Souvik Roy

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Assistant Professor,
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Professional Experience

- **University of Texas at Arlington (UTA)** — Arlington, Texas, USA
  Assistant Professor — *August 2018 – present*
- **Tata Institute of Fundamental Research, Centre for Applicable Mathematics (TIFR-CAM)** — Bangalore, India
  Visiting fellow — *March 2018 – July 2018*
- **University of Würzburg** — Würzburg, Germany
  Postdoctoral fellow — *Sep 2016 – Sep 2017*
- **International Centre for Theoretical Sciences (ICTS) and University of Nice** — Bangalore India / Nice, France
  Joint postdoctoral fellow — *Jan 2016 – August 2016*
- **University of Würzburg** — Würzburg, Germany
  Postdoctoral fellow — *July 2015 – Dec 2015*
- **University of Texas at Arlington** — Texas, USA
  Postdoctoral fellow — *Jan 2015 – May 2015*
- **University of Würzburg** — Würzburg, Germany
  Deutscher Akademischer Austauschdienst (DAAD) visiting scientist — *Oct 2014 – Dec 2014*

Educational Detail

- **Tata Institute of Fundamental Research, 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.
  - Advisors: A. S. Vasudeva Murthy, Praveen Chandrashekar and Venkateswaran P. Krishnan.

- **Tata Institute of Fundamental Research, CAM** — Bangalore, India
  M.Phil. Mathematics — *2010 – 2011*
  - Thesis title: Optical Flows – Determination of 2D velocities of a moving fluid.
  - Advisors: A. S. Vasudeva Murthy and Praveen Chandrashekhar.

- **Tata Institute of Fundamental Research, CAM** — Bangalore, India
  M.Sc. Mathematics — *2008 – 2010*
  - Graduated with 1st position and a 79.25% score.

- **Ramakrishna Mission Vidyamandira, Belur Math** — West Bengal, India
  University of Calcutta — *2005 – 2008*
  B.Sc. Mathematics
  - Graduated with 4th position and a 82.5% score.

Current Research Interests

- Inverse problems in medical imaging and fluid flows.

- Optimal control frameworks for stochastic processes, health sciences and medical imaging.

- QSP modeling and control for treatment of cancer.

- Numerical analysis and numerical linear algebra.

- Numerical methods for fluid flows.

- Shape optimization.

Grants

- **Multi-PI**: National Cancer Institute-National Institute of Health (NCI-NIH),
  Grant number: 1R21CA242933-01, $386,767.   2019-2021
  Title: "Data-driven QSP software for personalized colon cancer treatment".

- **PI**: H.C. Ørsted COFUND grant (under Marie Sklodowska-Curie Actions grant no. 609405 (FP7) and
  713683 (H2020)) for postdoctoral studies at Denmark Technical University, $151,210.
  Title: "Optimization methods for hybrid inverse problems".   2017-2019
  (S. Roy declined the offer due to accepting the UTA assistant professor position).

Awards, Fellowships & Honors

- Selected as one the 25 participants in the prestigious NCI-NIH Innovation Lab "Advancing Cancer
  Biology at the Frontiers of Machine Learning and Mechanistic Modeling".   2020.

- Certified Leader in Education, NRI Welfare Society of India and Association of Leaders in Education.
  2019.

- Teaching recognized by "Freshman Leaders On Campus (FLOC)" at UTA with recognition lunch.
  2019.

- Postdoctoral fellowship under Deutsche Forschungsgemeinschaft (DFG) grant at University of
  Würzburg, Germany.   Sep 2016–Sep 2017

- Indo-French Centre for Applied Mathematics (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, Germany.
  July 2015–Dec 2015

- University of Texas at Arlington and AIRBUS fellowship for postdoctoral studies at University of
  Texas at Arlington   Jan 2015–May 2015

- Deutscher Akademischer Austauschdienst (DAAD) visiting scholar fellowship for research visit to University of Würzburg, Germany. Oct 2014–Dec 2014

- TIFR-CAM doctoral fellowship. 2010–2015

- TIFR-CAM masters fellowship. 2008–2010

- Achieved 1st position in M.Sc exams at TIFR-CAM. 2008–2010

- 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, Abstracts and Reports

Submitted publications

1. **Souvik Roy**. A new nonlinear sparse optimization framework for superior reconstructions in ultrasound-modulated optical tomography, *(under review)*, 2020.

2. Madhu Gupta, Rohit Kumar Mishra and **Souvik Roy**. A sparsity-based nonlinear reconstruction method for two-photon photoacoustic tomography, *(under review)*, 2020.

3. Rim Gouia-Zarrad, **Souvik Roy** and Sunghwan Moon. Numerical inversion and uniqueness of a spherical Radon transform restricted with a fixed angular span, *(under review)*, 2020.

4. Hristo Kojouharov, **Souvik Roy**, Madhu Gupta, Fawaz Alalhareth and John M Slezak. A second-order nonstandard theta method for autonomous differential equations, *(under review)*, 2020.

5. Suvra Pal and **Souvik Roy**. A new non-linear conjugate gradient algorithm for destructive cure rate model and a simulation study: illustration with negative binomial competing risks *(under review)*, 2020.

6. Suvra Pal and **Souvik Roy**. A new estimation algorithm for Box-Cox transformation cure rate model and comparison with EM algorithm *(under review)*, 2020.

7. Jan Bartsch, Alfio Borzì, Francesco Fanelli and **Souvik Roy**. A numerical investigation of Brockett's ensemble optimal control problems. *(under review)*, 2020.

Peer-reviewed Publications

1. Madhu Gupta, Rohit Kumar Mishra and **Souvik Roy**. Sparse reconstruction of log-conductivity in current density impedance tomography, *Journal of Mathematical Imaging and Vision*, 62:189-205, 2020.

2. Suvra Pal and **Souvik Roy**. A new non-linear conjugate gradient algorithm for destructive cure rate model and a simulation study: illustration with negative binomial competing risks, *Communications in Statistics - Simulation and Computation*, doi: 10.1080/03610918.2020.1819321, 2020.

3. **Souvik Roy**. A sparsity-based Fokker-Planck optimal control framework for modeling traffic flows, *AIP Conference Proceedings (to appear)*, 2020.

4. Madhu Gupta, Fawaz Alalhareth, John M Slezak, **Souvik Roy** and Hristo Kojouharov. Second-order nonstandard explicit Euler method, *AIP Conference Proceedings (to appear)*, 2020.

5. Anisa M.H. Chorwadwala and **Souvik Roy**. How to place an obstacle having a dihedral symmetry centered at a given point inside a disk so as to optimize the fundamental Dirichlet eigenvalue. *Journal of Optimization Theory and Applications*, 184(1):162-187, 2020.

6. Jan Bartsch, Alfio Borzì, Francesco Fanelli and **Souvik Roy**. A theoretical investigation of Brockett's ensemble optimal control problems. *Calculus of Variation and Partial Differential Equations*, 58:162, 2019.

7. **Souvik Roy**, Mario Annunziato, Alfio Borzì and Christian Klingenberg. A Fokker-Planck approach to control collective motion. *Computational Optimization and Applications*, 69(2):423–459, 2018.

8. Gaik Ambartsoumian, Rim Gouia-Zarrad, Venkateswaran P. Krishnan and **Souvik Roy**. Image reconstruction from radially incomplete spherical Radon data. *European Journal of Applied Mathematics*, 29(3):470–493, 2018.

9. **Souvik Roy** and Alfio Borzì. A new optimisation approach to sparse reconstruction of log-conductivity in acousto-electric tomography. *SIAM Journal of Imaging Sciences*, 11(2):1759–1784, 2018.

10. Bolaji Adesokan, Kim Knudsen, Venkateswaran P. Krishnan and **Souvik Roy**. A fully non-linear optimization approach to acousto-electric tomography. *Inverse Problems*, 34:104004, 2018.

11. **Souvik Roy**, Alfio Borzì and Abderrahmane Habbal. Pedestrian motion constrained by FP-constrained Nash games. *Royal Society Open Science*, 4(9):170648, 2017.

12. Praveen Chandrashekar, **Souvik Roy** and A. S. Vasudeva Murthy. A variational approach to estimate incompressible fluid flows. *Proceedings of Mathematical Sciences, Springer*, 127(1):175–201, 2017.

13. **Souvik Roy** and Alfio Borzì. Numerical investigation of a class of Liouville control problems. *Journal of Scientific Computing*, 73(1):178–202, 2017.

14. 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.

15. **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.

16. **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.

17. **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.

Conference Abstracts

1. Gaik Ambartsoumian, **Souvik Roy**, Gaurav Khatri and Phillipe Zimmern. Automatic segmentation and 3D visualization of pelvic mesh using mathematical modelling and machine learning techniques in MRI, *Neurology and Urodynamics, ICS 49th Annual Meeting*, 2019.

Technical Reports and Dissertations

1. **Souvik Roy**. Reconstruction of a class of fluid flows by variational methods and inversion of integral transforms in tomography. *Doctoral Dissertation*, TIFR-CAM, 2015.

2. **Souvik Roy**. Optical Flows – Determination of 2D velocities of a moving fluid. *M.Phil Dissertation*, TIFR-CAM, 2011.

3. 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, Indian Institute of Science, Bangalore, India, 58-73, 2011.

4. 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, Indian Institute of Science, Bangalore, India, 32-55, 2011.

Selected list of invited presentations

1. **Personalized prediction of treatment response for peritoneal carcinomatosis via a hybrid mechanistic/AI approach (10 min)**
   Group report presentation at NCI-NIH Innovation Lab (Online)   *August, 2020*

2. **Reconstruction of sparse log-conductivity in current density impedance imaging (15 min).**
   SIAM conference on imaging sciences (IS20) (Online)   *July, 2020*

3. **A Pontryagin maximum principle based Fokker-Planck approach to control traffic motion. (30 min)**
   Mini-symposium talk at 12th conference of the Euro-American consortium AMiTaNS'20 (online)
         June 2020

4. **A Fokker-Planck approach to control crowd motion (30 min)**
   TX-LA SIAM Section Meeting, Southern Methodist University, USA   *November, 2019*

5. **A Nash games framework to control pedestrian behavior (30 min)**
   French-German-Swiss conference on optimization, Nice, France   *September, 2019*

6. **A new non-linear optimization framework for acousto-electric tomography (30 min)**
   Mini-symposium talk at the conference Applied Inverse Problems, Grenoble, France   *July, 2019*

7. **A Fokker-Planck approach to control crowd motion (30 min)**
   Collaborative Conference on Math-Finance and Statistics, Hawaii, USA   *March, 2019*

8. **Controlling pedestrian motion through a Nash games framework (50 min)**
   Guest Speaker, Mathematical Association of America,
   University of Texas at Arlington, USA   *March 2019*

9. **A fully non-linear optimization approach for acousto-electric tomography (50 min)**
   Computational Science Seminar, University of Texas, Dallas, USA   *February, 2019*

10. **Math: A boon or a curse (50 min)**
    Guest Speaker at a faculty program for student residents,
    University of Texas at Arlington, USA   *November, 2018*

11. **Inverse problems and PDE-constrained optimization (50 min)**
    SIAM Student Chapter, University of Texas at Arlington, USA   *October, 2018*

12. **Non-linear optimization methods for acousto-electric tomography (45 min)**
    Departmental Seminar, TIFR-CAM, India   *May, 2018*

13. **An introduction to linear ordinary differential equations and some numerical methods (50 min)**
    Mathematics Department Seminar, American University of Sharjah, UAE   *April, 2018*

14. **A Fokker-Planck Nash differential game to model crowd motion with avoidance (50 min)** *Mathematics Department Colloquium, American University of Sharjah, UAE*   *April 2018*

15. **A Fokker-Planck Nash differential game to model crowd motion with avoidance (50 min)**
    Mathematics Department Seminar, Denmark Technical University, Denmark   *August, 2017*

16. **A novel numerical method for a class of Liouville control problems (30 min)**
    Workshop on Numerical Methods for Optimal Control and Inverse Problems,
    Technical University of Munich, Germany   *April, 2017*

17. **Numerical inversion of a broken ray transform arising in single scattering optical tomography (30 min)**
    Mini-symposium talk at the conference "100 Years of the Radon Transform", The Radon Institute
    of Computational and Applied Mathematics, Linz, Austria   *March, 2017*

18. **Numerical investigation of a class of Liouville control problems (50 min)**
    Mathematics Department Seminar, University of Nice, France   *March, 2017*

19. **Inversion of a spherical Radon transform in a spherical shell (50 min)**
    Mathematics Department Seminar, Denmark Technical University, Denmark   *October, 2016*

20. **Numerical inversion of a broken ray transform arising in single scattering optical tomography (50 min)**
    Mathematics Department Seminar, ICTS, Bangalore, India   *July, 2016*

21. **Inversion of a spherical Radon transform in a spherical shell (30 min)**
    Mini-symposium talk at the conference
    "Inverse Problems: Modeling and Simulation", Turkey   *May, 2016*

22. **A Fokker-Planck approach to control collective motion (45 min)**
    Mathematics Department Seminar, ICTS, Bangalore, India   *October, 2015*

23. **Inverse problems in imaging (50 min)**
    Inverse Problem Seminar Series, University of Texas at Arlington, USA   *March, 2015*

24. **A variational approach to flow estimation of unsteady incompressible flows (45 min)**
    Finite Element Meet, TIFR-CAM, Bangalore, India   *December, 2014*

25. **A discontinuous Galerkin vorticity-velocity formulation for incompressible 2D Euler flow (50 min)**
    Mathematics Department Seminar, Indian Institute of Science Education and Research, Pune,
    India   *June, 2014*

26. **Optimal control approach for estimation of incompressible fluid flows (30 min)**
    28th Annual Conference Of Ramanujam Mathematical Society,
    Ramaiah Institute of Technology, Bangalore, India   *June, 2013*

Selected list of workshops and conferences attended

1. **NCI-NIH Innovation Lab**
   Online   *August, 2020*

2. **SIAM conference on imaging sciences**
   Online   *July, 2020*

3. **12th conference of the Euro-American consortium AMiTaNS'20**
   Online   *June, 2020*

4. **Applied Inverse Problems**
   University of Grenoble, France   *July, 2019*

5. **Collaborative Conference on Math-Finance and Statistics**
   Hawaii, USA   *March, 2019*

6. **Numerical Methods for Optimal Control and Inverse Problems**
   Technical University of Munich, Germany   *April, 2017*

7. **100 Years of the Radon Transform**
   The Radon Institute of Computational and Applied Mathematics, Linz, Austria   *March, 2017*

8. **8th International Conference on Inverse Problems: Modeling and Simulation**
   Turkey   *May, 2016*

9. **Conference on Computational Partial Differential Equations, Finite Element Meet**
   TIFR-CAM, Bangalore, India   *December, 2014*

10. **Gene Golub SIAM Summer School**
    The Radon Institute of Computational and Applied Mathematics, Linz, Austria   *August, 2014*

11. **Advanced Instructional School on Theoretical and Numerical Aspects of Inverse Problems**
    TIFR-CAM, Bangalore, India   *June, 2014*

12. **Workshop on Optimization with PDE Constraints**
    TIFR-CAM, Bangalore, India   *November, 2013*

13. **Summer School on Numerics and Control of PDEs**
    Indian Institute of Science, Bangalore, India   *July-August, 2013*

14. **Compact Course on Discontinuous Galerkin Methods by Chi-Wang Shu**
    TIFR-CAM, Bangalore, India   *July, 2013*

15. **International Conference on Conservation Laws and Applications**
    TIFR-CAM, Bangalore, India   *July, 2013*

16. **Theoretical and Computational Aspects of Nonlinear Waves**
    Indian Institute of Technology, Bombay, India   *May, 2013*

17. **Advanced Workshop on Non-Standard Finite Element Methods**
    Indian Institute of Technology, Bombay, India   *February, 2013*

18. **Instructional Workshop on Finite Element Methods**
    TIFR-CAM, Bangalore, India   *July, 2012*

19. **School on Cocompact Embeddings and Profile Decompositions**
    TIFR-CAM, Bangalore, India   *July, 2011*

20. **Workshop on Computational Science**
    Supercomputer Education Research Centre , Bangalore, India   *March, 2011*

21. **Mesh–Free Conference**
    Indian Institute of Science, Bangalore, India   *March, 2011*

22. **Monsoon School on Data Assimilation Research Programme**
    TIFR-CAM, Bangalore, India   *February, 2011*

23. **Workshop on Scientific Discovery through Intensive Data Exploration**
    Jawaharlal Nehru Centre For Advanced Scientific Research, Bangalore, India   *January, 2011*

24. **Conference on Recent Trends in Non-Linear Elliptic PDEs** *TIFR-CAM, Bangalore, India*
    January, 2011

25. **Indian Institute of Science Mathematics Initiative (IMI) Workshop and Symposium on
    Mathematical Ecology**
    Indian Institute of Science Education and Research, Kolkata, India   *November, 2010*

26. **International Conference of Mathematicians-Satellite Conference on Partial
    Differential Equations**
    TIFR-CAM, Bangalore, India   *August, 2010*

27. **IMI Workshop and International Conference on Homogenization**
    Indian Institute of Science, Bangalore, India   *May, 2013*

28. **Symposium on "Perspectives in Mathematics"**
    TIFR, Mumbai, India   *November, 2009*

Students Supervised

Supervised postdoctoral fellows

1. **Rohit Kumar Mishra**, University of Texas at Arlington, 2019-current.

Supervised Ph.D. Students

1. **John Montalbo**, University of Texas at Arlington (co-supervised with Gaik Ambartsoumian),
   2018-2020.
   Dissertation title: Inverse problems and forward propagation of optical flow.

2. **Madhu Gupta**, University of Texas at Arlington, 2019-current.

3. **Asma Ali Alghamdi**, University of Texas at Arlington, 2020-current.

4. **Mesfer Alajmi**, University of Texas at Arlington, 2020-current.

5. **Hussein Said Ed duweh**, University of Texas at Arlington, 2020-current.

Supervised Master Students

1. **Jan Bartsch**, MS 2017, University of Würzburg, Germany (co-supervised with Alfio Borzì and Francesco Fanelli).
   Dissertation title: Optimal control problems governed by Liouville models- Theoretical analysis and implementation.
   Position after MS: Ph.D. student, University of Würzburg, Germany.

Supervised Undergraduate Students

1. **Achyuth Manoj**, University of Texas at Arlington, 2020-current.

2. **Susanth Kakarla**, University of Texas at Arlington, 2020-current.

3. **Juan Villegas**, University of Texas at Arlington, 2020-current.

Dissertation/Thesis Committee

1. Rawan Joudeh, MS committee (chair Gaik Ambartsoumian), Mathematics, UTA.

2. John Montalbo, PhD committee (chair Gaik Ambartsoumian), Mathematics, UTA.

3. Zachry Angel, PhD committee (chair Suvra Pal), Mathematics, UTA.

4. Pei Wang, PhD committee (chair Suvra Pal), Mathematics, UTA.

Teaching

Teaching at UTA

1. **MATH 5321**- *Applied Partial Differential Equations (graduate)*, University of Texas at Arlington (Hybrid 3).
   Instructor, Class size - 18 students. Responsibilities: lectures, office hours, assignments, midterms and final exams.

2. **MATH 5320**- *Ordinary Differential Equations (graduate)*, University of Texas at Arlington (Transition to online classes mid-semester).
   Instructor, Class size - 12 students. Responsibilities: lectures, office hours, assignments, midterms and final exams.

3. **MATH 3319**- *Differential Equations and Linear Algebra (undergraduate)*, University of Texas at Arlington.
   Instructor, Class size - about 60 students. Responsibilities: lectures, office hours, 3 exams per semester.

4. **MATH 1426**-*Calculus 1 (undergraduate)*, University of Texas at Arlington.
   Instructor, Class size - about 80 students. Responsibilities: lectures, office hours, 3 exams per semester.

5. **MATH 2425**- *Calculus 2 (undergraduate)*, University of Texas at Arlington.
   Instructor, Class size - about 70 students. Responsibilities: lectures, office hours, 3 exams per semester.

Teaching outside of UTA

1. *Mechanics (graduate)*, TIFR-CAM, Bangalore, India.
   Teaching assistant, Class size - about 18 students. Responsibilities: assignment and examination evaluations, supplementary lectures.

2. *Computational Partial Differential Equations (graduate)*, TIFR-CAM, Bangalore, India.
   Teaching assistant, Class size - about 10 students. Responsibilities: assignment and examination evaluations, supplementary lectures.

Professional Service

1. Co-organizer of the *Calculus Bowl*, UTA, 2019-present.

2. Member of the *Mathematical Association of America*, 2018-present.

3. Life member of the *Indian Society of Industrial and Applied Mathematics*, 2016-present.

4. Organizer of the *Inverse Problems Seminar Series*, UTA, Spring, 2015.

5. Journal reviewer for

   - Inverse Problems
   - Journal of Mathematical Imaging and Vision
   - Inverse Problems in Science and Engineering
   - Applied Mathematics
   - Applied Mathematical Modeling
   - SIAM book reviews.
   - IEEE Signal Processing Letters.
   - Automatica
   - IMA Journal of Applied Mathematics
   - International Journal of Computer Mathematics
   - Zentralblatt MATH (zbMATH)
   - Journal of Ramanujan Mathematical Society

Articles in the Media (hyperlinks)

1. February 2018 - Science Trends: Solving mass transportation problems using Liouville equations

2. September 2017- Eureka Alert: On a collision course with game theory

3. September 2017 - PhysOrg: On a collision course with game theory

4. September 2017 - Science Daily: On a collision course with game theory

5. September 2017 - N+1: Pedestrian traffic described using game theory

6. September 2017- Jura Forum: On a collision course with game theory

Additional Information

Programming skills

- C++, PYTHON, MATLAB

- FENICS, COMSOL, DEAL.II

- PARAVIEW, VISIT

- GITHUB

Languages

Fluent in English, Bengali and Hindi