, USA
MS (1985), BS (1982), Aerodynamics, Nanjing University of Aeronautics and Astronautics, China

RESEARCH INTERESTS:

Aerodynamics
Fluid Mechanics
Heat Transfer
Measurement Techniques Applied to Aerospace Engineering and Sciences

TEACHING INTERESTS:

Incompressible Aerodynamics
Compressible Aerodynamics
Wing and Body Aerodynamics
Experimental Aerodynamics
Viscous Flows and Boundary Layer Theory
Engineering Fluid Mechanics
Heat Conduction and Convection
Flight Testing Engineering
Aircraft Performance and Design
Image-Based Measurement Techniques for Aerospace Applications
Turbulence
Scaling and Similarity

CURRENT POSITION:

Professor (9/2009-now)
Director of Applied Aerodynamics Laboratory
Department of Mechanical and Aerospace Engineering
Western Michigan University
Kalamazoo, MI 49008-5343, USA

EMPLOYMENT HISTORY:

Visiting Professor (7/26/2016-8/28/2016)
Institute of Global Innovation Research

Tokyo University of Agriculture and Technology, Tokyo, Japan

Visiting Professor (6/19/2016-6/26/2016)
Institute of Marine Hydrodynamics (INSEAN)
Rome, Italy

Visiting Professor (4/19/2015-9/2/2015)
Institute of Fluid Science (IFS) and Department of Aerospace Engineering
Tohoku University, Sendai, Japan

Visiting Professor (6/1/2012-9/1/2012)
Institute of Space and Astronautical Science (ISAS)
Japan Aerospace Exploration Agency (JAXA), Sagmihara, Japan

Associate Professor (9/2004-8/2008)
Department of Mechanical and Aeronautical Engineering
Western Michigan University, Kalamazoo, MI 49008-5343

Research Scientist (9/1999-9/2004)
Aerodynamics, Aerothermodynamics and Acoustics Competency
NASA Langley Research Center (LaRC), Hampton, VA 23681, USA

Research Scientist (2/1997-9/1999)
High Technology Corporation, Hampton, VA 23666, USA

Postdoctoral Research Assistant (1/1996-2/1997)
Purdue University, Indiana, USA

Visiting Scientist (2/1999-3/1999)
Japanese National Aerospace Laboratory (NAL), Tokyo, Japan

Graduate Research Assistant (8/1991-12/1995)
Purdue University, Indiana, USA

Researcher (11/1988-8/1990)
University of Houston, Houston, USA

Lecturer (12/1985-11/1988)
Nanjing University of Aeronautics and Astronautics, China

Visiting Scientist (5/1985-12/1985)
DLR Institute of Fluid Mechanics at Göttingen, Germany

PROFESSIONAL SERVICES AND MEMBERSHIP:

Reviewer for

AIAA Journal
AIAA Journal of Aircraft
AIAA Journal of Thermophysics and Heat Transfer
AIAA Journal of Aerospace Computing, Information and Communication
ASME Journal of Dynamic Systems, Measurement and Control
ASME Journal of Turbomachinery
Applied Mathematical Modeling
Experiments in Fluids
International Journal of Heat and Mass Transfer
Journal of Fluid Mechanics
Journal of Fluids Engineering,
Journal of Aerospace Engineering
Journal of Bionic Engineering
Journal of the American Helicopter Society
Journal of Applied Physics
Journal of Visualizations
Optical Engineering
Measurement Sciences and Technology
Physics of Fluids
Review of Scientific Instruments
Sensors and Actuators
SIAM Journal on Image Sciences
The Journal of The American Acoustics Society
NASA SBIR Phase I and II
NASA Institute for Advanced Concepts Phase II

Associate Fellow, AIAA

AIAA Aerodynamic Measurement Technical Committee, 2007
Session Chair, Skin Friction Measurement, Aerodynamic Measurement Technology and Ground Testing, AIAA Conferences, San Francisco, California, 5-8 June 2006

AWARDS:

2017 Outstanding Researcher Award of the College of Engineering and Applied Sciences, Western Michigan University, Kalamazoo, USA

2013 Outstanding Paper Award in the fluid mechanics area in Measurement Science and Technology on extraction of skin-friction fields from surface flow visualizations as an inverse problem

2009 The Kenneth Harris James Prize and The Thomas Hawksley Gold Medal of the Institution of Mechanical Engineers for the best paper on pressure sensitive paints in unsteady and hypersonic flows (with J. Gregory, A. Asai, M. Kamada and J. Sullivan)

2007 Outstanding New Researcher Award of the College of Engineering and Applied Sciences at Western Michigan University, Kalamazoo, USA

PATENT:

“Wind Oscillator for Power Generation” Tianshu Liu (WMU), 2016, US Patent # 9,464,623

“Airfoil/Wing Flow Control Using Flexible Extended Trailing Edge” by Qamar Shams (NASA LaRC) and Tianshu Liu (WMU), 2008, US Patent: LAR-17361-1

“Aeroship” by Tianshu Liu and William Liou, Provisional US Patent (WMU case #70 filed in 2005)

INVITED PRESENTATIONS:

“Flow Structures Extracted from Visualization Images: Vector Fields and Topology”
Tokyo University of Agriculture and Technology, 7-30, 2016

“Optical Flow Problems in Global Flow Diagnostics” Institute of Marine Hydrodynamics (INSEAN) in Italy and University of Rome, 6/19-6/30, 2016

Lectures at Tohoku University, Japan Aerospace Exploration Agency, Kanazawa Institute of Technology, Tokyo University of Agriculture and Technology, 5-8, 2015

(1) **Optical Flow Method — Theoretical Framework for Global Flow Diagnostics**

(2) **Temperature Sensitive Paint Heat Flux Measurements in High-Speed Wind Tunnels**

(3) **Thin-Wing Vibration Control Using Flexible Fins**

(4) **Fluid Mechanics of Deposition of Micron Liquid Droplets on Wall in Impinging Turbulent Air Jet**

(5) **The Lift Problem in Low-Reynolds-Number Flapping Flight**

“Image-Based Aerodynamic Measurements – Transfer from Aerospace to Automotive Applications,” Ford Motor Company, Detroit, MI, 4/20/2015

“Scaling, Wing Geometry and Kinematics of Bird Flight”, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, China, 8/25/2013

“Toward Unified Image-Based Measurements in Fluid Mechanics”, Institute of Mechanics, Chinese Academy of Sciences, Beijing, China, 12/27/2012

“Flow Structures of Jupiter’s Great Red Spot Extracted by Using Optical Flow Method”, Department of Physics, University of Central Florida, 4/13/2012

“Global Velocity and Skin Friction Diagnostics Using Physics-Based Optical Method”, Department of Aerospace Engineering, The Ohio State University, 11/28/2011

“Skin Friction Topology in a Region Enclosed by Penetrable Boundary”, Department of Aerospace Engineering, Peking University, 08/12/2011

“Flow Structures of Jupiter’s Great Red Spot Extracted by Using Optical Flow Method”, Peking University, 08/12/2011

“Skin Friction Topology in Region with Penetrable Boundary”, Michigan State University, 08/10/2010

“Fluid Flow and Optical Flow — Global Diagnostics of Velocity and Skin Friction Fields”, Beijing University of Aeronautics and Astronautics, 06/5/2010

“Fluid Flow and Optical Flow — Global Diagnostics of Velocity and Skin Friction Fields”, University of Notre Dame, 02/27/2009

“Global Diagnostics of Velocity and Skin Friction Fields in Complex Flows”, Case Western Reserve University, 12/16/2008

Lectures at The Chinese Aerodynamics Research and Development Center (CARDC), Sichun, China, December 16-19, 2007

(1) Fluid Flow and Optical Flow—Determination of Velocity Field from Images

(2) Pressure and Temperature Sensitive Paints

(3) Lift Enhancement Using Static Extended Trailing Edge

(4) Global Luminescent Oil-Film Skin Friction Meter

(5) Videogrammetric Techniques for Aerospace Applications

(6) Aeroship: A New Flight Platform

“Avian Wing Geometry and Kinematics,” AFOSR Biologically Inspired Flight for Micro Air Vehicles, Denver, June 21-23, 2006

“Flight Testing Engineering and Design”, Invited lectures at Tohoku University, Sendai, Japan, May 8-9, 2006

“A Unified View of Image-Based Measurements in Aerospace Applications”, Keynote Speech at the International Workshop on Molecular Imaging for Interdisciplinary Research, Tohoku University, Sendai, Japan, Nov. 8-9, 2004

“Comparative Scaling of Flapping- and Fixed-Wing Flyers”, 2003 Bioflight Workshop, NASA Langley Research Center (LaRC), Hampton, Virginia, August 7, 2003

“Pressure and Temperature Sensitive Paints”, AIAA Short Course, St. Louis, Missouri, June, 2002

“Image-Based Techniques for Wind Tunnel Testing”, George Washington University, Washington DC, April 8, 2002

“Pressure Sensitive Paints — Theories and Practices”, Keynote Speech at the Workshop on Molecular Sensors for Aero-Thermodynamic Research, Nagoya University, Nagoya, Japan, March 13, 2001

“Luminescent Molecule Sensors in Fluid Mechanics and Heat Transfer”, The University of Western Ontario, London, Canada, October 16, 1997

“TSP and PSP Developments at Purdue”, NASA Langley Research Center (LaRC), Hampton, Virginia, December 21, 1996

“Temperature- and Pressure-Sensitive Paints in Aerodynamics”, Japanese National Aerospace Laboratory (NAL), Tokyo, February 20, 1996

PUBLICATIONS:

Books and Book Chapters:

T. Liu and J. P. Sullivan, **“Pressure and Temperature Sensitive Paints,”** Springer, Berlin (2005)

T. Liu, **“Pressure- and Temperature-Sensitive Paints,”** in Encyclopedia of Aerospace Engineering, eds R. Blockley and W. Shyy, John Wiley: Chichester. DOI:10.1002/9780470686652, December (2011)

T. Jones, A. A. Dorrington, J. R. Blandino, C. Fraser and **T. Liu**, **“Photogrammetric Measurement Methods”** (Chapter 5), *Gossamer Structures*, AIAA Press, Washington DC (2006)

J. Gregory and **T. Liu**, **“Introduction to Flight Testing of Light Aircraft and UAVs,”** Wiley (Aerospace Series), New York (to be published in 2017)

Refereed Archival Publication:

- T. Liu**, “**Near-wall flow structures generated by surface pressure variations**,” *AIAA Journal* (under review) (2017).
- T. Liu**, S. Wang, and G. He, “**The explicit role of viscosity in generating lift**,” *AIAA Journal* (under review) (2017).
- T. Liu**, RSV. Ramasamy, R. Radermacher, and W. Liou, “**Oscillating-wing unit for power generation**,” *Journal of Renewable Energy* (under review) (2017).
- T. Liu**, “**An analytical solution for probability density function of stretching rate in homogenous isotropic turbulence**,” *European Journal of Mechanics: B/Fluids*, 62:42-50 (2017).
- T. Liu**, T. Misaka, K. Asai, S. Obayashi, and J-Z Wu, “**Feasibility of skin-friction diagnostics based on surface pressure gradient field**,” *Measurement Science and Technology*, 27(12), 125304 (2016).
- M. H. Makhmalbaf, **T. Liu**, P. Merati, “**A vortex flow intensified by thermal convection**,” *Physics of Fluids*, 29(1), 016603 (2017).
- M. Miozzi, I. A. Capone, F. Di Felice, C. Klein, and **T. Liu**, “**Global and local skin friction diagnostics from TSP surface patterns on an underwater cylinder in crossbow**,” *Physics of Fluids*, 28(12), 12410 (2016).
- K. Hayasaka, Y. Tagawa, **T. Liu**, and M. Kameda, “**Optical-flow-based background-oriented schlieren technique for measuring a laser-induced underwater shock wave**,” *Experiments in Fluids*, 57(12), 179 (2016).
- J. Zhu, T. Liu, L. Liu, S. Zou, and J-Z Wu “**Causal mechanism in airfoil-circulation formation**,” *Physics of Fluids*, 27(12):123601 (2015).
- S. Wang, X. Zhang, G. He and **T. Liu**, “**Lift enhancement by bats’ dynamically changing wingspan**,” *J. of Royal Society: Interface*, 12, 20150823 (2015)
- T. Liu**, A. Merat, MHM Makhmalbaf, C. Fajardo, P. Merati, “**Comparison between optical flow and cross-correlation methods for extraction of velocity fields from particle images**,” *Experiments in Fluids*, Vol. 56, pp. 166-189 (2015)
- S. Woodiga, **T. Liu**, RSV. Ramasamy, S. Kode, “**Effects of pitch, yaw, and roll on delta wing skin friction topology**,” *Journal of Aerospace Engineering*, July 14, 2015 (online) (2015)
- T. Liu**, MHM. Makhmalbaf, RSV. Ramasamy, S. Kode, P. Merati, “**Skin friction fields and surface dye patterns on delta wings in water flows**”, *Journal of Fluids Engineering*, Vol. 137, pp. 071202-1-14 (2015)
- B. Wang, Z. Cai, L. Shen and **T. Liu**, “**An analysis of physics-based optical flow method**,” *Journal of Computational and Applied Mathematics*, Vol. 276, pp. 62-80 (2015).
- H. Zhong, S. Woodiga, P. Wang, J. Shang, X. Cui, J. Wang, and **T. Liu**, “**Skin friction topology of wing-body junction flows**,” *European Journal of Mechanics – B/Fluids*, Vol. 53, pp. 55-67 (2015)
- T. Liu**, S. Wang, X. Zhang & G. He, “**Unsteady thin airfoil theory revisited: application of a simple lift formula**,” *AIAA Journal*, Vol. 53, No. 6, pp. 1493-1502 (2015)
- S. Wang, G. He, X. Zhang and **T. Liu**, “**Evaluation of lift formulas applied to low Reynolds number flows**,” *AIAA Journal*, Vol. 53, No. 1, pp. 161-175 (2015)
- S. Wang, G. He, X. Zhang and **T. Liu**, “**Numerical simulation of unsteady flow over a slow-flying bat**,” *Theoretical and Applied Mechanics Letters*, Vol. 5, pp. 5-8 (2015)

- T. Liu, S. Woodiga, J. Gregory and J. Sullivan, “**Global skin friction diagnostics based on surface mass-transfer visualizations,**” *AIAA Journal*, Vol. 52, No. 11, pp. 2369-2383 (2014)
- S. Wang, G. He, X. Zhang and T. Liu, “**Lift enhancement by dynamically changing wingspan in forward flapping flight,**” *Physics of Fluids*, Vol. 26, p. 061903 (2014)
- J. Gregory, H. Sakaue, T. Liu and J. Sullivan, “**Fast pressure sensitive paint for flow and acoustic diagnostics,**” *Annual Review of Fluid Mechanics*, Vol. 46, pp. 303-330, (2014)
- D. Peng, C. Jenson, T. Juliano, J. Gregory, J. Crafton, S. Palluconi, and T. Liu, “**Temperature-compensated fast pressure-sensitive paint,**” *AIAA Journal*, Vol. 51, No. 10, pp. 2420-2431 (2013)
- T. Liu, “**Extraction of skin-friction fields from surface flow visualizations as an inverse problem,**” *Measurement Science and Technology*, Vol. 24, p. 124004 (2013)
- T. Liu, A. Oyama and K. Fujii, “**Scaling analysis of propeller-driven aircraft for Mars exploration,**” *Journal of Aircraft*, Vol. 50, No. 5, pp. 1593-1604 (2013)
- S. Wang, X. Zhang, G. He, and T. Liu, “**A lift formula applied to low-Reynolds-number unsteady flows,**” *Physics of Fluids*, Vol. 25, p. 093605 (2013)
- J. Montefort, N. Pohl, T. Liu, J. Gregory, and J. Crafton, “**Thin-wing vibration control using flexible fins,**” *AIAA Journal*, Vol. 51, No. 9, pp. 2218-2230 (2013)
- T. Liu, J. Rubal, C. Ward, J. Sullivan, and S. Schneider, “**Heat-flux measurements with temperature sensitive paint in a Mach-6 quiet tunnel,**” *Journal of Spacecraft and Rockets*, Vol. 50, No. 2, pp. 282-293 (2013)
- T. Liu, B. Wang and D. Choi, “**Flow structures of Jupiter’s Great Red Spot extracted by using optical flow method,**” *Physics of Fluids*, Vol. 24, 096601-13 (2012)
- T. Liu, A. W. Burner, T. Jones, and Barrow, D., “**Photogrammetric techniques for aerospace applications,**” *Progress in Aerospace Sciences*, Vol. 54, pp. 1-58 (2012)
- T. Liu and S. Woodiga, “**Feasibility of global skin friction diagnostics using temperature sensitive paint,**” *Measurement Science and Technology*, Vol. 22, 115402 (2011)
- T. Liu, S. Woodiga and T. Ma, “**Skin friction topology in a region enclosed by penetrable boundary,**” *Experiments in Fluids*, Vol. 51, pp. 1549-1562 (2011)
- T. Liu, B. Wang, J. Rubal, and J. Sullivan, “**Correcting lateral heat conduction effect in image-based heat flux measurements as an inverse problem,**” *International Journal of Heat and Mass Transfer*, Vol. 54, pp. 1244-1258 (2011)
- Z. Cai, T. Liu, B. Wang, J. Rubal, and J. Sullivan, “**Numerical inverse heat transfer analysis for temperature-sensitive-paint measurements in hypersonic tunnels,**” *Journal of Thermophysics and Heat Transfer*, Vol. 25, No. 1, pp. 59-67 (2011)
- T. Liu, “**Probability density function of small separation between two inertial particles in homogeneous isotropic turbulence,**” *Physics of Fluids*, Vol. 22, Issue 4, pp. 045105-1 to 7 (2010)
- T. Liu, J. Montefort, W. Liou, and R. Pantula, “**Effects of flexible fin on low-frequency oscillation in post-stall flows,**” *AIAA Journal*, Vol. 48, No. 6, pp. 1235-1247 (2010)
- T. Liu, J. Nink, P. Merati, T. Tian, Y. Li, and T. Shieh “**Deposition of micron liquid droplets on wall in impinging turbulent air jet,**” *Experiments in Fluids*, Vol. 48, pp. 1037-1057 (2010)

- T. Liu, Z. Cai, J. Lai, J. Rubal, & J. Sullivan, “Analytical method for determining heat flux from temperature-sensitive-paint measurements in hypersonic tunnels,”** *Journal of Thermophysics and Heat Transfer*, Vol. 24, No. 1, pp. 85-94 (2010)
- S. Woodiga and **T. Liu**, “**Skin friction fields on delta wings,**” *Experiments in Fluids*, Vol. 47, pp. 897-911 (2009)
- T. Liu, W. Liou and M. Schulte, “Aeroship: A hybrid flight platform,”** *Journal of Aircraft*, Vol. 46, No. 2, pp. 667-674 (2009)
- T. Liu, S. Woodiga, J. Montefort, K. J. Conn, and L. Shen, “Global skin friction diagnostics in separated flows using luminescent oil,”** *Journal of Flow Visualization and Image Processing*, Vol. 16, No. 1, pp. 19-39 (2009)
- T. Liu and L. Shen, “Fluid flow and optical flow”** *Journal of Fluid Mechanics*, Vol. 614, No. 11, pp. 253-291 (2008)
- J. Gregory, A. Asai, M. Kamada, **T. Liu** and J. Sullivan, “**A review of pressure sensitive paints in hypersonic and unsteady flows,**” *Journal of Aerospace Engineering*, Vol. 222, Part G, pp. 249-290 (2008)
- T. Liu, P. Merati, S. A. Woodiga, C. Davis, C. H. Leong, J. Johnson, and K. H. Chen, “Drainage and filling in cylindrical and rectangular containers,”** *Journal of Automobile Engineering*, Vol. 222, No. D4, pp. 565-577 (2008)
- T. Liu, J. Montefort, S. Woodiga, P. Merati, and L. Shen, “Global luminescent oil film skin friction meter,”** *AIAA Journal*, Vol. 46, No. 2, pp. 476-485 (2008)
- T. Liu, J. Montefort, W. Liou, S. R. Pantula, and Q. Shams “Lift enhancement by static extended trailing edge,”** *Journal of Aircraft*, Vol. 44, No. 6, pp. 1939-1947 (2007)
- J. W. Naughton and **T. Liu**, “**Photogrammetry in oil film interferometry**”, *AIAA Journal*, Vol. 45, No. 7, pp. 1620-1629 (2007)
- T. Liu and J. Montefort, “Thin-airfoil-theoretical interpretation for Gurney flap lift enhancement,”** *Journal of Aircraft*, Vol. 44, No. 2, pp. 667-671 (2007)
- T. Liu, “Weight criterion on flow control in level flight,”** *Journal of Aircraft*, Vol. 44, No. 1, pp. 348-351 (2007)
- T. Liu, “Time-area-averaged momentum stream tube model for flapping flight”**, *Journal of Aircraft*, Vol. 44, No. 2, pp. 459-466 (2007)
- T. Liu, “Comparative scaling of flapping- and fixed-wing flyers”**, *AIAA Journal*, Vol. 44, No. 1, pp. 24-33 (2006)
- T. Liu, K. Kuykendoll, R. Rhew and S. Jones, “Avian wing geometry and kinematics”**, *AIAA Journal*, Vol. 44, No. 5, pp. 954-963 (2006)
- T. Liu, “Optimum bifurcating-tube tree for gas transport”**, *Journal of Fluids Engineering*, Vol. 127, No. 3, pp. 550-553 (2005)
- T. Liu, “Geometric and kinematic aspects of image-based measurements of deformable bodies”**, *AIAA Journal*, Vol. 42, No. 9, pp. 1910-1920, (2004)
- T. Liu and J. Sullivan, “In-situ calibration uncertainty of pressure-sensitive paint”**, *AIAA Journal*, Vol. 41, No. 11, pp. 2300-2302, (2003)
- T. Liu, “Pressure-correction method for low-speed pressure-sensitive paint measurements”**, *AIAA Journal*, Vol. 41, No. 5, pp. 906-911, (2003)
- T. Liu, D. Barrows, A. Burner and R. Rhew, “Determining aerodynamic loads based on optical deformation measurements”**, *AIAA Journal*, Vol. 40, No. 6, pp. 1105-1112, (2002)

- T. Liu**, T. Togerson, J. Sullivan, R. Johnston, and S. Fleeter, “**Transonic rotor blade pressure measurement using fluorescent paint**”, *Journal of Propulsion and Power*, Vol. 18, No. 2, pp. 491-493, (2002)
- A. Burner, **T. Liu**, S. Garg, T. Ghee and N. Taylor, “**Aeroelastic deformation measurements of flap, gap and overhang on a semispan model**”, *Journal of Aircraft*, Vol. 38, No. 6, pp. 1147-1154, (2001)
- T. Liu**, N. Teduka, M. Kameda and K. Asai, “**Diffusion timescale of porous pressure-sensitive paint**”, *AIAA Journal*, Vol. 39, No. 12, pp. 2400-2402, (2001)
- A. Burner and **T. Liu**, “**Videogrammetric model deformation measurement technique**”, *Journal of Aircraft*, Vol. 38, No. 4, pp. 745-754, (2001)
- T. Liu** and T. Finley, “**Estimating bias error distribution**”, *Review of Scientific Instruments*, Vol. 72, No. 9, pp. 3561-3571, (2001)
- T. Liu**, M. Guille and J. Sullivan, “**Accuracy of pressure sensitive paint**”, *AIAA Journal*, Vol. 39, No. 1, pp. 103-112, (2001)
- T. Liu**, L. Cattafesta, R. Radezsky and A. W. Burner, “**Photogrammetry applied to wind tunnel testing**”, *AIAA Journal*, Vol. 38, No. 6, pp. 964-971, (2000)
- A. W. Burner, **T. Liu**, S. Garg, J.H. Bell, and D.G. Morgan, “**Unified model deformation and flow transition measurements**”, *Journal of Aircraft*, Vol. 36, No. 5, pp. 898-901, (1999)
- L. Cattafesta, **T. Liu** and J. Sullivan, “**Uncertainty estimates for temperature sensitive paint measurements with CCD cameras**”, *AIAA Journal*, Vol. 36, No. 11, pp. 2102-2108 (1998)
- T. Liu** and J. Sullivan, “**Luminescent oil-film skin friction meter**”, *AIAA Journal*, Vol. 36, No. 8, pp. 1460-1465 (1998)
- T. Liu**, B. Campbell, S. Burns and J. Sullivan, “**Temperature- and pressure-sensitive paints in aerodynamics**”, *Applied Mechanics Reviews*, Vol. 50, No. 4, pp. 227-246 (1997)
- K. Asai, H. Kanda, T. Kunimasu, **T. Liu** and J. Sullivan, “**Detection of boundary layer transition in a cryogenic wind tunnel by using luminescent paint**”, *Journal of Aircraft*, Vol. 34, No. 1, pp. 34-42 (1997)
- T. Liu** and J. Sullivan, “**Heat transfer and flow structures in an excited circular impinging jet**”, *International Journal of Heat and Mass Transfer*, Vol. 39, No. 17, pp. 3695-3706 (1996)
- T. Liu**, B. Campbell and J. Sullivan, “**Heat transfer measurement on a waverider at Mach 10 using fluorescent paint**”, *Journal of Thermophysics and Heat Transfer*, Vol. 9, No. 4, pp. 605-611 (1995)
- T. Liu**, B. Campbell and J. Sullivan, “**Fluorescent paint for measurement of heat transfer in shock/turbulent boundary layer interaction**”, *Experimental Thermal and Fluid Science*, 10, pp. 101-112, (1995)
- T. Liu**, B. Campbell and J. Sullivan, “**Surface temperature of a hot film on a wall in shear flow**”, *International Journal of Heat and Mass Transfer*, Vol. 37, No. 17, pp. 2809-2814 (1994)
- T. Liu**, “**A note on the probability distribution of the dissipation rate in locally isotropic turbulence**”, *Physics of Fluids A* 5(9), pp. 2234-2238 (1993)
- T. Liu**, “**Non-orthogonal stagnation flow on the surface of a quiescent fluid — An exact solution of the Navier-Stokes equation**”, *Quarterly of Applied Mathematics*, Vol. L, No. 1, pp. 39-47, March (1992)

- T. Liu, S. Shi and M. D. Zhou, “**Horseshoe vortices generated by heat pulses in boundary layer**”, *Journal of Experimental Mechanics*, Vol. 4, No. 3, pp. 290-296 (1989)
- C. Dai, T. Liu, Y. Teng and M. Xiao, “**Measuring techniques for wall shearing stress in turbulent boundary-layer**”, *ACTA AERONAUTICA ET ASTRONAUTICA SINICA*, Vol. 9, No. 5, pp. 203-210 (1988)
- M. D. Zhou and T. Liu, “**Stability investigation in nominally two-dimensional laminar boundary layer by means of heat pulsing**”, *Perspectives in Turbulence Studies*, Ed. H. U. Meier and P. Bradshaw, Springer-Verlag, Berlin (1987)

Conference Papers:

- T. Liu, J. Z. Wu, J. Y. Zhu and L. Q. Liu, “**The Origin of Lift Revisited: I. A Complete Physical Theory**,” AIAA Paper, the 45th AIAA Fluid Dynamics Conference, 22-26 June 2015, Dallas, Texas.
- L. Q. Liu, J. Z. Wu, and T. Liu, “**Kutta-Joukowski lift and drag in two-dimensional viscous compressible flow: II. Linear analysis theory**,” AIAA Paper, the 45th AIAA Fluid Dynamics Conference, 22-26 June 2015, Dallas, Texas (submitted).
- J. Y. Zhu, L. Q. Liu, T. Liu, Y. P. Shi, W. D. Su, and J. Z. Wu, “**Kutta-Joukowski lift and drag in two-dimensional viscous compressible flow: I. Numerical evidence and far-field analysis**,” AIAA Paper, the 45th AIAA Fluid Dynamics Conference, 22-26 June 2015, Dallas, Texas.
- T. Liu, S. Wang, X. Zhang & G. He, “**The lift problem in flapping forward flight at low Reynolds numbers**,” AIAA SciTech 2015, Kissimmee, Florida, January (2015)
- T. Liu, “**Jupiter and Saturn’s unique flow structures extracted from cloud images by using optical flow method**,” 52nd AIAA Aerospace Sciences Meeting, 13-17 January 2014, National Harbor, Maryland (2014)
- Husen, N., Woodiga, S., T. Liu and J. P. Sullivan, “**Global luminescent oil-film skin friction meter generalized to three-dimensional geometry and applied to FAITH hill**,” ,” 52nd AIAA Aerospace Sciences Meeting, 13-17 January 2014, National Harbor, Maryland (2014)
- T. Liu, J. Motefort, J. Gregory, S. Palluconi, J. Crafton & S. Fonov, “**Wing deformation measurements from pressure sensitive paint images using videogrammetry**,” AIAA Paper 2011-3725, The 41th AIAA Fluid Dynamics Conference and Exhibit, Honolulu, Hawaii, June 27-30, (2011)
- T. Juliano, D. Peng , C. Jensen, T. Liu, J. Motefort, J. Gregory, S. Palluconi, J. Crafton & S. Fonov, “**PSP measurements on an oscillating NACA 0012 airfoil in compressible flow**,” AIAA Paper 2011-37828, The 41th AIAA Fluid Dynamics Conference and Exhibit, Honolulu, Hawaii, June 27-30, (2011)
- T. Liu, B. Wang and S. Woodiga, “**Physics-based optical flow method in global flow diagnostics**,” AIAA Paper 2010-4361, The 27th AIAA Aerodynamics Measurement Technology and Ground Testing Conference, Chicago, IL, June 27-July 1, (2010)
- T. Liu and S. Woodiga, “**Experimental examination of skin friction topology in separated flows**,” AIAA Paper 2010-0045, Orlando, Florida (2010)
- Gregory, J. W., Kumar, P., Peng, D., Fonov, S., Crafton, J. and Liu, T., “**Integrated optical measurement techniques for investigation of fluid-structure interaction**,” AIAA Paper 2009-4044, San Antonio, TX (2009)

- T. Liu, J. Montefort, W. Liou, R. Pantula, & Q. Shams, “Post-stall flow control using a flexible fin on airfoil,”** AIAA Paper 2009-1106, Orlando, FL (2009)
- T. Liu, Z. Cai, J. Lai, J. Rubal, & J. Sullivan, “Analytical methods for determination of heat transfer fields from temperature sensitive paint measurements in hypersonic tunnels,”** AIAA Paper 2009-0736, Orlando, FL (2009)
- T. Liu, “Flight testing on Cirrus aircraft,”** AIAA Paper 2009-0571, Orlando, FL (2009)
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