

Souvik Roy

Post Doctoral Fellow,
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January 15, 2017

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Research interests

- Big data problems in medicine and life sciences.
- Optimal control framework for stochastic processes, optimization theory.
- Inverse problems in medical imaging and fluid flows.
- Computer vision.
- Numerical analysis and numerical linear algebra.
- Data assimilation.
- Numerical methods for fluid flows.
- Shape optimization.

Softwares Known and Programming Language Skills

- C++ - a high-level object oriented programming language.
- FENICS- a Python programming oriented language for finite element method.
- COMSOL- Multiphysics interface for finite element method.
- DEAL.II- a C++ programming oriented library package for finite element method.
- MATLAB- for various areas like problems in medical imaging, industrial problems.
- OPENCV- a C++ programming oriented language used for Computer Vision problems.
- PARAVIEW- a plotting tool for .vtk file formats.
- VISIT- a plotting kit for .vtk and .eps file formats.
- GITHUB- Web-based Git repository hosting service.

Educational Detail

- **Tata Institute of Fundamental Research, Centre for Applicable Mathematics (CAM)** Bangalore, India
Ph.D. Mathematics 2011 – 2015
 - Thesis title: Reconstruction of a class of fluid flows by variational methods and inversion of integral transforms in tomography – 2015.
 - Advisors: Prof. A. S. Vasudeva Murthy, Dr. Praveen Chandrashekar. and Dr. Venkateswaran P. Krishnan.
- **Tata Institute of Fundamental Research, CAM** Bangalore, India
M.Phil. Mathematics 2010 – 2011
 - Thesis: Optical Flows – Determination of 2D velocities of a moving fluid .
 - Advisors: Prof. A. S. Vasudeva Murthy and Dr. Praveen Chandrashekar .
- **Tata Institute of Fundamental Research, CAM** Bangalore, India
M.Sc. Mathematics 2008 – 2010
 - Graduated with a Masters in Mathematics .
 - Graduated with 1st position and a 79.25% score .
 - Relevant courses: Partial Differential Equations, Computational PDE, Numerical Analysis, Mechanics, Measure Theory .
- **Ramakrishna Mission Vidyamandira, Belur Math** West Bengal, India
University of Calcutta 2005 – 2008
B.Sc. Mathematics
 - Graduated with a major in Mathematics and a minor in Physics and Computer Science .
 - Graduated with Honours, a 82.5% score, and 4th position in the University of Calcutta rank list .
 - Relevant courses: Mathematics, Physics, Computer Science .

Academic Positions

- **University of Würzburg** Würzburg, Germany
Post doctoral fellow Sep 2016 – June 2017
 - Working with Prof. Dr. Alfio Borzi on Fokker-Planck Kolmogorov optimal control problems related to mean field games.
- **ICTS, Bangalore and University of Nice** India and France
Post doctoral fellow Jan 2016 – August 2016
 - Worked jointly with Prof. Didier Auroux and Prof. Amit Apte on developing observers for compressible Navier Stokes equation.
- **University of Würzburg** Würzburg, Germany
Post doctoral fellow July 2015 – Dec 2015
 - Worked with Prof. Dr. Alfio Borzi on a bang-bang optimal control problem for Liouville equation.

- **University of Texas, Arlington** Texas, USA
Post doctoral fellow *Jan 2015 – May 2015*
 – Worked with Prof. Gaik Ambartsoumian on inverse problems related to medical imaging.
- **University of Würzburg** Würzburg, Germany
DAAD visiting scientist *Oct 2014 – Dec 2014*
 – Worked with Prof. Alfio Borzì and Prof. Mario Annunziato on Fokker-Planck equations related to stochastic processes.

Awards, Grants & Honours

- DFG grant for postdoctoral studies at University of Würzburg, Germany September 2016–present
- IFCAM visiting scientist fellowship for postdoctoral studies
 at University of Nice, France. April 2016–June 2016
- ICTS postdoctoral fellowship Jan 2016–August 2016
- Postdoctoral fellowship under the project “Multi-ITN Strike”
 at University of Würzburg. July 2015–Dec 2015
- University of Texas, Arlington and EADS fellowship for postdoctoral studies
 at University of Texas, Arlington, USA Jan 2015–May 2015
- Received DAAD visiting scholar fellowship for research visit
 to University of Würzburg, Germany. Oct 2014–Dec 2014
- Received A.R.Drone for being one of the top 20 teams
 in EADS “Join the Spirit” contest. 2013
- Tata Institute of Fundamental Research doctoral fellowship 2010–2015
- Tata Institute of Fundamental Research masters fellowship 2008–2010
- Achieved 1st position in M.Sc exams
 at Tata Institute of Fundamental Research, CAM 2008–2010
- Achieved 3rd position in CSIR-UGC NET exams 2010
- Achieved 4th position in B.Sc exams at University of Calcutta 2005–2008
- Achieved 71st (out of more than 10000 participants) rank
 in the National Science Olympiad, India 2004

Publications, Research Problems and Projects

Publications/Submitted for publication

1. Souvik Roy, Venkateswaran P. Krishnan, Praveen Chandrasekhar and A. S. Vasudeva Murthy. An efficient numerical algorithm for Radon transform inversion with applications in ultrasound imaging. *Journal of Mathematical Imaging and Vision, Springer*, 53:78–91, 2015.
2. Souvik Roy, Praveen Chandrashekar and A. S. Vasudeva Murthy. A variational approach to optical flow estimation of unsteady incompressible flows. *International Journal of Advances in Engineering Sciences and Applied Mathematics, Springer*, 7(3):149–167, 2015.
3. Praveen Chandrashekar, Souvik Roy and A. S. Vasudeva Murthy. A variational approach to estimate incompressible fluid flows. *Proceedings of Mathematical Sciences, Springer*, (to appear), 2016.
4. Gaik Ambartsoumian and Souvik Roy. Numerical inversion of a broken ray transform arising in single scattering optical tomography *IEEE Transactions on Computational Imaging*, 2(2): 166–173, 2016.
5. Souvik Roy, Mario Annunziato and Alfio Borzì. A Fokker–Planck feedback control-constrained approach for modelling crowd motion. *Journal of Computational and Theoretical Transport*, 45(6): 452–458, 2016.
6. Souvik Roy, Mario Annunziato, Alfio Borzì and Christian Klingenberg. A Fokker-Planck approach to control collective motion. (*under review*), 2015.
7. Souvik Roy and Alfio Borzì. Numerical investigation of a class of Liouville control problems. (*under review*), 2016.

Technical reports

1. Gaurav Sharma and Souvik Roy. Bubble drag coefficient formulation and stability analysis for multiphase-turbomachinery problems(Shear flow/breakup GE2), *Modeling week and study group meeting on industrial problems, Supercomputer education research center*, 58-73, 2011.
2. Andrew A. Lacey, A. S. Vasudeva Murthy and Souvik Roy. Fish feeding. *Modeling week and study group meeting on industrial problems, Supercomputer education research center*, 32-55, 2011.

Preprints/Works Under Preparation

1. Gaik Ambartsoumian, Rim-Gouia-Zarrad, Venkateswaran P. Krishnan and Souvik Roy. Inversion of spherical Radon transform in a spherical shell. (*under preparation, preprint available*), 2016.
2. Anisa MHC and Souvik Roy. Extremal first Dirichlet eigenvalue in a class of doubly connected domains related to shape of musical instruments. (*under preparation, preprint available*), 2016.
3. Praveen Chandrashekar and Souvik Roy. Discontinuous Galerkin scheme for vorticity-velocity formulation of incompressible flows. (*under preparation, preprint available*), 2016.
4. Amit Apte, Didier Auroux, Mythily Ramaswamy, Vishal Vasan, and Souvik Roy. Tracer based observers for compressible Navier-Stokes equations . (*under preparation*), 2016.
5. Alfio Borzì, Paola Goatin, Abderrahmane Habbal and Souvik Roy. Crowd motion modelled by Fokker-Planck Kolmogorov–constrained games. (*under preparation*), 2016.

Other Completed Projects

1. Worked with Deep Ray of TIFR-CAM to develop an algorithm to compare human beings in photographs for the second phase of the global competition “Join The Spirit” organized by EADS-2013.
2. Worked with Deep Ray of TIFR-CAM to develop an algorithm to detect human beings for the global competition “Join The Spirit” organized by EADS-2013.
3. Worked along with Prof. Laxmivarahan, Prof. Ravi Nanjundiah and Prof. Mythily Ramaswamy to solve the Lorenz 63 model and the Ikeda map model using variational approach during the Data Assimilation workshop held at TIFR-CAM, Bangalore-2011.
4. Worked along with Prof. Andrew Lacey and Prof. A.S.Vasudeva Murthy and presented a report on the fish feeding problem during the Study Group Meeting on Industrial Problems held at Super Computer Education Research Center-IISc, Bangalore-2011.
5. Worked along with Prof. John Ockendon on the bubble growth problem during the Study Group Meeting on Industrial Problems held at Super Computer Education Research Center-IISc, Bangalore-2011.

Teaching Experience

- **ODE and Linear Algebra-MATH 3319** University of Texas, Arlington, USA
Course Instructor Spring 2015
 - Was instructor for the course, created assignments and examinations, evaluated assignments and examinations.
- **Mechanics (M.Sc.)** TIFR-CAM
Teaching Assistant Spring 2014
 - Created assignments and examinations, evaluated assignments and examinations.
 - Held supplementary sessions for students.
- **Computational PDE (M.Sc.)** TIFR-CAM
Teaching Assistant Spring 2012
 - Evaluated assignments, examinations, course notes, and taught a part of the course.
 - Held supplementary sessions for students.
- **ATML School for Lecturers** University of Vadodara
Teaching Assistant Summer 2011
 - As an assist to Prof. A. S. Vasudeva Murthy, Prof. Mythily Ramaswamy and Dr. K. Sandeep, prepared numerical experiments for ODE theory taught in the school.

Organized Events

- **Organizer of the Inverse Problem Seminar Series**
University of Texas, Arlington, USA Spring, 2015

Presentations and Talks Given

- **Numerical inversion of a broken ray transform arising in SSOT**
Radon100 conferene, JKU, Linz, Austria *March, 2017*
- **Numerical inversion of a broken ray transform arising in SSOT**
ICTS-TIFR, Bangalore *July, 2016*
- **Inversion of a spherical Radon transform in a spherical shell**
Paper presentation, Inverse problems in modelling and simulation, Turkey *May, 2016*
- **A Fokker-Planck approach to control collective motion**
ICTS, Bangalore *October, 2015*
- **A Fokker-Planck approach to control pedestrian motion**
Paper presentation, ICTT, Taormina, Italy *September, 2015*
- **Inverse problems in imaging**
Inverse Problem Seminar Series, University of Texas, Arlington, USA *March, 2015*
- **A Variational approach to flow estimation of unsteady incompressible flows**
Paper presentation, Finite Element Meet, TIFR-CAM, Bangalore *July, 2014*
- **Efficient numerical reconstruction from partial Radon data in imaging**
Poster presentation, SIAM Summer School, JKU, Linz, Austria *August, 2014*
- **On some inverse problems in fluid flows and imaging**
Synopsis talk, TIFR-CAM, Bangalore *July, 2014*
- **A DG vorticity-velocity formulation for incompressible 2D Euler flow.**
IISER Pune *June, 2014*
- **Vorticity-velocity formulation for 2D Euler equation**
In-House Symposium, TIFR-CAM, Bangalore *August, 2013*
- **Optimal control approach for estimation of incompressible fluid flows**
28th Annual Conference Of Ramanujam Mathematical Society, RIT, Bangalore *June, 2013*
- **Motion estimation using computational techniques in PDE**
In-House Symposium, TIFR-CAM, Bangalore *August, 2012*

Participation in Workshops and Conferences

- **8th International Conference on Inverse Problems (IPMS)** *Fethiye, Turkey*
IPMS *2016*
- **Conference on Computational PDE** *Bangalore, India*
TIFR-CAM, Bangalore *2014*
- **Gene Golub SIAM Summer School** *Linz, Austria*
Johannes Kepler Universität *2014*
- **AIS on Theoretical and Numerical Aspects of Inverse Problems** *Bangalore, India*
TIFR-CAM, Bangalore *2014*
- **Scientific Writing Workshop** *Bangalore, India*
TIFR-CAM, Bangalore *2014*
- **Workshop on Optimization with PDE Constraints** *Bangalore, India*
TIFR-CAM, Bangalore *2013*

- **Summer School on Numerics and Control of PDEs** Bangalore, India
IISC, Bangalore 2013
- **Compact Course on Discontinuous Galerkin Methods (Prof. Shu)** Bangalore, India
TIFR-CAM, Bangalore 2013
- **International Conference on Conservation Laws and Applications** Bangalore, India
TIFR-CAM, Bangalore 2013
- **TCANW** Mumbai, India
IIT, Bombay 2013
- **Advanced Workshop on Non-Standard Finite Element Methods** Mumbai, India
IIT, Bombay 2013
- **Course on Heterogeneous Parallel Programming** Online
University of Illinois 2013
- **Instructional Workshop on Finite Element Methods** Bangalore, India
TIFR-CAM, Bangalore 2012
- **School on Cocompact Embeddings and Profile Decompositions** Bangalore, India
TIFR-CAM, Bangalore 2012
- **Monsoon School on Data Assimilation Research Programme** Bangalore, India
TIFR-CAM, Bangalore 2011
- **Study Group Meeting on Industrial Problems** Bangalore, India
SERC-IISC, Bangalore 2011
- **Workshop on Computational Science** Bangalore, India
SERC-IISC, Bangalore 2011
- **Workshop on Scientific Discovery through Intensive Data Exploration** Bangalore, India
JNCASR, Bangalore 2011
- **Mesh-Free Conference** Bangalore, India
IISC, Bangalore 2011
- **Conference on Recent Trends in Non-Linear Elliptic PDEs** Bangalore, India
TIFR-CAM, Bangalore 2011
- **IMI Workshop and Symposium on Mathematical Ecology** Kolkata, India
IISER, Kolkata 2010
- **ICMPDE** Bangalore, India
TIFR-CAM, Bangalore 2010
- **IMI Workshop and International Conference on Homogenization** Bangalore, India
IISC, Bangalore 2010
- **Symposium on ‘Perspectives in Mathematics’** Mumbai, India
TIFR, Mumbai 2009
- **Seminar on ‘Mathematics Vis-à-Vis World of Experience’** Kolkata, India
Bethune College 2008
- **MTTS Programme** Kolkata, India
Jadavpur University 2006