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About Dr K. Muralidhar...

1. Name

KRISHNAMURTHY MURALIDHAR

2. Present position

Professor (HAG), Department of Mechanical Engineering
Indian Institute of Technology Kanpur

3. Postal address

Dr. K. Muralidhar, FNAE, FNASc, F-ASTFE
Professor
Department of Mechanical Engineering
Indian Institute of Technology Kanpur
Kanpur 208016 UP India

4. Email address

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URL: <http://home.iitk.ac.in/~kmurli/>

5. Phone number (mobile) and (landline)

99193 73363; 0512 2597182 (office); 2598421 (residence)

6. Date of birth

19th November 1958

7. Educational qualifications

Doctor of Philosophy (Applied Science), April 1985, University of Delaware, Newark DE, USA

Dissertation Title: EFFECT OF BUOYANCY ON MIXING LAYERS.

Thesis advisors: Professor Frank A. Kulacki, presently at University of Minnesota, Minnesota; and Professor Selcük Güçeri, Dean of Engineering, Drexel University, Philadelphia

Master of Technology (Mechanical Engineering), 1981, Indian Institute of Technology Madras, India

Bachelor of Engineering (Mechanical Engineering), 1979, Visvesvaraya Regional College of Engineering, Nagpur, India

8. Present scale of pay

Rs. 67,000-79,000 (Higher Academic Grade scale since 2009); Rs 79,000 since 1st July 2012

9. Experience (academic/teaching and administrative)

ACADEMIC

- i. June 2009 onwards, Professor (HAG), Indian Institute of Technology, Kanpur (India).
- ii. December 1995 to present, Professor, Indian Institute of Technology, Kanpur (India).
- iii. August 2003 – December 2003, Adjunct Professor, Mewbourne School of Petroleum and Geological Engineering, and Department of Mechanical Engineering, University of Oklahoma, USA.
- iv. 23rd June 2007 – 6th July 2007; 4 June – 20 June 2008; 6 July – 16 July 2009, Visited Computer Vision Laboratory, Department of Electrical Engineering, Swiss Federal Institute of technology (ETH), Zurich, Switzerland.
- v. May-July 1999, INSA/JSPS Invitation Fellow, Kyoto University, Kyoto, Japan.
- vi. June-July 1997, Visiting Research Professor, SUNY Stony Brook, USA.
- vii. August 1996 to May 1997, JSPS Invitation Fellow, Kyoto University, Kyoto, Japan.
- viii. March 1993 to December 1995, Associate Professor, IIT, Kanpur, India.
- ix. July 1987 to March 1993, Assistant Professor, IIT Kanpur, India.
- x. January 1986 to July 1987, Post-doctoral Fellow, Lawrence Berkeley Laboratory, Berkeley, USA.
- xi. April 1985 to December 1985, Post-doctoral Fellow, University of Delaware, Newark, DE USA.

ADMINISTRATIVE

1. Dean: Faculty Affairs, January 2016 onwards.
2. Dean: Research and Development, January 2015 to May 2015.
3. Dean: Research and Development, January 2008 to January 2011.
4. Head: Department of Mechanical Engineering, June 2005 to February 2008.
5. Chairman GATE, JMET-2006 and JAM-2006, May 2005 to June 2006.

10. Patents

INTERNATIONAL

Enhancing blood flow images using computational fluid dynamics, jointly with ETH Zurich, WO 2010/022762 A3 (filed in August 2008, international publication date, March 2010); K. Muralidhar, G. Szekeley, D. Szczerba, and R. McGregor.

INDIAN

1. *Functional flow generator for multi-drug delivery system*, (functional and design) patents filed (May 2011, reference: 1557/DEL/2011); K. Muralidhar, A. Jain, R. Dwivedi, Rama Rao, P. Khanna, and Manoj Sharma.
2. *Non-invasive technique for evaluation of flow rates and identification of vascular deformation*, K. Muralidhar, Abhinav Parashar, Rahul Singh, Manoj Sharma, P. K. Panigrahi, patent filed (February 2013, reference: PD008489-IN-SC 363/ DEL/ 2013).
3. *Water purification system using an enhanced solar still*, K. Muralidhar, A. Anand, A. Bhandari, S. Prakash, Manoj Sharma, Raj G. Pala (patent filed; 2894/DEL/2013).
4. *Light streak imaging technique for determining mass diffusivity in a binary diffusion process*, K. Muralidhar, Y. Nimdeo, Subhajit Kar, Y.M. Joshi (patent filed; 904/DEL/2014).
5. *Unsteady wall heat flux sensor for extreme applications*, Ravindra Sonawane, S. Khandekar, K. Muralidhar (patent filed application number 3977/DEL/2014 dated 29th December 2014).
6. *Spherical tri-leaflet heart valve*, Kamal K. Kar, Malay Das, Sutapa Mandal, K. Muralidhar, patent application number 201711043075, dated 30th November 2017.

11. Awards/recognitions

- i. **Fellow**-ASTFE (American Society of Thermal and Fluids Engineering), since April 2019.
- ii. **Fellow** of National Academy of Sciences (2014).
- iii. **Fellow** of Indian National Academy of Engineering (2006).
- iv. **Editor-in-Chief**, Journal of Flow Visualization and Image Processing, since January 2018.
- v. Nominated as **KEYNOTE SPEAKER** from India in International Heat Transfer Conference held at Kyoto University, Kyoto, Japan (2014).
- vi. Invited Lecture entitled FLOW AND TRANSPORT IN POROUS MEDIA WITH APPLICATIONS, presented on 19th March 2015 at *The Institute of Fluid Science*, Tohoku University, Japan.
- vii. **KEYNOTE SPEAKER** at the Asian Society for Computational Heat Transfer and Fluid Flow, held at Busan, S. Korea during 22-25 November, 2015.
- viii. University rank holder and degree with **distinction** in the undergraduate program (1979).

- ix. Awarded the **Institution Prize** of Institution of Engineers (India) for paper on enhanced oil recovery (1995).
- x. Awarded the M.G. Deshpande **Best Paper** Prize in the National Fluid Mechanics and Fluid Power Conference held at IIT Kharagpur, (1999).
- xi. Received **letters of commendation** from Director, IIT Kanpur for the following courses on over 15 occasions: Conduction and radiation, Experimental techniques in thermal sciences, Programming and Numerical methods.
- xii. University of Delaware **Fellowship** holder during the entire Ph.D program (1981-1985).
- xiii. Awarded Institute Medal and **Dr Sengupto** Prize for standing First in the Master's program at IIT Madras, India (1981).

Postdoctoral Fellows

- a) Samarjeet Chanda, Surrogate modeling for property and boundary condition estimation in an inverse framework.
- b) Arshad Afzal (Inspire), Optimization of rib geometry for gas turbine blade cooling.

PhDs guided (completed/in progress)

- i. P.M.V. Subbarao, Experimental study of the effect of stable thermal stratification on a class of turbulent shear flows, (1995).
- ii. Debasish Mishra, Experimental study of Rayleigh-Benard convection using interferometric tomography, (1998).
- iii. Arun K. Saha, Dynamical Characteristics of the wake of a square cylinder at low and high Reynolds numbers, (1999).
- iv. Tanuja Sheorey, Numerical modeling of enhanced oil recovery from porous and fractured formations on parallel computers, (2001).
- v. Sunil Punjabi, Interferometric Study of Convection in Superposed Gas-Liquid Layers, (2002).
- vi. Andallib Tariq, Heat transfer enhancement and fluid flow behind surface mounted solid and permeable ribs (2004).
- vii. Jyotirmay Banerjee, Modeling of the Czochralski crystal growth process, role of magnetic fields and influence on the thermo-mechanical properties, (2004).
- viii. Atul Srivastava, Optical imaging of convection around a KDP crystal growing from its aqueous solution, 2006 (given the best-PhD thesis award during the National Laser Symposium-2006, held at RRCAT Indore; also given the best-PhD thesis award of Indian National Academy of Engineering for the year 2006.).
- ix. Sushant Dutta, Structure of flow and the turbulent field over ribbed surfaces, (2006).

- x. Chanpreet Singh, Unsteady convective heat transfer in liquid saturated and unsaturated porous media with reference to an energy storage system (2007).
- xi. Sunil Verma, Convection, concentration, and surface feature analysis during crystal growth from solution using shadowgraphy, interferometry, and tomography (2008) (selected for the best-PhD thesis award during the National Laser Symposium-2007, held at MS University of Baroda, Vadodara).
- xii. Robert H.P. McGregor, Enhancing medical images with high quality blood flow information (2010), at ETH Zurich (under the Indo-Swiss joint research program of DST, New Delhi).
- xiii. Trushar Gohil, Flow control using three dimensional perturbed jets (2011).
- xiv. Anamika Sethia-Gupta, Optical visualization of protein crystal growth (April, 2012).
- xv. Sushanta Biswal, Open channel junction flows in simple and compound channels in the transcritical regime (June, 2012).
- xvi. Basant Sikarwar, Motion of droplets on physically and chemically textured surfaces (December, 2012).
- xvii. S.K. Bhandari, Transport phenomena in aging gels and colloidal glasses (June, 2013).
- xviii. Yogesh Nimdeo, Mass diffusivity of solutions and sol/gel forming colloidal suspensions (2016).
- xix. Narendra Gajbhiye, Numerical Simulation of Magnetohydrodynamics Flow and Heat Transfer in Enclosures and Ducts (2016).
- xx. Praveen Somwanshi, Three dimensional imaging of coalescence dynamics of drops underneath textured surfaces (December, 2018).
- xxi. Abdullah Usmani, Imaging oscillatory flow in deforming arterial bifurcations (January 2018).
- xxii. Ganesh Shirsath, Design and performance of an improved solar still using membranes (October, 2018).
- xxiii. Krishna Chandran, Accelerators for linear solvers in three dimensional CFD (in progress).
- xxiv. Raghavendra Pratap Singh, Analysis of methane recovery techniques and CO₂ sequestration in the K-G basin (in progress).
- xxv. Supriya Upadhyay, Electrically controlled coalescence of droplets on mesh-like hydrophobic surfaces (in progress).
- xxvi. Manish Bhendura, Evaporation and condensation in variable porosity media with an application to a loop heat pipe (in progress).
- xxvii. Gopinath Sahu, Jet impingement mist cooling of electronic components using micro-nozzles (in progress).
- xxviii. Waquar Raza, Dropwise condensation over mesh-like surfaces (in progress).

- xxix. Raghavendra Dwivedi, Locomotion of small liquid drops in minichannels using an electric field (in progress).

Master's theses guided

1. Applications of a PC- Based Data Acquisition System to frequency Measurement in Fluid Flows (1989).
2. Study of Free Stream Turbulence in an Adverse Pressure Gradient Flow (1989).
3. Decay of Turbulence in a Homogeneous Stably Stratified Flow (1990),
4. Operator Splitting Algorithms for Convection- Diffusion Problems (1990).
5. Experimental Study of Cooling of Electronic Components (1991).
6. Experimental Study of Dynamic Performance of Flow Transducers (1992).
7. An Experimental Study of the Effect of Heating on Flow Past Cylinders (1992).
8. Force and Displacement Spectra for Sluice Gates Placed in Open Channel Liquid Flow (1993).
9. Interferometric Study of Cooling of Electronic Equipment using Digital Image Processing (1993).
10. Numerical Study of Enhanced Oil Recovery Using Surfactants, (1993).
11. Interferometric Study of Transient Rayleigh - Benard Convection using Digital Image Processing (1993).
12. Experimental Study of Transformation of Regular and Random Surface Waves in a Variable Depth Liquid Layer, (1994).
13. Experimental Study of Forces and Moments Induced on a Circular Cylinder by Regular and Random Waves, (1994).
14. Development of a Preconditioned Conjugate Gradient Method for Transient Diffusion Problems in Complex Geometries, (1995).
15. Development of a FEM-based Operator-Splitting Code with Domain Decomposition for Advection-diffusion Problems, (1995).
16. Interferometric Study of Rayleigh - Benard Convection in a Square Cavity Including Three Dimensional Reconstruction, (1995).
17. Wake Interference and Vortex Shedding a Pair of Circular Cylinders in Cross-flow, (1996).
18. Investigations on Extent of Thermally Generated Noise in Interferometric Images, (1996).
19. Experimental Study of Turbulent Fluctuations in Depth and Base Pressure in a Hydraulic Jump, (1996).
20. Tomographic reconstruction of Axisymmetric Temperature Fields using a Mach-Zehnder Interferometer, (1997).
21. Comparison between Direct and Non-intrusive Measurements of the Temperature Fields in Rayleigh-Benard Convection, (1997).
22. Experimental Study of Rayleigh-Benard Convection in an Intermediate Aspect Ratio Enclosure (1998).
23. Interpretation of Relaxation Factors of Iterative Methods in Computerized Tomography, (1999).
24. On the Determination of the Viscosity of AFM Media, (1999).
25. Numerical Simulation of Enhanced Oil Recovery from Porous Formations, (1999).

26. Numerical Analysis and Thermodynamic Modeling of a Stirling Cycle Cryocooler, (1999) at Kyoto University, Japan.
27. Analysis of Pulse-tube Cryocoolers using the Method of Characteristics, (2000) at Kyoto University, Japan.
28. Parameter Estimation in Nonlinear Diffusion Problems by an Inverse Techniques, (2000).
29. Laser Interferometric Study of Rayleigh-Benard Convection in an Axisymmetric Differentially Heated Fluid Layer, (2000).
30. Simulation and Correction of the Beam Hardening Effect in X-ray Tomography, (2000).
31. Buoyancy-driven Convection in Superimposed Air-Water Layers, (2001)
32. Experimental Study of Convective Heat Transfer from Flat and Ribbed Surfaces, (2001).
33. Modeling Drop Shapes above and below Horizontal and Inclined Surfaces, (2001).
34. Parallelization of a 3-D Finite Volume Incompressible Navier-Stokes Solver for a Complex Geometry, (2002).
35. Flow, Heat and Mass Transfer in Low Pressure CVD Reactors, (2002).
36. Visualization and Analysis of Convective Fields using a Schlieren Technique, (2003).
37. Role of Unsteadiness in Heat Transfer Enhancement from a Ribbed Surface, (2003).
38. Development of a Transient Inverse Technique for Determination of the Nusselt Number Distribution over Flat and Ribbed Surfaces (2003).
39. Assessment of a Preconditioned Conjugate Gradient Algorithm for Matrix Inversion and its Application to Solutal Transport in a Crystal Growth Process (2003).
40. Modeling Flow Patterns within a Liquid Drop Sliding on a Flat Inclined Surface (2003).
41. Interferometric study of Steady and Unsteady Convection in Cylindrical and Eccentric annuli (2005).
42. Color schlieren imaging of solutal concentration around a KDP crystal growing from its aqueous solution (2006).
43. Wake interactions at intermediate Reynolds numbers for an oscillating square cylinder placed in a uniform stream (2006).
44. Interface deformation and convective transport in a horizontal differentially heated fluid layer (2006).
45. Turbulence characteristics of boundary perturbed channel flow: experiments at low and high frequencies (2006).
46. Imaging hanging drops on inclined textured surfaces (2007).
47. Study of aging behavior of aqueous laponite suspensions by interferometry technique (2007).
48. Simulation of flow in a laser dye cell (2007).
49. Amplitude modulated synthetic jet actuator array for control of turbulent channel flow (2007).
50. Computational investigation of jet mixing in a tubular reactor (2008).
51. Imaging convective transport using coherent gradient sensing interferometry (2008).
52. Understanding ageing dynamics in colloidal glasses (2008).
53. Laminar and turbulent boundary layer manipulation using synthetic jet actuation (2008).
54. Schlieren interferometry study of a square cylinder wake: influence of buoyancy and orientation (2008).
55. Vapor-liquid equilibrium of systems containing organic phosphates (2009).

56. Imaging steady and oscillatory flows in tubular bifurcations (2009).
57. Dropwise condensation over inclined surfaces (2009).
58. Study of heat transfer through soft glassy materials using laser light interferometry (2010).
59. Experimental Study of Heat Transfer from a Plate placed inside a Rotating Enclosure (2010).
60. Imaging oscillatory flow in straight compliant tubes and bifurcations (2010).
61. Mathematical modeling of methane recovery from gas hydrates reservoirs (2011).
62. An educational website on interferometry (2011).
63. Numerical simulation of flow and transport in curved tubes and T-junctions (2011).
64. Imaging fluid flow during impingement of differentially heated jets over a flat surface (2012).
65. Interferometry- website and implementation of the phase-shifting algorithm (2012).
66. Imaging oscillatory flow in arterial models (2012).
67. Understanding coalescence of pendant drops on a textured surface via simulation and experiments (2012).
68. Numerical simulation of oscillatory flow in rigid and flexible tubes with a bulge (2012).
69. Pulsatile flow in porous media with applications in aortic and cerebral aneurysms (2013).
70. Determination of mass diffusivity of a binary liquid system using shadowgraph technique (2013).
71. Modeling methane recovery from gas hydrate reservoirs jointly with CO₂ sequestration (2013).
72. Wake dynamics of a square cylinder subjected to mild longitudinal shear (2013).
73. Simulation and experimental study of a digital off-axis holographic system (2013).
74. A generalized Lagrangian model of drop spreading on textured surfaces (2014).
75. Effect of coil embolization on fluid loading in a cerebral aneurysm (2014).
76. Measurement of viscosity and drag coefficient using unsteady motion of a spherical particle (2014).
77. Effect of intracranial pressure and fluid loading on the hemodynamics of a cerebral aneurysm (2015).
78. Inverse measurement of local and average heat fluxes during coalescence of liquid drops on a solid surface (2015).
79. Effect of aorto-iliac bifurcation and iliac stenosis on flow dynamics in abdominal aortic aneurysm (2016).
80. Evaporation of a sessile droplet over different substrates (2016).
81. Classical molecular dynamics simulations of evaporation of contaminated water (2016).
82. Parallel Algorithms in Simulation of Methane Recovery from Hydrate Reservoirs (2017).
83. Effect of mesh movement on simulation of flow in a bulge (2017).
84. Simulation of methane recovery from gas hydrate reservoirs using nitrogen injection (2018).

M.Sc. DISSERTATION

1. Applying operator splitting algorithms to the advection-diffusion equation as applied to Stirling cryocoolers (2005; University of Karlsruhe, Germany).

2. Imaging and interferometric analysis of protein crystal growth (2007; Cochin University of Science and Technology).

UNDERGRADUATE PROJECTS

1. A diaphragm-pump as a heart machine (1990).
2. A linear pneumatic drag measuring apparatus (1991).
3. Nonlinear fluidic device exhibiting chaos (1999).
4. Stirling cryocooler for demonstration (1999).
5. Linear motor driven free piston, free displacer cryocooler (2000). *Awarded the best project prize for the year.*
6. Piston-driven miniature cryocooler (2000).
7. FPDF cryocooler with an energized displacer (2001).
8. Monitoring of a crystal growth apparatus using the schlieren technique (2001).
9. Control of convection in a low-temperature Czochralski crystal growth test cell (2003).
10. Tomographic crystal growth apparatus for laser interferometry (2003). *Awarded the best project prize for the year.*
11. An experimental set-up to study interaction of curvature with rotation in channel flow geometry (2006).
12. Artificial heart machine for testing aortic valves (2006).
13. Vortex generation in micro-, mini-, and macro-channels at low Reynolds numbers (2007).
14. An attachment for uniaxial testing of anisotropic specimens (2007).
15. Test facility for oscillatory flow in an aortic bifurcation (2010).
16. Functional flow generator (2011). *Awarded the Jayesh Memorial prize for the year.*
17. Design and fabrication of a compact pulse tube cryocooler (2012).
18. Design and fabrication of a solar still for drinking water applications (2012). *Awarded the Jayesh Memorial prize for the year as well as the Prime'83 award.*
19. Developing a Stirling refrigerator with built-in engine for utilization of waste heat (2014).
20. Thermosyphon-based water purification system (2015).
21. Multi-frequency peristaltic pump with two independent drives for non-sinusoidal periodic waveforms (2019).

Publications (national/international)

PUBLICATIONS IN THE LAST TEN YEARS

1. Praveen Somwanshi, K. Muralidhar, and Sameer Khandekar, Coalescence Dynamics of Sessile and Pendant Liquid Drops Placed on a Hydrophobic Surface, *Physics of Fluids*, Vol. 30, 092103, 15 pages (2018).
2. Arshad Afzal, Hyung Hee Cho, Heeyon Chung, K Muralidhar, Neural-network-assisted optimization of rectangular channels with intersecting ribs for enhanced thermal performance, accepted for publication in *Heat Transfer Engineering*, Vol. 41(20), 2019.

3. Ganesh Shirsath, Raj G. S. Pala, J. Ramkumar, and K. Muralidhar, Condensation of Water Vapor underneath an inclined Hydrophobic Textured Surface Machined by Laser and Electric Discharge, accepted for publication in *Applied Surface Science* (2019).
4. V. Baghel, B.S. Sikarwar, K. Muralidhar, Modeling of heat transfer through a liquid droplet, *Heat and Mass Transfer*, <https://doi.org/10.1007/s00231-018-2520-2>, 15 pages, November 2018.
5. Ganesh Shirsath, Raj Pala, K. Muralidhar, and K. Muralidhar, Effect of salinity and water depth on the performance of doubly inclined solar still, *Desalination and Water Treatment*, Vol. 124, pp. 72-87 (2018).
6. Praveen Somwanshi, K. Muralidhar, and Sameer Khandekar, Dropwise Condensation Patterns of Bismuth Formed on Horizontal and Vertical Surfaces, *Int. J. Heat and Mass Transfer*, Vol. 122, pp. 1024-1039 (2018).
7. Krishna Chandran and K. Muralidhar, Condition Number Analysis of Flow Fields arising from CFD Simulations, *International Journal of Advances in Engineering Sciences and Applied Mathematics (Special issue on Computational Heat Transfer and Fluid Dynamics)* Vol. 10(4):238–251 (2018).
8. Aashutosh Mistry and K. Muralidhar, Spreading of a pendant liquid drop underneath a textured substrate, *Physics of Fluids*, Vol. 30(4), paper number 042104, 18 pages (2018).
9. Abdullah Usmani and K. Muralidhar, Flow in an Intracranial Aneurysm Model: Effect of Parent Artery Orientation, *Journal of Visualization*, Vol. 21(5), pp. 795-721 (2018).
10. Abdullah Usmani and K. Muralidhar, Pulsatile flow in a compliant stenosed asymmetric model, *Experiments in Fluids*, Vol. 57:186, pp. 1-24 (2016).
11. Shivam Patel, A. Usmani and K. Muralidhar, Effect of aorto-iliac bifurcation and iliac stenosis on flow dynamics in an abdominal aortic aneurysm, *Fluid Dynamics Research*, Vol. 49, 035513 (29pp) (2017).
12. Samarjeet Chanda and K. Muralidhar, Joint estimation of thermal and mass diffusivities of a solute-solvent system using ANN-GA based inverse framework, *International J. Thermal Sciences*, Vol. 123, pp. 27-41 (2018).
13. Sachin K. Singh, Mohit Gogna, K. Muralidhar and Sameer Khandekar, Combined effect of substrate wettability and thermal properties on evaporation dynamics of a sessile droplet, accepted for publication, *Interfacial Phenomena and Heat Transfer*, Vol. 5, pp. 321-335, (2017).
14. Y. Nimdeo, Y.M. Joshi, and K. Muralidhar, Diffusion of charged nano-disks in aqueous media: Influence of competing inter-particle interactions and thermal effects, *Chemical Engineering Science*, Volume 164, pp. 71–80 (2017).
15. Trushar Gohil, A.K. Saha, and K. Muralidhar, Simulation of Blooming Phenomenon in Forced Circular Jets, *J. Fluid Mechanics*, Vol. 783, pp. 567-604 (2015).
16. A. Usmani and K. Muralidhar, Oscillatory flow in an enlarged compliant vasculature, *Biomedical Physics & Engineering Express*, Vol. 2, paper 025016 (17 pages) (2016).
17. M.G. Visakh, A.K. Saha, and K. Muralidhar, Effect of spanwise shear on flow past a square cylinder at intermediate Reynolds numbers, *Physics of Fluids*, Vol. 28, 033602, 31 pages (2016).
18. Y. Nimdeo, Y.M. Joshi, and K. Muralidhar, Refractive Index Measurement of Sol Forming Laponite JS Dispersion Using Interferometry, Vol. 123, pp. 273-278, *Applied Clay Science* (2016).
19. Sachin K. Singh, Mahesh Yadav, S. Khandekar, and K. Muralidhar, Estimation of time-dependent wall heat flux from single thermocouple data, *International Journal of Thermal Sciences*, Vol. 115, pp. 1-15 (2017).

20. M. R. Gunjan, P. Somwanshi, Ayush Agarwal, S. Khandekar and K. Muralidhar, Recoil of drops during coalescence on super-hydrophobic surfaces, *Interfacial Phenomena and Heat transfer*, Vol. 3 (2), pp. 1–18 (2015).
21. B.S. Sikarwar, K. Muralidhar and S. Khandekar, Dropwise condensation of metal vapour underneath inclined textured substrates, *Interfacial Phenomena and Heat transfer (Kutataladze special issue)* Vol. 3(1), pp. 85-113 (2015).
22. Aashutosh Mistry and K. Muralidhar, Axisymmetric model of drop spreading on a horizontal surface, *Physics of Fluids*, Vol. 27, 092103, 26 pages (2015).
23. S.K. Biswal, P.K. Mohapatra, and K. Muralidhar, Transitional flow in a right-angled compound open canal junction, accepted for publication in *Irrigation and Drainage* (2016); available on wileyonlinelibrary.com.
24. S.K. Biswal, P.K. Mohapatra, and K. Muralidhar, Hydraulics of combining flow in a right-angled open channel junction, to appear in *Sadhana* (2016).
25. K. Muralidhar and Malay K. Das, Hydrate Reservoirs – Methane Recovery and CO₂ Disposal, *Proceedings of the Indian National Science Academy, special issue on Energy*, Vol. 81(4), pp. 787-800, edited by Baldev Raj, Kamachi Mudali, and I. Manna (2015).
26. K. Muralidhar, Life with Experiments, in *The Mind of an Engineer*; a publication of INAE, pp. 359-361, Springer, edited by P. Ghosh and Baldev Raj (2015).
27. Y. Rathee, B.R. Vinoth, P.K. Panigrahi, and K. Muralidhar, Imaging flow during the impingement of differentially heated jets over a flat surface, *Nuclear Engineering and Design*, Vol. 294 pp. 1-15, December (2015).
28. Y. Nimdeo, Y.M. Joshi, and K. Muralidhar, Measurement of Mass Diffusivity by Light Streak Imaging, *Chemical Engineering Research and Design*, Vol. 102, pp. 207–215 (2015).
29. Trushar Gohil, A.K. Saha, and K. Muralidhar, Large eddy simulation of a free circular jet, *ASME J. Fluids Engg.*, Vol. 136, 051205-1 to -14 (2014).
30. Y. Nimdeo, Y.M. Joshi, and K. Muralidhar, Measurement of mass diffusivity using interferometry through sensitivity Analysis, *Industrial and Engineering Chemistry Research*, Vol. 53, pp. 19338–19350 (2014).
31. Kathrin Burkhardt, Dominik Szczerba, Esra Neufeld, K. Muralidhar, Niels Kuster, Parallel smoothing pressure correction solver for biomedical flow problems: Convergence criteria, preconditioning, scalability, *Progress in Computational Fluid Dynamics*, Vol. 16(4), pp. 201-215 (2016).
32. Trushar Gohil, A.K. Saha, and K. Muralidhar, Direct Numerical Simulation of Free and Forced Square Jets, *International Journal of Heat and Fluid Flow*, Vol. 52, pp. 169-184 (2015).
33. Vishal Agarwal, Chandan Paul, M.K. Das, and K. Muralidhar, Effect of coil embolization on blood flow through a saccular cerebral aneurysm, *Sadhana (Springer)* Vol. 40(3), May 2015, pp. 875–887 (May 2015).
34. Chandan Paul, M.K. Das, and K. Muralidhar, Three-dimensional simulation of pulsatile flow through a porous bulge, *Transport in Porous Media*, Vol. 107(3), pp. 843-870 (2015).
35. S. S. Bhandari, K. Muralidhar, and Y. M. Joshi, Enhanced thermal transport through a soft glassy nanodisc paste, *Physical Review E*, Vol. 87, pp. 022301(1-6) 2013.
36. Trushar Gohil, A.K. Saha, and K. Muralidhar, Direct numerical simulation of forced circular jets: effect of varicose perturbation, *International Journal of Heat and Fluid Flow*, Vol. 44, pp. 524-541 (2013).

37. B.S. Sikarwar, K. Muralidhar, and S. Khandekar, Effect of drop shape on heat transfer during dropwise condensation underneath inclined surfaces, *Interfacial Phenomena and Heat transfer*, Vol. 1(4), pp. 339-356 (2013).
38. S.S. Bhandari, K. Muralidhar, and Y.M. Joshi, Thermal diffusivity and viscosity of suspensions of disc-shaped particles, *Industrial and Engineering Chemistry Research*, Vol. 52, 15114–15123, (2013).
39. Gaurav Bhutani, K. Muralidhar, Sameer Khandekar, Determination of apparent contact angle and shape of a static pendant drop on a physically textured inclined surface, *Interfacial Phenomena and Heat Transfer*, Vol. 1 (1), pp. 29–49 (2013).
40. Abhishek Khetan, Malay K. Das, and K. Muralidhar, Analysis of Methane Production from a Porous Reservoir via Simultaneous Depressurization and CO₂ Sequestration, accepted for publication in *Special Topics and Reviews in Porous Media*, Vol. 4(3), pp. 237-252 (2013).
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4. K. Muralidhar and J. Banerjee, **Conduction and Radiation**, Narosa Publishers, (479 pages), ISBN: 978-81-8487-080-0, February 2010.
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6. P.K. Panigrahi and K. Muralidhar, **Imaging Heat and Mass Transfer Processes - Visualization and Analysis**, Springer Briefs in Thermal Engineering and Applied Science, New York, USA, (October, 2012) ISBN 978-1-4614-4790-0.
7. Sameer Khandekar and K. Muralidhar, **Dropwise Condensation on Inclined Textured Surfaces**, Springer Briefs in Thermal Engineering and Applied Science, New York, USA, ISBN 978-1-4614-8446-2 (September 2013).
8. A.K. Saha, Rajesh Srivastava, Debopam Das, P.K. Panigrahi, and K. Muralidhar, Editors, **Fluid Mechanics and Fluid Power – Contemporary Research**, Springer, January 2016, ISBN: 978-81-322-2743-4.
9. Malay K. Das, P.P. Mukherjee, and K. Muralidhar, **Modeling Transport Phenomena in Porous Media with Applications**, Springer, November 2017; ISBN 978-3-319-69866-3, (258 pages).

CONFERENCE PROCEEDINGS

1. G. Biswas, S. Srinivasa Murthy, K. Muralidhar and V. K. Dhir, Editors, **Proceedings of the 14th National Heat and Mass Transfer Conference and the 3rd ASME-ISHMT Conference**, held at IIT Kanpur (India), ISBN: 81-7319-218-9, 1228 pages, 1997.
2. A.K. Saha, Rajesh Srivastava, Debopam Das, P.K. Panigrahi, and K. Muralidhar, Editors, **Proceedings of the 5th International and 41st National Conference on FMFP 2014**, held at IIT Kanpur during 12-14 December 2014.
3. Amit Agrawal and K. Muralidhar, Guest Editors – Sadhana, **Special Issue on FLUID MECHANICS AND FLUID POWER**, Vol. 40(3), May 2015.
4. C. Balaji and K. Muralidhar, 2017, Proceedings of **The Asian Symposium on Computational Heat Transfer & Fluid Flow** held at IIT Madras during 10-13 December 2017.

REFEREED REPORT

K. Muralidhar and J. C. S. Long, **Scheme For Calculating Flow in Fractures Using Numerical Grid Generation in Three Dimensional Domains of Complex Shapes**, Report No. 24453, pp 1-137, Lawrence Berkeley Laboratory, Berkeley, USA (1987).

BOOK CHAPTERS

1. Coalescence Characteristics of Liquid Drops with Application to Dropwise Condensation, Praveen Somwanshi, K. Muralidhar, and Sameer Khandekar, in Applications Paradigms of Droplet and Spray Transport, pp. 165-200, edited by S. Basu et al. (2018), for the series on Energy, Environment, and Sustainability, Springer; ISBN 978-981-10-7232-1.
2. Visualization of Convective Heat Transfer, P.K. Panigrahi and K. Muralidhar, in Handbook of Thermal Science **and Engineering**, edited by F.A. Kulacki, pp. 759-804, 2018 (Springer) ISBN 978-3-319-26694-7.

3. Optical interferometers: Principles and Applications in Transport Phenomena, S. Verma, Y.M. Joshi, K. Muralidhar, in **Interferometry – Principles and Applications**, Edited by Mark E. Russo, Nova Publishers, USA, ISBN: 978-1-61209-347-5, Chapter 13, pp. 353-414 (2012).
4. Mechanism and localization of wall failure during abdominal aortic aneurysm formation, D. Szczerba, R. McGreggor, K. Muralidhar and G. Szekely, in *Biomedical Simulation*, pp. 119-126, edited by F. Bello and P.J. Edwards, LNCS 5104 Springer, New York (2008).
5. Three dimensional reconstruction of convective features during crystal growth from solution using computerized tomography, with S. Verma (pp. 103-114) and Reconstruction of concentration field around a growing KDP crystal using direct and iterative tomography algorithms with A. Srivastava and P.K. Panigrahi (pp. 115-128), in *CT2008: Tomography Confluence*, edited by P. Munshi, American Institute of Physics Conference Proceedings 1050, New York (2008).
6. Ranjini Raghunandan, Anamika S. Gupta, and K. Muralidhar, Imaging and interferometric analysis of protein crystal growth, Proc. SPIE, Vol. 6991, 69912H(1-9), Proceedings of the SPIE conference entitled *Biophotonics: Photonic Solutions for Better Health Care*, ISBN: 97808 1947 1895, ISSN: 1605-7422, edited by Popp, Drexler, Tuchin, and Mathews (2008).
7. Imaging buoyancy-driven convective field around a KDP crystal using schlieren tomography, with Atul Srivastava and P.K. Panigrahi (pp. 133-147); Determination of the concentration field around a growing crystal using laser shadowgraphic tomography (pp. 158-175), with Sunil Verma and V.K. Wadhawan, in *Computerized Tomography for Scientists and Engineers*, edited by P. Munshi, Anamaya Publishers, New Delhi, 2006.
8. K. Muralidhar, Introduction to turbulence, pp 1-40, Classical idealization of turbulent flows, pp 75-114, Introduction to experimental techniques, pp 141-178, in *Turbulent Flows: Fundamentals, Experiments and Modeling*, Edited by G. Biswas and V. Eswaran, Narosa Publishers, New Delhi, 2002.
9. K. Muralidhar, Equivalent thermal conductivity of a heterogeneous medium, in *High Temperature Fiber Composite Materials*, pp. 243-257, edited by V.K. Srivastava, Allied Publishers, New Delhi (2000).
10. K. Muralidhar and J. C. S. Long, A New Approach to Characterize Flow in Single Rock Fractures, in *Flow and Transport Through Unsaturated Rocks*, Editors: D. Evans and J. Nicholson, pp 115 - 120, Geophysical Monograph Series, No. 42, Washington DC (USA), 1987.
11. K. Coakley, K. Muralidhar, J.C.S. Long and L.R. Myer, 1988, Equivalent Permeability of Statistically Simulated Single Fractures, Proceedings of the Conference on *Geostatistical, Sensitivity and Uncertainty Methods for Groundwater Flow and Radioactive Transport Modeling*, Editor: B.E. Buxton, Battelle Press, pp 441-469.
12. G. Biswas and K. Muralidhar, Fundamentals and Modeling of Turbulent Flow, in *Transport Phenomena in Metallurgical Processes*, Edited by S. Prakash and P.R. Rao, pp 25-43, National Metallurgical Laboratory, Jamshedpur, 1996.

AUDIO-VISUAL AND WEB-BASED COURSE CONTENT

1. Educational film entitled, **Hot-Wire Anemometry**, 1993 (39 minutes).
2. **Optical Measurement Techniques in Thermal Sciences**, web-course prepared under the NPTEL program, April 2012 (<http://www.nptel.iitm.ac.in/courses/112104039/>).
3. **An educational website for interferometry**, developed as an MHRD project (2010-2012); <http://202.3.77.50/~opticalv/interferometry/>.
4. **Introduction to Fluid Mechanics**, a series of 37 lectures available on YouTube (2017).

Projects (completed/in progress)

CENTRALLY COORDINATED AND MULTI-DISCIPLINARY PROJECTS

1. GENERATION OF SOLAR HYDROGEN, supported by the Technology Systems Development Program of DST, New Delhi for an amount of Rs. 8 crores (March 2012-December 2014).
2. INTERNET-BASED EXPERIMENTS, supported by MHRD, New Delhi (2009 onwards).
3. DEVELOPMENT OF A GENERAL PURPOSE CFD CODE, Board of Research in Nuclear Sciences, Mumbai (2005-2010), Rs 3.2 crores, ; with V. Eswaran.
4. DEVELOPMENT OF A GENERAL PURPOSE CFD SOLVER OVER A HYBRID UNSTRUCTURED GRID, Department of Atomic Energy, Mumbai (2013-2016); with Amaresh Dalal (IIT Guwahati) and V. Eswaran (IIT Hyderabad).
5. FUTURISTIC MECHANICS RELATED TO FAST BREEDER REACTORS, supported by IGCAR Kalpakkam (phase I, 2009-2013; phase II, 2014 onwards).
6. Equipment grant of Rs 9.6 crores in the areas of MICROSCALE ENGINEERING, NON-INVASIVE MEASUREMENTS, NEW-ERA MACHINES and ENERGY, under the FIST scheme of Department of Science and Technology, New Delhi (2006).

SPONSORED PROJECTS

1. THERMO-HYDRODYNAMICS OF MICRO-DROPLETS INTERACTING WITH ENGINEERED SURFACES, INDO-RUSSIAN DST project (2018-2020).
2. ESTIMATION OF TRANSPORT PROPERTIES OF BLOOD MODELED AS A FLUID-PARTICULATE MIXTURE FROM EXPERIMENTAL AND THEORETICAL APPROACHES, Department of Science and Technology, New Delhi (2017-2019) with Indranil Saha-Dalal and Kazuya Tatsumi.
3. MODELING AND SIMULATION OF METHANE EXTRACTION FROM GAS HYDRATES VIA SIMULTANEOUS DEPRESSURIZATION AND CO₂ INJECTION, National Gas Hydrates Program (coordinated by ONGC Dehradun) (2014-2017); with Malay K. Das.

4. STATICS AND DYNAMICS OF MICRO DROPLETS FORMED ON TEXTURED SURFACES DURING CONDENSATION, Board of Research in Nuclear Sciences, Department of Atomic Energy, Mumbai (2012-2015); with Sameer Khandekar.
5. A PREDICTIVE MODEL OF ANEURYSM DEVELOPMENT IN AN ARTERIAL BIFURCATION, Department of Biotechnology, New Delhi (2010-2013); with P.K. Panigrahi.
6. OPTICAL VISUALIZATION OF HEAT TRANSFER AND FLUID FLOW PHENOMENA, supported as a part of the *Internet-based experiments* project of MHRD, New Delhi (2010-2012); with P.K. Panigrahi.
7. QUANTITATIVE ANALYSIS OF *IN VIVO* MAGNETIC RESONANCE IMAGING DATA FOR DIAGNOSTICS OF VASCULAR DISEASES SUPPORTED BY CFD SIMULATION, Indo-Swiss project supported by Department of Science and Technology, New Delhi, (2006-2008).
8. EXPERIMENTS IN ACTIVE CONTROL OF BLUFF BODY DRAG USING SCHLIEREN VELOCIMETRY TECHNIQUE, ER and IPR (DRDO), New Delhi (2005-2008).
9. OPTICAL VISUALIZATION OF PROTEIN CRYSTAL GROWTH, Department of Science and Technology, New Delhi (2005-2008).
10. DROPWISE CONDENSATION AND HEAT TRANSFER ON AN INCLINED SURFACE EXPOSED TO A VAPOR FLUX, Department of Atomic Energy, Mumbai (2005-2009).
11. RAINBOW SCHLIEREN TOMOGRAPHIC MEASUREMENTS DURING COMBUSTION OF GASEOUS FUELS SUCH AS HYDROGEN, MHRD (thrust area project) (2003-2004).
12. EXPERIMENTAL STUDY OF HEAT TRANSFER ENHANCEMENT IN VORTEX DOMINATED FLOWS USING LIQUID CRYSTAL THERMOGRAPHY, ARDB New Delhi (2002-2003).
13. BEAM HARDENING AND PHOTON STATISTICS, DRDL Hyderabad (2001-2002).
14. LASER INTERFEROMETRIC STUDY OF SOLUTAL TRANSPORT AND KINETICS OF CRYSTAL GROWTH IN AN AQUEOUS SOLUTION, Department of Science and Technology, New Delhi, (2000-2003).
15. INTERFEROMETRIC STUDY OF BUOYANCY-DRIVEN CONVECTION AND INTERFACIAL TRANSPORT IN SUPERPOSED HORIZONTAL FLUID LAYERS, Department of Science and Technology, New Delhi (2001-2004).
16. MATHEMATICAL MODELING OF THE CVD AND CZOCHRALSKI CRYSTAL GROWTH SYSTEMS, ROLE OF MAGNETIC FIELDS AND THEIR EFFECT ON THE THERMOMECHANICAL PROPERTIES, Department of Atomic Energy, Mumbai (2000-2003).
17. MODELING AND SIMULATION OF ENHANCED OIL RECOVERY FROM POROUS AND FRACTURED FORMATIONS, Oil Industry Development Board, N. Delhi, (1998-2001).

18. UNSTEADY SEPARATED FLOW IN THE WAKE OF A SQUARE CYLINDER IN A CHANNEL: NUMERICAL AND EXPERIMENTAL STUDY, Aeronautics Research and Development Board (Aerodynamics panel), New Delhi (1998-2001).
19. NUMERICAL SIMULATION OF ENHANCED OIL RECOVERY ON PARALLEL COMPUTERS, Department of Science and Technology New Delhi, (1997- 2000).
20. NOISE REMOVAL, THREE DIMENSIONAL RECONSTRUCTION AND DATA RETRIEVAL FOR OPTICAL IMAGES OF STRATIFIED FLUIDS, Department of Science and Technology, New Delhi (1994 -1997).
21. LABORATORY MEASUREMENTS OF HEAT AND MASS TRANSFER COEFFICIENTS IN FRACTURED AND POROUS MEDIA, Department of Atomic Energy, Mumbai (1992-1995).
22. EXPERIMENTAL AND THEORETICAL STUDY OF FREE, FORCED AND MIXED CONVECTIVE COOLING OF ELECTRONIC EQUIPMENT, Department of Science and Technology, New Delhi (1991-1994).
23. NUMERICAL SOLUTION OF CONVECTION-DIFFUSION PROBLEMS WITHOUT USING UPWIND METHOD, Department of Science and Technology, New Delhi (1990-1993).
24. STUDY OF FLOW, HEAT AND MASS TRANSFER FROM BURIED NUCLEAR WASTE CANISTERS, Department of Atomic Energy, Mumbai (1989-1992).
25. LABORATORY STUDIES OF FREE STREAM TURBULENCE IN STRATIFIED SHEAR FLOWS USING HOT-WIRE ANEMOMETRY Aeronautics Research and Development Board, New Delhi (1989-1991).

SPONSORED PROJECTS (Co-investigator)

1. DEVELOPMENT OF HIGH-PERFORMANCE COOLING SYSTEMS FOR HIGH POWER ELECTRONICS, LED AND ACCELERATED LIFE CYCLE MODELS, BRICS DST project (2018-2020).
2. STUDIES OF HEAT TRANSFER DURING CONDENSATION OF STEAM-HYDROGEN MIXTURES INSIDE CLOSED CONTAINMENTS, Bhabha Atomic Research Center, Mumbai (2015-2017).
3. LOCAL HEAT TRANSFER COEFFICIENT DURING FILM CONDENSATION OF STEAM-HYDROGEN MIXTURES IN UPWARD AND DOWNWARD FLOW CONFIGURATIONS FOR CONTAINMENT APPLICATION, Board of Research in Nuclear Sciences, Mumbai (2015-2017).
4. CO₂ SEQUESTRATION IN MARINE HYDRATE SEDIMENTS WITH SIMULTANEOUS CH₄ RECOVERY, Department of Science and Technology, New Delhi (2014-2015), with Malay K. Das.
5. SYNTHETIC JET ACTUATORS FOR DRAG REDUCTION OF UNDERWATER VEHICLES, Naval Research Board, New Delhi (2012-2014), with A.K. Saha.
6. UNDERSTANDING TRANSPORT OF ENERGY AND MASS IN JAMMED SOFT MATERIALS USING LASER INTERFEROMETRY, Department of Science and Technology, New Delhi (2011-2014); with Y.M. Joshi.

7. THERMAL STRIPING STUDY IN A FAST BREEDER REACTOR: EDDIES TRANSPORT USING COMBINED PIV/LIF AND SCHLIEREN TECHNIQUE, IGCAR Kalpakkam (2010-2012); with P.K. Panigrahi.
8. LASER HEATED PEDESTAL GROWTH OF CRYSTALLINE RF3+:YAG FOR DOSIMETRY, Board of Research in Nuclear Sciences, Mumbai (2006-2008), with Bansi Lal.
9. SYNTHETIC JETS FOR PROPULSION AND MANEUVERING OF UNDERWATER VEHICLES, Naval Research Board, New Delhi (2007-2008); with A.K. Saha.
10. ACTIVE FLOW CONTROL BY DYNAMIC OBSTACLES IN PROPULSION APPLICATIONS, Naval Research Board, New Delhi (2004-2006); with A.K. Saha.
11. EXPERIMENTAL STUDY OF HEAT TRANSFER ENHANCEMENT IN VORTEX DOMINATED FLOW USING LIQUID CRYSTAL THERMOGRAPHY, ARDB, New Delhi (2002-2003).
12. SCHLIEREN MEASUREMENTS OF UNSTEADY HEAT AND MASS TRANSFER FROM BLUFF OBJECTS, UP Science and Technology, Lucknow (1999-2001).
13. A GENERAL PARALLEL MATRIX INVERTER FOR CFD APPLICATIONS, Department of Science and Technology, New Delhi (1998-2001); with V. Eswaran.
14. UNSTEADY SEPARATED FLOW IN THE WAKE OF A SQUARE CYLINDER IN A CHANNEL: NUMERICAL AND EXPERIMENTAL STUDY, Aeronautics Research and Development Board (Aerodynamics panel) (1998-2001); with G. Biswas.
15. FAST SEARCH ALGORITHMS AND THEIR IMPLEMENTATION ON PARALLEL COMPUTERS, Department of Science and Technology, New Delhi (1997-2000); with K. Deb.
16. FAULT DIAGNOSIS OF PRESSURIZED HEAVY WATER REACTORS USING NEURAL NETWORKS: IDENTIFICATION OF SOME TRANSIENTS, Board of Research in Nuclear Sciences, Mumbai (1997-2000); with K. Deb.
17. NUMERICAL SIMULATION OF UNSTEADY THREE DIMENSIONAL FLOW AROUND A BODY MOVING IN AN INCOMPRESSIBLE FLUID ON A PARALLEL COMPUTER, Defence Research and Development Laboratory, Hyderabad (1995-1996); with V. Eswaran.

CONSULTANCY PROJECTS

1. DESIGN AND PROTOTYPE DEVELOPMENT OF A DIAMOND COLORIMETER, Sahajanand Technologies, Surat (April 2013 onwards) with K. Pradeep Kumar.
2. DESIGN OF A SOLAR STILL FOR WATER SOFTENING, Anglo-American Chile Ltd., Chile (September 2012 onwards); with R.G. Pala.
3. Technical advisor, CARBON CAPTURE AND STORAGE TECHNOLOGY, Siva Ventures Limited, Chennai (2012).
4. CFD SIMULATION OF MIXING IN A CRUCIBLE FOR MOLTEN LASER GLASS, Central Glass and Ceramics Research Institute, Kolkata (2010); with V. Eswaran.
5. TOMOGRAPHIC ALGORITHMS FOR NON-DESTRUCTIVE TESTING OF SOLID ROCKET PROPELLANTS, Defence Research & Development Laboratory, Hyderabad (1999-2001); with P. Munshi.
6. THERMODYNAMIC AND TRANSPORT MODELS FOR STIRLING CRYOCOOLERS, Solid State Physics Laboratory, New Delhi (1999 – 2000).
7. CAE ANALYSIS OF FLIGHT DATA RECORDER (THERMAL ANALYSIS), Hindustan Aeronautics Ltd., Korwa 1999.
8. THERMAL ANALYSIS OF TRANSFORMER-RECTIFIER UNIT, Hindustan Aeronautics Ltd., Lucknow 1996.

9. COMPUTER-AIDED DESIGN AND ANALYSIS OF HANDGUARD, Defence Materials Research and Development Establishment (1994-1995).

Membership in societies

President, National Society of Fluid Mechanics and Fluid Power
Fellow, Indian National Academy of Engineering
Fellow, National Academy of Sciences, India
Fellow, American Society of Thermal and Fluids Engineers
World Innovation Foundation
New York Academy of Sciences
American Physical Society
Optical Society of America
Indian Society for Advancement of Materials and Process Engineering

Any other information

NEW COURSES DEVELOPED

1. Computational Fluid Flow and Heat Transfer
2. Experimental Methods in Thermal Sciences
3. Measurement and Control of Flow Systems
4. Modeling and Simulation in Engineering Problem-Solving
5. Laser Measurement Techniques in Mechanical Engineering

Remarks: (a) I have taught professional courses at University of Oklahoma, Norman (USA) and a graduate level elective at Kyoto University, Japan. (b) I have received letters of commendation for excellence in teaching on eight occasions from the Director, IIT Kanpur.

LABORATORY DEVELOPMENT

I have developed an excellent fluid mechanics laboratory that specializes in turbulence measurement, imaging of flow, thermal and solutal concentration fields, flow control, and inverse experiments. I am presently working on internet based experiments for optical imaging of flow and heat transfer.

NEW EXPERIMENTS DEVELOPED FOR INSTRUCTION

- Velocity and turbulence measurements in a free shear layer.
- Determination of drag coefficient and Strouhal number for cylinders placed in cross-flow; Effect of free stream turbulence and heating.
- Boundary-layer velocity profiles over rough surfaces.
- Determination of viscosity of gases, oils and viscoelastic media.

- Study of transient Rayleigh-Benard convection using laser interferometry and digital image processing.
- Demonstration experiment for illustrating data acquisition and control in boiling heat transfer.
- Measurement of turbulence statistics in an adverse pressure gradient flow.
- Refractive index techniques for visualizing thermal fields in fluids.
- Visualization of flow separation in oscillating bluff objects.
- Pressure drop characteristics of micron-diameter tubes.

CONFERENCES AND SHORT TERM COURSES ORGANIZED

1. MODERN MEASUREMENT TECHNIQUES IN FLUID MECHANICS, Sponsored by the Quality Improvement Program of the Ministry of Human Resource Development, Government of India and held from 9 - 14 December 1991, K. Muralidhar and T. Sundararajan,
2. COMPUTATIONAL FLUID FLOW AND HEAT TRANSFER, Sponsored by the Indian Society for Technical Education and held from from 11 - 23 May 1992. K. Muralidhar and P.S. Ghoshdastidar.
3. COMPUTER APPLICATIONS IN EXPERIMENTAL MECHANICS, Sponsored by the Quality Improvement Program of the Ministry of Human Resource Development, Government of India, held from 9 - 13 May 1994; K. Ramesh and K. Muralidhar (45 participants).
4. PARALLEL COMPUTING APPLICATIONS IN SCIENCE AND ENGINEERING, Sponsored by DST, AICTE, CSIR and IIT Kanpur, 6-8 January 1997; M.K. Verma, V. Eswaran and K. Muralidhar.
5. 14th NATIONAL HEAT AND MASS TRANSFER CONFERENCE, 29-31 December 1997, organized by G. Biswas and K. Muralidhar, served as Secretary of ISHMT/ASME joint committee.
6. SPECIAL TOPICS IN FLUID MECHANICS, 20-25 July 1998, Sponsored by QIP, Government of India; K. Muralidhar and G. Biswas.
7. EXPERIMENTAL METHODS IN THERMAL SCIENCES, 2-7 August 1999, Sponsored by QIP, Government of India; P.K. Panigrahi and K. Muralidhar.
8. Coordinator of the session on ART OF EXPERIMENTS in the symposium entitled REACH (for **Research Challenges**) organized by IIT Kanpur in March 2007 and held at Parwanoo, Himachal Pradesh.
9. Inaugural JOINT IITK – NTU SINGAPORE WORKSHOP IN MECHANICAL, AEROSPACE, AND INDUSTRIAL ENGINEERING, 10-11th July 2007, organized at the Department of Mechanical and Aerospace Engineering, NTU Singapore in the areas of computational mechanics, multi-scale modeling, micro-scale transport, energy, and supply chain management; K. Muralidhar and M. Damodaran.
10. Second JOINT IITK – NTU SINGAPORE WORKSHOP IN MECHANICAL, AEROSPACE, AND INDUSTRIAL ENGINEERING held during 5-6 April 2008 at IIT Kanpur (India).
11. Served as *Advisor* for the third REACH symposium held at IIT Kanpur from 10-12 October 2010. Coordinated and chaired the session on **Research Vision for IIT Kanpur**.
12. 5th **International and 41st National Conference on FMFP 2014** held at IIT Kanpur during 12-14 December 2014.

13. Honorary Chair, Asian Symposium on Computational Heat Transfer and Fluid Flow, held at IIT Madras during 10-13 December 2017.

INVITED SEMINARS (since 2000)

1. OPTICAL MEASUREMENT TECHNIQUES FOR FLUID FLOW AND HEAT TRANSFER, Proceedings of the 16th National Convention of Mechanical Engineers, University of Roorkee, September 2000.
2. THERMAL CONDUCTIVITY OF A HETEROGENEOUS MEDIUM, Indo-German Workshop on High-temperature Fiber Composite Materials, Banaras Hindu University, September 2000.
3. ESTIMATION OF THERMAL CONDUCTIVITY OF HETEROGENEOUS MATERIALS BY AN INVERSE TECHNIQUE, CEP course on Spectroscopic and Thermal Techniques for materials characterization, organized by DMSRDE Kanpur, November 2000.
4. MODELLING AND SIMULATION OF TRANSPORT PROCESSES DURING CRYSTAL GROWTH, Center of Advanced Technology, Indore, November 2000.
5. PARAMETER ESTIMATION IN NONLINEAR DIFFUSION PROBLEMS BY AN INVERSE TECHNIQUE, 27th National Fluid Mechanics and Fluid Power Conference held at FCRI, Palghat, December 2000.
6. MODELING OF IMMISCIBLE DISPLACEMENT DURING ENHANCED OIL RECOVERY FROM A POROUS FORMATION, National Conference on Mathematical and Computational Models, held at PSG College of Technology, Coimbatore, pp 15-20, December 2001.
7. LASER-BASED MEASUREMENT OF TEMPERATURE IN FLUIDS, Short term course on *Wind Tunnel Testing*, IIT Kanpur, 11-15 February 2002.
8. CONVECTION IN DIFFERENTIALLY HEATED FLUID LAYERS, presented at the International Conference on Fluid Mechanics and Fluid Power as a PLENARY LECTURE at IIT Roorkee, December 2002.
9. Lecture 1: MATHEMATICAL MODELING OF CRYOCOOLERS, Lecture 2: PULSE TUBE REFRIGERATORS: PRINCIPLES AND MODELING, at Solid State Physics Laboratory, New Delhi, Invited lectures on *Cryogenics*, in December 2002.
10. APPLICATION OF INVERSE TECHNIQUES IN ENGINEERING, presented at Mewbourne School of Petroleum and Geological Engineering, University of Oklahoma on 12th September 2003.
11. FLOW VISUALIZATION USING OPTICAL MEASUREMENT TECHNIQUES, presented at Department of Aerospace and Mechanical Engineering, University of Oklahoma, on 2nd October 2003.
12. LASER MEASUREMENT OF BUOYANCY-DRIVEN CONVECTION FIELDS, presented at Department of Mechanical Engineering, Louisiana State University, on 24th October 2003.
13. ROLE OF CONVECTION IN THE GROWTH OF OPTICAL CRYSTALS, presented at Department of Mechanical and Materials Engineering, Florida International University, on 10th November 2003.
14. LASER MEASUREMENT OF TEMPERATURE AND CONCENTRATION FIELDS IN BUOYANCY DRIVEN CONVECTION, presented at Department of Mechanical Engineering, University of Minnesota, on 10th December 2003.

15. IMPORTANCE OF CONVECTION IN THE GROWTH OF OPTICAL CRYSTALS, presented at the symposium entitled *Topical meeting on Frontiers in Materials Science and Technology*, on 30th December 2004 at Center of Advanced Technology, Indore.
16. OPTICAL IMAGING AND CONTROL OF CONVECTION AROUND A CRYSTAL GROWING FROM ITS AQUEOUS SOLUTION, presented at the symposium entitled *Crystal Growth and Characterization* on 29th September 2005 at Loyola College, Chennai.
17. STRUCTURE OF LOW REYNOLDS NUMBER FLOW BEHIND A PRISM OF SQUARE CROSS-SECTION AT VARIOUS ORIENTATIONS, presented at the 50th (Golden Jubilee) ISTAM Congress at IIT Kharagpur, 14-17 December 2005.
18. Two lectures each on TRANSPORT PHENOMENA IN POROUS MEDIA and MEASUREMENTS IN TURBULENT FLOW, delivered at Department of Mechanical Engineering, Jadavpur University, Kolkata on 12th and 13th January 2007.
19. MODELING FLOW AND TRANSPORT IN A HIERARCHICAL POROUS MEDIUM, presented at the Indo-Australian Workshop on CFD APPROACH ON FLUID FLOW, HEAT AND MASS TRANSFER held at Department of Mathematics, IIT Roorkee during 12-14 April 2007.
20. GENERALIZED MODELING OF FLOW AND TRANSPORT IN POROUS MEDIA, presented at the Joint IIT Kanpur – NTU Singapore symposium on Mechanical, Aerospace, and Industrial Engineering held at NTU Singapore during 10-11 July 2007.
21. LASER MEASUREMENTS IN FLUID AND THERMAL SCIENCES, Keynote lecture delivered at the *International Conference on Recent Trends in Mechanical Engineering*, College of Engineering, Ujjain, KN 46-52, October 2007.
22. RECONSTRUCTION OF TIME-DEPENDENT CONCENTRATION GRADIENTS AROUND A KDP CRYSTAL GROWING FROM ITS AQUEOUS SOLUTION, **Subir Kar Memorial** Lecture delivered at the 37th Fluid Mechanics and Fluid Power Conference, BIT Mesra (Ranchi), during 10-12 December 2007; also see pp 195-208 in the conference proceedings.
23. GROWTH OF YAG CRYSTALS IN A CZOCHRALSKI PROCESS, presented at the INAE Annual Convention held during 7-8 December 2008 at RCI Hyderabad.
24. OPTICAL IMAGING OF CONVECTION DURING GROWTH OF KDP AND PROTEIN CRYSTALS, presented during the second joint symposium between NTU Singapore and IIT Kanpur during 5-6 April 2008.
25. REFRACTIVE INDEX METHODS FOR THE MEASUREMENT OF TEMPERATURE, SOLUTAL CONCENTRATION AND FLUID FLOW, presented at **AFFTS-2008** (National Conference on Advanced Fluid Flow and Thermal Sciences) held during 22-24 May 2008 (**Keynote**) at SVNIT Surat.
26. SIMULATION OF OSCILLATORY FLOW IN TUBULAR BIFURCATIONS ON UNSTRUCTURED GRIDS, presented at the International Workshop on New Horizons in Nuclear Reactor Thermal Hydraulics, held on 24th March 2009 at Bhabha Atomic Research Center, Mumbai (2009).
27. INTERFEROMETRY, SCHLIEREN, AND SHADOWGRAPH, presented at the International Symposium on Recent Trends in Flow Visualization, held at IIT Roorkee during 29-31 December 2009.
28. RECENT DEVELOPMENTS IN COMPUTATIONAL FLUID FLOW AND HEAT TRANSFER, presented at Vellore Institute of Technology, Vellore, 4th February 2011.
29. (i) OPTICAL MEASUREMENT USING REFRACTIVE INDEX AND SCATTERING TECHNIQUES and (ii) RECENT DEVELOPMENTS AND APPLICATIONS OF COMPUTATIONAL FLUID DYNAMICS, presented at National Institute of Technology Agartala, 8-9 March 2011.

30. OPTICAL MEASUREMENT TECHNIQUES IN FLUID AND THERMAL SCIENCES, presented at IIT Roorkee, 9th July 2011.
31. FREE AND FORCED JETS: EXPERIMENTS AND SIMULATION, presented at the theme meeting on FBR Core Design: Current Status and Future Directions, held on 19th September 2011 at IGCAR Kalpakkam.
32. OPTICAL MEASUREMENT TECHNIQUES IN TRANSPORT PHENOMENA, presented at the 2nd ICAMB conference held at VIT Vellore during 9-11 January 2012.
33. Lecture 1: INTRODUCTION TO INVERSE METHODS; Lecture 2: APPLICATIONS OF INVERSE TECHNIQUES, presented at the Department of Mechanical Engineering, IIT Roorkee, 2nd July 2012.
34. EXTRACTING DATA FROM IMAGE SEQUENCES USING INVERSE TECHNIQUES, Plenary Lecture at the National Workshop on Image Processing Applications in Industry, Medicine, and Aerospace, organized by DRDL Hyderabad held at the Research and Innovation Center, IITM research Park during 28-29 December 2012.
35. MODELING METHANE PRODUCTION FROM A HYDRATE RESERVOIR VIA SIMULTANEOUS DEPRESSURIZATION AND CO₂ SEQUESTRATION, Keynote Lecture at the Gas Hydrates Symposium held at National Institute of Oceanography, Goa on 18th January 2013.
36. IMAGING UNSTEADY THREE DIMENSIONAL FLUID FLOW AND TRANSPORT PHENOMENA, Plenary lecture at the National Laser Symposium-21 held at BARC Mumbai during 6-8 February 2013.
37. OPTICAL MEASUREMENT TECHNIQUES IN THERMAL SCIENCES, Invited Lecture delivered at BR Ambedkar NIT-Jalandhar, 22nd April 2013.
38. RESEARCH METHODOLOGY, Invited Lecture delivered at VIT Vellore, 25th May 2013.
39. FUNDAMENTALS AND MODELING OF DROPWISE CONDENSATION, three Invited Lectures delivered at IIT Roorkee, 24th June 2013.
40. HEAT CONDUCTION FUNDAMENTALS, ten Invited Lectures delivered at SVNIT Surat, 1-2 July 2013.
41. (A) CASE STUDIES IN EXPERIMENTAL FLUID MECHANICS AND HEAT TRANSFER; (B) CARRYING OUT LITERATURE SURVEY AND PROBLEM DEFINITION IN RESEARCH, Lectures delivered at the NSF/MFP-sponsored workshop on Research Methodology, held at NMMIT Allahabad during 27-28 September 2013.
42. FLOW AND TRANSPORT IN POROUS MEDIA WITH APPLICATIONS, presented at the TEQIP workshop (*Pravartana*) held at IIT Kanpur during 5-7 October 2013.
43. PROBLEM DEFINITION AND VALIDATION, Inaugural lecture at the course entitled *Research methodology*, Bengal Engineering and Science University, Kolkata, 29th January 2014.
44. CASE STUDIES IN EXPERIMENTAL FLUID MECHANICS, lecture delivered at the NSF/MFP-sponsored workshop on Research Methodology, held at NIT Surathkal during 10-12 July 2014.
45. DROPWISE CONDENSATION OVER TEXTURED SURFACES: INFLUENCE OF DROP SHAPE AND COALESCENCE, **Keynote Lecture**, International Heat Transfer Conference – 15, held at Kyoto Japan (August 2014).
46. FLOW AND TRANSPORT IN POROUS MEDIA WITH APPLICATIONS, **Invited Distinguished Lecture**, presented on 19th March 2015 at The Institute of Fluid Science, Tohoku University, Japan.

47. SHAPE AND MOTION OF A LIQUID DROP PLACED OVER A TEXTURED SURFACE, **Keynote lecture**, 17th ISME Conference, 3-4 October 2015, held at IIT Delhi.
48. FLOW AND HEAT TRANSFER DURING DROP SPREADING OVER A HORIZONTAL SURFACE, **Keynote Lecture**, ASCHT2015, Busan, S. Korea (November 2015).
49. TECHNOLOGY DEVELOPMENT FOR EXTRACTION OF METHANE FROM UNCONVENTIONAL HYDROCARBON RESOURCES, **Keynote Lecture** delivered during the KDMIPE Day celebrations of ONGC Dehradun, 19th December 2015.

OTHER ACTIVITIES

1. **President**, National Society of Fluid Mechanics and Fluid Power, January 2012 – December 2014.
2. Reviewer for leading journals in fluid mechanics and heat transfer including Journal of Fluid Mechanics, Physics of Fluids, International Journal of Heat and Mass Transfer, ASME Journal of Heat Transfer, ASME Journal of Fluids Engineering, ASCE J Fluids and Structures, International Journal of Thermal Sciences, Experiments in Fluids, Journal of Computational and Applied Mathematics, and Journal of Scientific and Industrial Research.
3. Popular scientific articles written: (a) CHAOS IN PHYSICAL SYSTEMS, The Hindu, 7 December 1988. (b) DISPOSAL OF NUCLEAR WASTE, Science Reporter, October, 1990. (c) MODELING REGENERATORS IN STIRLING CRYOCOOLERS, in **Directions** – a research publication of IIT Kanpur, 1999. (d) FORWARD AND INVERSE MEASUREMENTS, in **Directions**, Vol. 8(2), 2007. (e) EXPLOITATION OF GAS HYDRATES (with A. K. Saha) in **Directions**, Vol. 9(1), 2008. (f) SIMULATION OF OSCILLATORY FLOW IN AORTIC BIFURCATIONS, in **Directions**, Vol. 10(1), 2009. (g) CREATING A RESEARCH VISION FOR IIT KANPUR, in **Directions**, Vol. 12(1) (2012). (h) IMAGING TRANSPORT PHENOMENA AND SURFACE MORPHOLOGY IN CRYSTAL GROWTH, in **Directions**, Vol. 13(1) (2013); (i) LIFE WITH EXPERIMENTS, in **INAE** Newsletter, August 2014.
4. High-level Summer Consultancy: Spent two months at ANURAG, (Advanced Numerical Research and Analysis Group), Ministry of Defence, Hyderabad from 15 May to 20 June 1993. Spent one week at C-DAC (Centre for Development of Advanced Computing), Pune, for parallelizing a two dimensional enhanced oil recovery code on 2 and 4 node machines (June 1994).
5. Member, Research Advisory Committee for *Gas Hydrates Program* of Department of Ocean Development, New Delhi (2008-onwards).
6. Member, Board of Courses and Studies, Department of Mechanical Engineering, Indian School of Mines, Dhanbad (2006-2008).
7. Chairman: Organizing committee, International and INCCOM-6 Conference-2007 on *Innovations in Composites in the New Century*, held at IIT Kanpur during 12-14 December 2007.
8. Created the IGCAR-IITK cell with a focus on futuristic mechanics and mechatronics (2008-2011).
9. Member, Academic Monitoring Committee of the Department of Mechanical Engineering, Indian Institute of Technology Kharagpur (2010 onwards).
10. Member, International Advisory Committee, The Asian Symposium on Computational Heat Transfer and Fluid Flow (ASCHT'11) held at Kyoto University during 22-26 September 2011

and ASCHT'13 to be held at Hong Kong University of Science and Technology during 3-6 June 2013.

11. Member, Academic Council, Homi Bhabha National Institute, DAE, Mumbai (2011 onwards).
12. IIT Kanpur representative in the Asia-Africa Development University Network (AADUN), University of Malaya, Kaula Lumpur, Malaysia (2009 onwards).
13. IIT Kanpur representative in CREST - Collaboration for Research in Engineering, Science and Technology, an international initiative of the Government of Malaysia with leading Universities in US, Singapore, and Taiwan.
14. Member, Expert Advisory Group on the *Good Governance project* of World Bank for the TEQIP phase II initiative. I will be responsible for developing course material in the context of training facilitators who will address the members of Board of Governors of various educational institutes.
15. Member, Board of Studies, Department of Mechanical Engineering, Harcourt Butler Technological Institute, Kanpur (2012 onwards).
16. **Major collaborators** (within India): Bhabha Atomic Research Center, RRCAT Indore, IGCAR Kalpakkam, DRDL Hyderabad, SSPL New Delhi, NIOT Chennai, National Gas Hydrates Program, (Ministry of Petroleum).
17. **Major collaborators** (international): Kyoto University, Japan; Lawrence Berkeley Laboratory, USA; ETH Zurich, Switzerland; IT'IS Zurich, University of Minnesota, USA.

About Dr K. Muralidhar, IIT Kanpur...

Dr. Muralidhar has conducted a wide range of experiments and performed numerical simulation in subjects related to fluid mechanics and heat transfer. Over hundred publications arising from this research have been published in well-known international journals. He has developed optical measurement techniques and numerical algorithms in the area of fluid and thermal sciences. His work has led to better understanding of transport phenomena in porous media, wake dynamics, flow control, crystal growth, and biomedical flows. Dr. Muralidhar's research finds applications in enhanced oil recovery, gas hydrates, regenerators, nuclear waste disposal, growth of optical crystals and CVD reactors. He was among the earliest to apply a thermal non-equilibrium model for performance evaluation of regenerators in cryocoolers. His work on interferometric tomography, fluid-fluid interfaces and schlieren imaging of convection patterns around growing crystals is well-recognized and have appeared as invited review articles. In this connection, the need for special techniques to accommodate partial data and incomplete information in measurements has been addressed. He has an international patent related to enriching coarse MRI images of blood flow, four Indian patents on – (i) peristaltic pump for time-dependent flow rates and (ii) imaging chaotic flow in enlarged arteries, (iii) enhanced solar stills, (iv) optical determination of thermal diffusivity, and one on (v) wall heat flux sensor using a single thermocouple sensor.

Dr. Muralidhar has developed algorithms for numerical simulation of multi-phase flow in porous media, oscillatory flows, and inverse techniques for optical imaging and wall heat flux measurement. In the area of wake dynamics, his work shows that three dimensional vortex

interactions in nominally two dimensional geometries can be used for flow control. At IIT Kanpur, Dr. Muralidhar has developed excellent experimental facilities related to turbulence measurement and laser imaging of flow and temperature fields. These laboratories are widely used for teaching and research. His commitment to technical education is seen in the books authored and contributed chapters.

In his tenure as **Head**, Department of Mechanical Engineering, Dr Muralidhar was successful in increasing the number of students in the doctoral program. At the same time, a large number of new faculty joined the Department and major funding for equipment was secured from the Department of Science and Technology, New Delhi. He brought focus on micro-engineering – mechanics, transport, imaging, and manufacturing, within the Department. As **Dean, Research and Development**, he consolidated groups on solar energy, advanced mechanics, and high performance computing, apart from streamlining operations related to research management. The Institute saw a substantial growth in project funding during this period. Dr Muralidhar created research outlets for undergraduate students, resulting in activities such as an autonomous vehicle and a lunar rover, a popular publication called NERD, an informal group called POWER dedicated to solving industry-oriented problems, and an all-India conference series for undergraduate students, called ICARUS.

He has coordinated a national initiative on solar hydrogen generation, a multi-institutional project on CFD code development on unstructured grids, and an initiative on futuristic mechanics. He is presently engaged in research related to gas hydrates and vapor-liquid interfacial phenomena over textured surfaces. He has co-authored monographs on optical measurement techniques and modeling dropwise condensation. He is the immediate past-President, National Society of Fluid Mechanics and Fluid Power (India).



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