

Laser Applications and Holography Laboratory

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Research Group



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Present Research Areas

- **Digital Holographic Microscopy for Clinical Applications**
- **Opto-electronic Sensing for Point of Care (PoC) Diagnostics**
- **Laser based instrumentation for Inspection and Monitoring of Industrial Processes**
- **Spectroscopic Instrumentation for Trace Detection**

R&D Projects in the Past 3 Years

Completed Sponsored Consultancy Projects (Role: CI/PI)

1. Digital Holographic Microscopy for Cellular Diagnostic (FT103/1965/2018)
Funding Agency: SigTuple Technologies Pvt. Ltd., Bangalore.
Budget (INR): ~21.78 Lakhs
2. Characterization and Assessment of the Fertility Monitor "Inito" using standard Lateral Flow Reader (CW14266N)
Funding Agency: Samplytics Technologies Pvt. Ltd., Bangalore
Budget (INR): ~1 Lakh

Ongoing Sponsored R&D Projects (Role: PI)

1. Development of an Explosive Detection System using Surface Enhanced Raman Scattering (SERS) Process (RP03496)
Co-PI- Dr. Padmnabh Rai, DAE UM-DAE Centre for Excellence in Basic Sciences, University of Mumbai
Funding Agency: DST, Govt. of India.
Budget (INR): ~75 Lakhs
2. Title: Development of Opto-electronic sensor for point-of-care diagnostics of micro-albumin in urine sample (MI02113G)
PI from AIIMS: Dr. Sudip Kumar Datta, Department of Laboratory Medicine, AIIMS, New Delhi
Funding Agency: IRD, IIT Delhi (Under MFIRP in collaboration with AIIMS)
Sanctioned Budget (INR): 10 Lakhs

Research Publications in the Past 3 Years

International Peer Reviewed Journals

1. Mugdha Joglekar; Vismay Trivedi; Ritu Bhatt; Vani Chhaniwal; **S. K. Dubey**; Giancarlo Pedrini; Rainer Leitgeb; Bahram Javidi; Arun Anand, "Compact, low cost, large field-of-view self-referencing digital holographic interference microscope," Optik -International Journal for Light and Electron Optics 245 (2021) 167615. <https://doi.org/10.1016/j.ijleo.2021.167615> **(IF=2.44)**
2. Richa Goel, Vimarsh Awasthi, Padmnabh Rai, **S. K. Dubey**, "Design of Polarization Independent SERS Substrate with Raman Gain Evaluated Using Purcell Factor," Plasmonics 16, 1365–1373 (2021). <https://doi.org/10.1007/s11468-021-01410-z> **(IF=2.33)**
3. Tapas Kumar Das, Richa Goel, Vimarsh Awasthi, Tapender Singh, Vivek Shukla, A. Kumar, H. K. Poshwal, A. P. Srivastava, **S. K. Dubey**, P. Rai, "Surface enhanced Raman scattering from single-walled carbon nanotube decorated on Ag nanowires," Plasmonics 16, 1339–1348 (2021). <https://doi.org/10.1007/s11468-021-01393-x> **(IF=2.33)**
4. Richa Goel, Vimarsh Awasthi, **S. K. Dubey**, "Detection Of Illicit Drugs Using Surface Enhanced Raman Spectroscopy," Int J Forens Sci 2021, 6(1): 000220. <https://doi.org/10.23880/ijfsc-16000220> **(IF=1.62)**
5. R. Thakur, P. Maheshwari, S. K. Datta, **S.K. Dubey** and C. Shakher, "Machine learning based rapid diagnostic- test reader for albuminuria using smartphone," in IEEE Sensors Journal, vol. 21, no. 13, pp. 14011-14026, 1 July1, 2021. <https://doi.org/10.1109/JSEN.2020.3034904> **(IF=3.07)**
6. Nimit Patel, Siddhart Rawat, Mugdha Joglekar, Vani Chhaniwal, **S.K. Dubey**, Timothy O'Connor, Bahram Javidi, Arun Anand, "Compact and low-cost instrument for digital holographic interference microscopy of immobilized micro-particles," Optics and Lasers in Engineering 137 (2021) 106397. <https://doi.org/10.1016/j.optlaseng.2020.106397> **(IF=4.96)**
7. Richa Goel, Vimarsh Awasthi, Padmnabh Rai, **S. K. Dubey**, "Numerical Design of Photonic Crystal-Based Nanostructured Substrate for Efficient Surface-Enhanced Raman Scattering," Plasmonics 16, 107–114 (2021). <https://doi.org/10.1007/s11468-020-01268-7> **(IF=2.33)**
8. V. Awasthi, R. Goel, S. Agarwal, P. Rai, **S.K. Dubey**, "Optical nanoantenna for beamed and surface-enhanced Raman spectroscopy". J Raman Spectrosc. 2020;1–25. <https://doi.org/10.1002/jrs.5932> **(IF=3.13)**
9. Sudhabrata Majumder, Sakshi Gupta, and **S.K. Dubey**, "Spectral imaging using compressive sensing based single-pixel modality," Electronics Letters, vol. 56, no. 19, pp.1013-1016 (2020). <https://doi.org/10.1049/el.2020.0757> **(IF=1.68)**
10. Ritambhara Thakur, Faiz Akram, Vivek Rastogi, Amit Mitra, Rahul Nawani, Varun AV, **S.K. Dubey** and Chandra Shakher, "Development of Smartphone-Based Lateral Flow Device for the Quantification of LH and E3G Hormones," in IEEE Sensors Journal, vol. 20, no. 23, pp. 14491-14500, 1 Dec.1, 2020. <https://doi.org/10.1109/JSEN.2020.3008566> **(IF=3.78)**
11. Vivek Rastogi, Shilpi Agarwal, **S.K. Dubey**, Gufran Sayeed Khan, Chandra Shakher, "Design and Development of Volume Phase Holographic Grating based Digital Holographic Interferometer for Label-Free Quantitative Cell Imaging," Applied Optics, vol. 59, no. 12, pp.3773-3783 (2020). <https://doi.org/10.1364/AO.387620> **(IF=1.961)**

Research Publications in the Past 3 Years

International Conferences/Conference Proceedings

1. Vivek Rastogi, Varun Kumar, Satish Kumar Dubey, Gufran Sayeed Khan, Chandra Shakher, "Volume phase holographic grating based digital holographic interferometer for measurement of temperature distribution and temperature fluctuations in diffusion flames," Proc. SPIE 11782, 117820K (2021). <https://doi.org/10.1117/12.2592405>
2. Sunita Bhatt, Aparna Ningobam and Satish Kumar Dubey, "Numerical Classification of RBC images retrieved using diffraction phase microscopy," presented in European Conferences on Biomedical Optics (ECBO), 20- 24 June 2021.
3. Ritish Kamboj, T R Dastidar, Ashish Lal and **S. K. Dubey**, "Twin image free digital lens-less microscopy by using TIE in Fresnel zone," Oral presentation, OSA Imaging and Applied Optics Congress, Vancouver, British Columbia, Canada, June 22-26, 2020.
4. K. Dhingra, **S. K. Dubey**, D. Mishra, P K Chaudhari, "Lateral shearing digital holographic microscope for imaging of oral pathology," J Dent Res 2020; 99: 3327362. <https://iadr.abstractarchives.com/abstract/20iags-3327362/lateral-shearing-digital-holographic-microscope-for-imaging%20of-oral-pathologys>
5. Tapas K. Das, A. Kumar, H. K. Poshwal, A. P. Srivastava, **S. K. Dubey** and P. Rai, "Remote Surface Enhanced Raman Scattering of Single-walled Carbon Nanotube," International Conference on Nano Science and Technology (ICONSAT-2020), S. N. Bose National Centre for Basic Sciences, Kolkata, March 5-7, 2020.
6. V. Awasthi, **S. K. Dubey** and P. Rai, "Explosive detection using Surface Enhanced Raman Spectroscopy (SERS)," Frontiers in materials from Basic Science to Real time Applications, Organized by CNMS, JAIN University, Bengaluru, India, March 13-16, 2019.
7. Vivek Rastogi, Shilpi Agarwal, **S. K. Dubey**, Gufran Sayeed Khan, Chandra Shakher, "Microscopic Urinalysis by Digital Holographic Microscopy," Proc. SPIE 11188, Holography, Diffractive Optics, and Applications IX, 1118818, 2019. (<https://doi.org/10.1117/12.2537315>).
8. Vivek Rastogi, Rahul Gadkari, Shilpi Agarwal, **S. K. Dubey**, Chandra Shakher, "Digital holographic interferometric in-vitro imaging of Escherichia coli (E. coli) bacteria," Proc. SPIE 11030, Holography: Advances and Modern Trends VI, 1103011, 2019. (<https://doi.org/10.1117/12.2520881>)
9. Shilpi Agarwal, Vivek Rastogi, Varun Kumar, **S. K. Dubey**, Chandra Shakher, "Measurement of temperature and temperature fluctuations in wick stabilized micro flame using digital holographic interferometry," Proc. SPIE 11030, Holography: Advances and Modern Trends VI, 1103012, 2019. (<https://doi.org/10.1117/12.2520885>)

Patent Filings

1. **Satish Kumar Dubey**, Padmnabh Rai, Richa Goel, Vimarsh Awasthi, Chandra Shakher, "Substrate for surface enhanced Raman spectroscopy," Patent Application No.: 202011041435, dt. 24-09-2020.
2. Chandra Shakher, Vivek Rastogi, Shilpi Agarwal, **Satish Kumar Dubey**, Gufran Sayeed Khan, "An improved digital holographic interferometer for quantitative phase imaging," Patent Application No.: 201911030117, dt. 25-07-2019.
3. Dalip Singh Mehta, Mayank Gupta, **Satish Kumar Dubey**, Naveen Chandra Nautiyal, Atul Kumar Dubey, Virendra Kumar, and Muskan Kularia, "non-mechanical tracking solar concentrator," Patent Application No.: 201811005585, dt. 14-02-2018.

Book Chapter

1. Padmnabh Rai and Satish Kumar Dubey, "Raman Spectroscopy: A Potential Characterization Tool for Carbon Materials," Handbook of Materials Characterization, 405-434, Springer International Publishing AG, part of Springer Nature, 2018. https://link.springer.com/chapter/10.1007%2F978-3-319-92955-2_11

Laser Applications and Holography Laboratory

Research Areas covered in the Past 25 Years

Digital Holography

- Contouring/Profiling •Monitoring of drying process of paints
- Temperature measurement of gaseous flame and around heated wire •Heat and mass transfer
- Measurements of refractive index in fluids

Talbot Interferometry

- Temperature measurement of gaseous flames •Surface profiling •Collimation Testing •Focal length measurement

Shearing and Speckle Shearing Interferometry

- Temperature measurement of gaseous flames

Digital Speckle Pattern Interferometry

- Measurement/Monitoring of vibration and visualization of mode shapes
- Temperature measurement of gaseous flames

Interferometric Imaging

- Optical coherence tomography (OCT) for simultaneous measurement of tomography and topography

Optical Tweezers

- Particle Trapping

Magneto-optic Current Sensor by using Optical Fibers & BSO Crystal

Sponsored R&D Projects Completed in the Past 25 Years

Sl. No.	Title of project	Year (duration in Years)	Amount (Lacs)	Sponsoring agency
1	Development of inexpensive laser based alignment instrument using self-imaging phenomenon for application in electrical industries. Proj.No:DYA-88-127-44	1988 (1.6)	5.00	BHEL
2	Development of laser alignment system for hydro/system rotor shafts. Proj.No:QYN-87-926-44	1987 (2)	12.00	BHEL
3	Holographic vibrational and dynamic displacement analysis of LP Turbine-120 MW set. Proj.No:PYA-85-662-44	1985 (1.5)	5.00	BHEL
4	Holographic analysis of cover plate of water box of industrial condenser.(1984)	1984 (2)	6.00	BHEL
5	Development of Digital holographic techniques for the contouring of diffuse objects and measurements of temperature of gaseous flames (Rp02282)	2009(3)	37.418	DST, Govt. of India
6	Synthesized spatio-temporal optical coherence for 3-D profilometry and tomography RP-01686	2004 (3)	30	DST, Govt. of India
7	Interferogram analysis techniques RP – 01315	2001 (3 .5)	17.77	DST, Govt. of India
8	Development of an instrument for scanning & separation of contaminants from Indian cotton RP-01048	1999 (2)	15	DST, Govt. of India
9	Design and development of electro-optic sensor for displacement-measurement (phase-Istarted) RP-74-95	1995 (2)	5	DST, Govt. of India
10	Design & development of digital speckle pattern interferometer for measurement/monitoring of vibrations RP-01034	2001 (1.6)	6.63	AR & DB Propulsion Panel
11	Design & development of digital speckle pattern interferometer for measurement /monitoring of vibrations RP-01034	1998 (2)	9.93	AR & DB Propulsion Panel
12	Condition monitoring of joints using digital speckle pattern interferometry. RP-019/93	1993(2)	9.29	AR & DB Propulsion Panel
13	Condition monitoring of joints using laser speckle technique (R-422)	1990 (3)	8.75	AR & DB Propulsion Panel
14	Development of interferometric techniques by using semiconductor lasers and its applications in contouring of optical components and optical testing. RP-07/94	1994 (3)	9.93	CSIR
15	Team member in other three institute projects	1993 (6)	.100	OPTEL Telecommunication Ltd.
16	Development of Moiré and semiconductor laser interferometry and electronic systems for precision length measurement instruments	1991 (1)	10.00	MHRD
17	Design and development of Twyman Green interferometer with automatic fringe analysis capabilities (R-390)	1990 (3)	9.00	CSIR
18	Development of holographic grating and holographic optical elements	1979 (5)	25	Internal Funding by CSIO Chandigarh
19	Diffraction optics as null elements for absolute aspheric metrology	2013 (1.5)	44.44	DRDO/IRDE Dehradun
20	Testing of Micro Optics Using Digital Holographic Interferometry	2014 (2.5)	45.317	DRDO, Ministry of Defence

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Graduating Students in the Past 25 Years

S.No.	Title of the research work	Research Scholar	Supervisor(s)	Year
1	Holographic lenses in speckle metrology and solar concentration	Hari Lal Yadav	Prof. Chandra Shakher & Prof. B. N. Gupta	1992
2	Diffraction optical elements in speckle metrology and temperature measurement	A .J. Pramila Deniel,	Prof. Chandra Shakher.	1993
3	Laser speckle techniques temperature profile measurement	A K Nirala	Prof .Chandra Shakher and Prof. B. N. Gupta	1995
4	Application of laser speckle and acoustic emission techniques to study crack propagation”	D. Ravi	Prof. Chandra Shakher & Prof. Sethuramiya	1995
5	Scientific and engineering applications of diffractive optical elements	Shashi Prakash,	Prof Chandra Shakher	2003
6	Applications of Lau-Phase Interferometry in optical metrology	Madhuri Thakur	Prof Chandra Shakher & Prof. A. L. Vyas	2003
7	Measurement/monitoring of vibrations using Digital Speckle Pattern Interferometry	Rajesh Kumar	Prof. Chandra Shakher & Dr. I.P. Singh	2003
8	Applications of Shear Interferometry in optical metrology	Priti Singh	Prof. Chandra Shakher & Prof. R. S. Sirohi	2006
9	Use of phase shifting Talbot Interferometry for surface profiling and DSPI for monitoring/ measurement of vibration	Saba Kazmi	Prof. Chandra Shakher & Prof. A. L. Vyas	2006
10	Applications of digital holography in optical metrology and information reduction	Mosarraf Hossain	Prof. Chandra Shakher & Prof. D. S. Mehta	2008
11	Investigations on some opto-electronic techniques for dimensional metrology	K .P. Chaudhary	Prof. Chandra Shakher & Dr. L. S. Tanwar	2008
12	Development of full-field swept-source optical coherence tomographic system for scientific and engineering applications	Satish Kumar Dubey	Prof. D. S. Mehta	2009
13	Effect of nano-materials on the electro-optical properties of deformed helix ferroelectric liquid crystals and their applications	Jai Prakash	Prof. D. S. Mehta & Dr. A. M. Birader	2010
14	Investigations on encryption techniques for coloured and gray scale images in Fourier and Fractional Fourier domain	Madhusudan Joshi	Prof. Chandra Shakher & Prof. Kehar Singh	2010
15	Scientific and industrial applications of digital holography	Gyanendra Sheoran	Prof. Chandra Shakher	2011
16	Optical trapping of mesoscopic transparent metallic particles by spatially structured laser beam and characterization of trapped RBCs	Ranjeet Kumar	Prof. Chandra Shakher & Prof. D S Mehta	2012
17	Full-field frequency domain optical coherence microscopy for simultaneous topography and tomography of engineering and biological materials	Tulsi Anna	Prof. Chandra Shakher & Prof. D S Mehta	2012
18	Measurement of temperature of gaseous flames using digital holographic interferometry	Shobhna Sharma	Prof .Chandra Shakher	2013
19	Studies on the Electro-optical Properties of Organic light-emitting diodes	Arunandan Kumar	Prof. D. S. Mehta & Dr. M. N. Kamalasanan, NPL, New Delhi.	2013
20	Laser based explosive detection	Sakshi Gupta	Prof. D. S. Mehta & Dr. M. N. Reddy LASTEC, New Delhi	2016
21	Wide-field low coherence interference microscopy for quantitative imaging of biological and industrial objects	Vishal Srivastava	Prof. D. S Mehta	2013
22	Optical Interferometric Characterization of LEDs and OLEDs	Gyanendra Singh	Prof. D. S Mehta	2015
23	Optical interferometric studies of nematic liquid-crystal materials and their applications	Mohammad Inam	Prof. D. S Mehta	2015
24	Studies on the improvement of efficiency and life time of Organic light emitting devices	Rakhi Grover	Prof. D. S Mehta & Dr. M. N. Kamalasanan, NPL, New Delhi	2013
25	Digital holography and its applications in optical metrology	Varun Kumar	Prof. Chandra Shakher	2016
26	Optical metrology using Digital Speckle Pattern Interferometry and Digital Holography	Manoj Kumar	Prof Chandra Shakher & Dr. Gufran S. Khan	2016
27	Optical metrology using interferometric techniques	Shilpi Agarwal	Prof. Chandra Shakher	2019