

BIOGRAPHICAL SKETCH

SANJAY KUMAR

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Education:

Ph. D. 2003, Aeronautics, California Institute of Technology (Cal Tech. – Pasadena, USA).

GPA (4.0, out of 4.0)

Minor: Applied Mathematics

Thesis: An Experimental study of Richtmyer-Meshkov Instability.

Advisor(s): (Late) Prof. B. Sturtevant and Prof. Hans G. Hornung (Cal Tech.).

M.Tech. 1996, Aerospace Engineering, Indian Institute of Technology-Kanpur, India.

GPA (9.7, out of 10)

Thesis: An Experimental Study of near wake structure behind linearly tapered cylinders.

Advisor: Prof. Kamal Poddar (IIT-Kanpur, India)

B. Tech. 1994, Aerospace Engineering, Indian Institute of Technology-Kanpur, India.

GPA (8.7, out of 10)

Professional Appointments:

2011 - present	Associate Professor (<u>Tenured</u>), Department of Engineering, The University of Texas at Brownsville, Brownsville, TX.
2006 – 2011	Assistant Professor, Department of Engineering, The University of Texas at Brownsville, Brownsville, TX.
2003 – 2006	Post-doctoral fellow, Los Alamos National Laboratory, Los Alamos, NM.
1998 – 2003	Graduate Research and Teaching assistant, Cal Tech.
1997 – 1998	Project Engineer, National Wind Tunnel Facility at IIT-Kanpur, India.
1996 – 1997	Scientist (level B) at Defense Research and Development Organization (DRDO) - India

Research Interests:

(Experimental Fluid Mechanics)

- Fluid Instabilities and Turbulence
- Wakes
- Shock-accelerated flows.

Teaching Interests:

- Fluid Mechanics: Incompressible & Compressible Flows, Boundary layer theory, Hydrodynamic Instability, Turbulence, Sources of Vorticity, Hypersonic Aerodynamics, Aerodynamics, Viscous Fluid Flows, Unsteady Gas Dynamics.
- Thermodynamics
- Heat & Mass Transfer
- Statics & Dynamics.

Publications:

1. **S.Kumar**, C.Lopez, O.Probst, G.Francisco, D.Askari, and Y.Yang “Flow past a rotationally oscillating cylinder,” *Journal of Fluid Mechanics*, (accepted – to appear soon)(2013).
2. P.Wayne, P.Vorobieff, H.Smith, T.Bernard, C.Corbis, A.Meloney, J.Conroy, R.White, M.Anderson, **S.Kumar**, C.R.Truman, and D.Srivastava “Shock driven particle transport off smooth and rough surfaces,” *Journal of Fluids Engineering – ASME Transactions*, 133 (4), 041201 (2013).
3. M.Anderson, P.Vorobieff, J.Conroy, R.White, C.R.Truman, **S.Kumar**, “An experimental and numerical study of shock interaction with a gas column seeded with droplets,” *Physics of Fluids – under consideration*. (2013).
4. P.Vorobieff, M.Anderson, J.Conroy, C.R.Truman, and **S.Kumar**, “Morphology of shock-accelerated multiphase flow: experiment and modeling, Computational methods in multiphase flow ” *Computational Methods in Multiphase Flow VII*, eds. C.A.Brebbia, A.A. Mammoli, P.Vorobieff, WIT Press, Southampton UK, in press (2013).
5. **S.Kumar**, B.Gonzalez, and O.Probst, “Flow past two rotating cylinders,” *Physics of Fluids*, 23, 014102 (2011).
6. **S.Kumar**, C.Cantu, and B.Gonzalez, “Flow past a rotating cylinder at low and high rotation rates,” *Journal of Fluids Engineering – ASME Transactions*, 133 (4), 041201 (2011).
7. P.Vorobieff, M.Anderson, J.Conroy, R.White, C.Randall Truman, and **S.Kumar** “Vortex formation in shock accelerated gas induced by particle seeding,” *Physical Review Letters*, 106, 184503 (2011).
8. P.Vorobieff, M.Anderson, J.Conroy, R.White, C.Randall Truman, and **S.Kumar** “Analogues of Rayleigh-Taylor and Richtmyer-Meshkov instabilities in flows with non-uniform particle and droplet seeding,” *Computational Methods in Multiphase Flow. VI*, Edited by C.A. Brebbia and A.Mammoli, pp. 17-28 (2011).
9. **S.Kumar**, G.Laughlin, and C.Cantu, “Near Wake Structure behind Two Circular Cylinders in a Side-by-Side configuration with heat release,” *Physical Review E*, 80, 066307 (2009).
10. C.Tomkins, **S.Kumar**, G.Orlicz, and K.Prestridge, “An Experimental Investigation of Mixing Mechanisms in Shock-Accelerated Flow,” *Journal of Fluid Mechanics*, 611, 131-150 (2008).
11. **S.Kumar**, G.Orlicz, P.Vorobieff, A.Palekar, C.Tomkins, C.Goodenough, M.Marr-Lyon, and R.Benjamin, “Complex Flow Morphologies in Shock-Accelerated Gaseous Flows,” *Physica D: Nonlinear Phenomenon* 235, 21-28, (2007).
12. **S.Kumar**, G.Orlicz, C.Tomkins, C.Goodenough, K.Prestridge, P.Vorobieff, and R.Benjamin, “Stretching of material lines in shock-accelerated gaseous flows,” *Physics of Fluids* 082107, Vol. 17: No.8 (2005).
13. P.Vorobieff, C.Tomkins, **S.Kumar**, C.Goodenough, N.G.Mohamed, and R.Benjamin, “Secondary instabilities in shock induced transition to turbulence,” *Advances in Fluid Mechanics V*, eds. Brebbia, Mendes and Rahman, pp 139-148, WIT Press, Southampton, UK/Boston, USA (2004), p.139.
14. P.Vorobieff and **S.Kumar**, (**Book Chapter**), “Experimental studies of Richtmyer-Meshkov instability,” In *Recent Research Developments in Fluid Dynamics*, 5(2004): 33-55 ISBN: 81-7895-146-0. Publisher: Transworld Research Network, Trivandrum-695 023, Kerala, India.
15. **S.Kumar**, H.G. Hornung, and B.Sturtevant, “Growth of shocked gaseous interfaces in a conical geometry,” *Physics of Fluids* pp. 3194, Vol. 15: No.10 (2003).
16. J.K.Prasad, A. Rasheed, **S.Kumar** and B.Sturtevant, “The Late time development of Richtmyer – Meshkov instability,” *Physics of Fluids* , pp. 2108, Vol. 12: No. 8 (2000).
17. **S.Kumar** and K.Poddar, “Control of near wake structure behind straight and linearly tapered cylinders,” *Journal of Aeronautical Society of India*, pp 148-152, Vol. 52, No.3 (2000).
18. **S.Kumar** and K.Poddar, “An experimental study of near wake structure behind linearly tapered cylinders,” *Journal of Aeronautical Society of India*, pp 34-41, Vol. 48, No.1 (1996)

Conference Presentations:

1. Experimental studies of shock interaction with a multiphase medium. (with P.Vorobieff et. al.) *to be presented at ISSW – 29 and to appear in the Proceedings of the 29th International Symposium on Shock Waves (ISSW) - 2013, Madison (Wisconsin) (U.S.A).*
2. Experimental studies of shock interaction with a multiphase medium. (with P.Vorobieff et al.) APS Division of Fluid Dynamics 65th. Annual Meeting Nov. 18-20, (2012), San Diego (CA) (USA).
3. An experimental study of flow past a rotationally oscillating cylinder. (with C.Lopez et al.) APS Division of Fluid Dynamics 65th. Annual Meeting Nov. 18-20, (2012), San Diego (CA) (USA).
4. Shock-Accelerated gas cylinder: A Mach number study. (with T.Bernard et al.) APS Division of Fluid Dynamics 65th. Annual Meeting Nov. 18-20, (2012), San Diego (CA) (USA).
5. Three dimensional modeling of Richtmyer-Meshkov instability. (with M.Anderson et al.) APS Division of Fluid Dynamics 65th. Annual Meeting Nov. 18-20, (2012), San Diego (CA) (USA).
6. An experimental study of flow past an oscillating cylinder. (with C.Lopez et al.) Presented at APS Division of Fluid Dynamics 64th Annual Meeting Nov. 20-22, (2011), Baltimore (MD) (USA).
7. Vortex formation in a shock-accelerated gas induced by particle seeding. (with P.Vorobieff et. al.) Proceedings of the 28th International Symposium on shock waves (ISSW), Manchester (U.K) (2011).
8. Numerical simulation of a shock-accelerated multiphase fluid interface. (with M.Anderson et al.) Proceedings of the 28th International Symposium on shock waves (ISSW), Manchester (U.K) (2011).
9. An experimental study of flow past two rotating cylinders. (with B.Gonzalez and O.Probst). Presented at APS Division of Fluid Dynamics 63rd Annual Meeting Nov. 21-23, (2010), Long Beach (CA) (USA).
10. Generalized Rayleigh-Taylor and Richtmyer-Meshkov instabilities in particle seeded flows. (with P.Vorobieff et al.). Presented at APS Division of Fluid Dynamics 63rd Annual Meeting Nov. 21-23, (2010), Long Beach (CA) (USA).
11. Experimental study of a gas flow non-uniformly seeded with droplets . (with J.Conroy et al.). Presented at APS Division of Fluid Dynamics 63rd Annual Meeting Nov. 21-23, (2010), Long Beach (CA) (USA).
12. Modeling a shock-accelerated fluid-multiphase fluid interface. (with M.Anderson et al.). Presented at APS Division of Fluid Dynamics 63rd Annual Meeting Nov. 21-23, (2010), Long Beach (CA) (USA).
13. An experimental study of flow around a spinning cylinder. (with C.Cantu and B.Gonzalez). APS Division of Fluid Dynamics 62st Annual Meeting Nov. 22-24, (2009), Minnesota (MN) (USA).
14. An experimental study of near wake structure behind a spinning cylinder. (with C.Cantu and B.Gonzalez). NHSB/NHSP Conference, February 11-15 (2009).
15. An experimental study of near wake structure behind two circular cylinders with heat addition. (with G.Laughlin) APS Division of Fluid Dynamics 61st Annual Meeting Nov. 23-25, 2008, TX - San Antonio (USA).
16. Measurements of a re-shocked heavy gas curtain using PLIF. (with K.Prestridge et al.) APS Division of Fluid Dynamics 58th Annual Meeting Nov. 20-22, 2005, Chicago(USA).
17. Statistical characterization of mixing induced by Richtmyer-Meshkov instability . (with C.Tomkins et al.) APS Division of Fluid Dynamics 58th Annual Meeting Nov. 20-22, 2005, Chicago(USA).
18. Experimental measurements of interfacial area generation in Richtmyer-Meshkov instability. Proceedings of the 25th International Symposium on Shock Waves – ISSW 25, July 17-22, 2005, Indian Institute of Science – Bangalore (INDIA)
19. Experimental measurements of integral stretching rates of material lines due to Richtmyer-Meshkov Instability. APS Division of Fluid Dynamics 57th Annual Meeting Nov. 21-23, 2004, Seattle, Washington(USA).

20. An experimental study of the interaction of three Richtmyer-Meshkov-unstable gas cylinders. 9th International Workshop on the Physics of Compressible Turbulent Mixing, July 19-23, 2004, Cambridge – UK.
21. Visualizing the onset and growth of secondary instabilities in Richtmyer-Meshkov-unstable flows (with C.Tomkins *et al.*). 9th International Workshop on the Physics of Compressible Turbulent Mixing, July 19-23, 2004, Cambridge – UK.
22. Planar velocity and scalar concentration measurements in shock-accelerated, unstable fluid interfaces (C.Goodenough *et al.*) Proceedings of the 26th International Congress on High Speed Photography and Photonics., pp. 186-192, Sept. 19-24, 2004 (sponsored by SPIE). Alexandria, VA (USA).
23. Interaction of three shock-generated counter rotating vortex pairs. APS Division of Fluid Dynamics 56th Annual Meeting Nov. 23-25, 2003, East Rutherford, New Jersey (USA).
24. Visualizing the onset and growth of secondary instabilities in shock-accelerated flows (with C. Tomkins *et al.*). APS Division of Fluid Dynamics 56th Annual Meeting Nov. 23-25, 2003, East Rutherford, New Jersey (USA).

Awards and Honors:

1. Exceptional Merit Award 2010, The University of Texas at Brownsville – USA.
2. Olegario Vasquez Rana Faculty Fellow 2008-10, The University of Texas at Brownsville – USA.
3. Charles D. Babcock award, 2002, for significant contribution to teaching in Aeronautics Department at Cal Tech.
4. Donald Wills Douglas Prize Fellowship, 2000-01, Cal Tech., USA.
5. General Proficiency Medal 1994 for the best academic performance in B.Tech program of Aerospace Engineering at IIT-Kanpur (India).
6. Academic excellence certificate, 1997 for best performance in Integrated Foundation and Orientation course (INFO-96) of Defense Research and Development organization (DRDO, India).
7. National merit scholarship (1988-94).
8. Merit Certificate for appearing in the merit list of UP Board examination, 1988.

External funding:

- NSF MRI AWARD (*Principal Investigator*)
Title: MRI: Acquisition of Particle Image Velocimetry System for Study of Bluff Body Wakes and Shock-Accelerated Flows
Award no. CMMI – 0723094
Duration: 08/01/2007 – 07/31/2008.
Amount: \$102,096
- NSF AWARD - Robert Noyce Teacher Scholarship Program Phase I, Track 1
Personnel: Jerzy K. Mogilski (PI), Carmen Garcia-Caceres (Co-PI), Eli E. Pena (Co-PI), Reynaldo Ramirez (Co-PI), **Sanjay Kumar (Co-PI)**.
Award Number – DUE 0934896
Duration: 2009 – 2014
Amount: \$900,000
- DOE-NNSA grant (Consultant) (Prof. P.Vorobieff from UNM as PI)
Title: Shock-driven multiphase hydrodynamic experiments for hydrocode validation.
Duration: December 2009 – December 2012
Amount: \$540,000 (for three years) (my share - \$12000/yr for three years).

- Department of Education Grant Award :
Personnel: Mikhail Bouniaev (PI), *Sanjay Kumar (Co-PI)*, and Jerzy K. Mogilski (Co-PI).
Title: Readiness, Recruitment, Retention, Graduation – four dimensions for achieving hispanic student STEM success.
Award Number – P120A110083
Duration: October 2011 – September 2014
Amount: \$748,832

Teaching Experience:

Since joining the Engineering Department at the University of Texas – Brownsville, I have taught the following courses:

- Fall 2006: ENGR 3303 (THERMODYNAMICS) and ENGR 2301 (STATICS)
- Spring 2007: ENGR 4406 (FLUID MECHANICS)
- Fall 2007: ENGR 3303 (THERMODYNAMICS) and ENGR 2301 (STATICS)
- Spring 2008: ENGR 2302 (DYNAMICS) and ENGR 4406 (FLUID MECHANICS)
- Fall 2008: ENGR 3303 (THERMODYNAMICS) and ENGR 2301 (STATICS)
- Spring 2009: ENGR 2302 (DYNAMICS) and ENGR 4406 (FLUID MECHANICS)
- Fall 2009: ENGR 2301 (STATICS) and ENGR 4242 (SENIOR DESIGN – I)
- Spring 2010: ENGR 2302 (DYNAMICS) and ENGR 4243 (SENIOR DESIGN - II).
- Fall 2010: ENGR 2301 (STATICS) and ENGR 4242 (SENIOR DESIGN – I).
- Spring 2011: ENGR 2301 (STATICS) and ENGR 4242 SENIOR DESIGN (– II).
- Fall 2011: ENGR 4242 (SENIOR DESIGN – I) and ENGR 4310 (HEAT & MASS TRANSFER).
- Spring 2012: ENGR 2302 (DYNAMICS) and ENGR 3303 (THERMODYNAMICS).
- Fall 2012: ENGR 2302 (DYNAMICS) and ENGR 4242/4243 (SENIOR DESIGN I/II)
- Spring 2013: ENGR 2301(STATICS), ENGR 2302 (DYNAMICS), and ENGR 4242/4243 (SENIOR DESIGN I/II).

Invited lectures/seminars:

1. *Indian Institute of Technology*, Kanpur(INDIA), Nov 04, 2004
2. *The University of British Columbia*, Vancouver (CANADA), April 04, 2005
3. *The University of Texas*, Brownsville (USA), April 27, 2005
4. *Indian Institute of Technology*, Delhi (INDIA), Oct. 7, 2005
5. *Indian Institute of Technology*, Mumbai (INDIA), Nov. 8, 2005
6. *Bhabha Atomic Research Center*, Trombay (Mumbai, INDIA), Nov. 9, 2005
7. *The University of Texas, Department of Physics and Astronomy*, Brownsville (USA), September 22, 2006
8. *University of Toronto, Institute for Aerospace Studies*, Toronto (CANADA), Oct. 13, 2006.
9. *The University of New Mexico, Department of Mechanical Engineering*, Albuquerque, New Mexico (USA), March 07, 2008.
10. *The University of Texas at Brownsville, TSC Board Briefing* (Oct. 30, 2008)
11. *The Army Corps of Engineers, Vicksburg, Mississippi*, Oct.9 (2009)
12. *The University of Texas, Department of Physics and Astronomy*, Brownsville (USA), October 16, 2009.
13. *The University of Texas at Brownsville, CSMT seminar* October 2011.

Student Advisor:

Undergraduate Students: I have advised 16 undergraduate students towards their final thesis.

Master's Graduate Student: Advised 1 master's student, Mr. Ross White, of the University of New Mexico with Dr. P.Vorobieff from UNM (Thesis defense: April 30, 2012).

Doctoral Graduate Student: Presently co-advising Mr. Jose Francisco from Monterrey Tech. (Mexico) towards his Ph.D.

Hosting Visiting Faculty – Prof. Oliver Probst from Monterrey Tech. (Mexico) spent his sabbatical year in my newly created Fluid Mechanics Laboratory studying bluff body wakes.

Professional Membership:

American Physical Society, Sigma-Xi

Professional Service:

- Continue to provide service as a referee for: Journal of Fluid Mechanics, Physical Review E, International Journal of Shock Waves, ASME – Journal of Fluids Engineering, Physics of Fluids, Journal of Fluids and Structures, and Materials & Metallurgical Transactions B.
- Session Chair: Separated Flows III (Session H27) American Physical Society – 65th Annual Meeting of the Division of Fluid Dynamics (Nov. – 18-22, 2012, San Diego, California (USA)).
- Session Chair: Separated Flows I (Session GF). American Physical Society – 63rd Annual Meeting of the Division of Fluid Dynamics (Nov. – 21-23, 2010, Long Beach, California (USA)).
- Session Chair: Hele-Shaw cells and Marangoni Instabilities (Session HF). American Physical Society - 61st Annual Meeting of the Division of Fluid Dynamics (Nov. – 23-25, 2008, San Antonio TX (USA)).

Departmental and University Service:

In my present position, I am involved in the service of the Department of Engineering at The University of Texas at Brownsville in various capacities such as:

- Dean's Fund Committee (Member), 2010-present: College of Science, Mathematics and Technology.
- Dean's Search Committee (Member), 2008-09: College of Science, Mathematics and Technology.
- Mechanical Engineering Faculty Search Committee (for two faculty hiring) – Chair (2008-09)
- Electrical Engineering Faculty Search Committee (for one faculty hiring) – Chair (2008)
- Actively involved with the recruitment efforts of the department.
- Departmental ABET committee – member (2008-present).
- Registration Officer for Engineering Department – 2009-present
- Member of Curriculum Committee (2006 – present)
- Departmental Scholarship Committee – Chair (2007-08), presently member.
- Academic advisor for the Engineering Physics – Mechanical. (2006 – present).
- Department Personnel Committee – Chair (2012 – present)
- College Personnel Committee – Member (2011 – present).
- Departmental Review Committee –Member (2012).

Laboratory Development:

I built the first Fluid Mechanics Laboratory in the newly created Engineering Department of the University of Texas – Brownsville. The laboratory now has several facilities and diagnostic techniques for research and teaching. The laboratory has evolved into a research grade laboratory as publications by students have started to emerge in reputed journals.

- A new shock-tube facility has been designed and built in the fluid mechanics laboratory. The facility is capable of producing shock-waves upto Mach number 2.0 in air. The facility is unique owing to its inclining capability thus facilitating study of oblique interactions with gaseous inhomogeneities. The facility has been recently instrumented using LabView platform. The facility is presently being used students working on senior design projects and for writing several research proposals.
- The water – tunnel facility in the department has been equipped with hydrogen bubble flow visualization technique and quantitative laser-based diagnostic techniques such as Particle Image Velocimetry Technique. The facility is being used by students to study flow around bluff bodies. Several publications in reputed journals and presentations by students have emerged from the research being conducted on this tunnel.
- Soap Film Tunnel: A soap film tunnel has been built to study fluid flows in flowing films and is equipped with flow visualization techniques to investigate 2D turbulence.
- The teaching of the Fluid Mechanics course is now augmented with several (~ 6 to 8) experiments which have been designed and implemented.

References

1. Prof. Hans G. Hornung, Kelly Johnson Professor of Aeronautics
Graduate Aerospace Laboratories California Institute of Technology, Pasadena, CA 91125
E-Mail: hans@galcit.caltech.edu (Ph. No. 626-395-4551)
2. Prof. Peter Vorobieff, Professor, Department of Mechanical Engineering
The University of New Mexico, Albuquerque, NM87131
E-Mail: kalthoth@unm.edu
3. Prof. Oliver Probst, Professor, Physics Department
Tecnologico De Monterrey., Monterrey (Mexico).
E-mail: oprobst@itesm.mx
4. Prof. Fred E. Culick, Richard L. and Dorothy M. Hayman Professor of Mechanical Engineering and Professor of Jet Propulsion.
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