

Dr. Pratibhamoy Das

CONTACT

INFORMATION

Assistant Professor
Indian Institute of Technology, Patna, India

Past: Visiting Faculty, IISER Bhopal,
Einstein Foundation Fellow
Technische Universität Berlin, Germany
Postdoc: IISc Bangalore
Supercomputer Education Research Center
Ph.D. (IIT Guwahati), M.Sc. (IIT Bombay)

D.O.B: 4th January, 1986

Mobile: 00917319953110 OR
00919836839388 (Home)

E-mail:

pratibhamoy86@gmail.com
pratibhamoy@iitp.ac.in
www.iitp.ac.in/~pratibhamoy
page.math.tu-berlin.de/
~pratibha
https://sites.google.com/site/
/pratibhamoy/

RESEARCH INTERESTS

A posteriori Error Estimates for Singularly Perturbed Differential Equations on Adaptively Generated Nonuniform Grids: Numerical Analysis, Moving Mesh Methods, A posteriori Error Analysis, Singularly Perturbed Parabolic Differential Equations, Delay Differential Equations.

ACADEMIC

APPOINTMENTS

Assistant Professor

February 2016- Continuing

Department of Mathematics, **Indian Institute of Technology**, Patna, India

Visiting Faculty

June 2015- January 2016

Department of Mathematics, **Indian Institute of Science Education and Research**, Bhopal, India

Researcher

April 2014 - May 2015

Institut für Mathematik, Technische Universität Berlin, Germany

- Einstein Foundation Fellowship, IMU Berlin (EFP-2014)
- Institute: **Technische Universität Berlin**, Berlin, Germany
- Mentor: Professor Volker Mehrmann

Postdoctoral Researcher

June 2013 -March 2014

Supercomputer Education Research Center, Indian Institute of Science, Bangalore

- NBHM-DAE Fellowship (NBHM-2013)
- Institute: **IISc Bangalore**, Bangalore, Karnataka
- Mentor: Professor Soumyendu Raha

EDUCATION

Ph.D. (through Institute Fellowship GATE-2008)

July 2008 to May 2013

Department of Mathematics, Indian Institute of Technology, Guwahati,

- Institute: **IIT Guwahati**, Guwahati, Assam
- Thesis Title: *Robust Numerical Schemes for Singularly Perturbed Boundary-Value problems on Adaptive Meshes*
- Adviser: Professor Srinivasan Natesan
- Area of Study: Numerical Analysis, Differential Equations

M.Sc. (through JAM-2006), Applied Mathematics, May 2008

- Institute: **IIT Bombay**, Powai, Mumbai
- Thesis Title: *Numerical Schemes for Hamilton-Jacobi Equation and its Application on Finance*
- Adviser: Professor S. Baskar

B.Sc., Pure and Applied Mathematics, June 2006

- Institute: **Calcutta University**, College Street, Kolkata
Ramkrishna Mission Vivekananda Centenary College, Rahara

- *Magna cum Laude*, With Honors in Mathematics

Intermediate and Secondary, General Science, June 2003 & June 2001

- Institute: **W.B.C.H.S.E. & W.B.B.S.E.**
Sodepur High School, Sodepur

AWARDS

- **YOUNG SCIENTIST AWARD**, 100th Indian Science Congress, 2013
- **EINSTEIN Foundation Program Fellowship**, IMU Berlin, 2014
- NBHM Postdoctoral Fellowship, 2013
- NBHM Ph.D. Research Grant Award, 2010
- CSIR-NET Fellowship 2009, **All INDIA RANK-25**
- GATE Scholarship 2008
- IIT Bombay Merit cum Mean Scholarship, 2006-'08

REFEREED JOURNAL PUBLICATIONS

- [1] P. Das and V. Mehrmann, Numerical solution of singularly perturbed parabolic convection-diffusion- reaction problems with two small parameters, *BIT Numerical Mathematics*, 56, 51-76, doi:10.1007/s10543-015-0559-8, Springer, 2016, ISSN No:0006-3835.
- [2] P. Das, Comparison of a priori and a posteriori meshes for singularly perturbed nonlinear parameterized problems, *Journal of Computational and Applied Mathematics*, 290, 16-25, 2015, Elsevier, ISSN No:0377-0427.
- [3] P. Das and V. Mehrmann, Upwind based parameter uniform convergence analysis for two parametric parabolic convection diffusion problems by moving mesh methods, *Proc. Appl. Math. Mech.*, 15, 591-592 doi:10.1002/pamm.201510285, 2015, Wiley, ISSN No:1617-7061.
- [4] P. Das and S. Natesan, Optimal error estimate using mesh equidistribution technique for singularly perturbed system of reaction-diffusion boundary value problems, *Applied Mathematics and Computation*, 249, 265-277, 2014, Elsevier, ISSN No:0096-3003.
- [5] P. Das and S. Natesan, Adaptive mesh generation for singularly perturbed fourth-order ordinary differential equations, *International Journal of Computer Mathematics*, Taylor & Francis, 92(3), 562-578, 2015, ISSN No:0020-7160.
- [6] P. Das and S. Natesan, Numerical solution of a system of singularly perturbed convection diffusion boundary value problems using mesh equidistribution technique, *Australian Journal of Mathematical Analysis and Applications*, 10(1), 1-17, 2013, Australian Internet Publishing. ISSN No:1449-5910.
- [7] P. Das and S. Natesan, Richardson extrapolation method for singularly perturbed convection-diffusion problems on adaptively generated mesh, *CMES: Computer Modelling in Engineering & Sciences*, 90(6), 463-485, 2013, Tech Science Press. ISSN No:1526-1492.
- [8] P. Das and S. Natesan, A uniformly convergent hybrid scheme for singularly perturbed system of reaction-diffusion Robin type boundary value problems, *Journal of Applied Mathematics and Computing*, 41(1-2), 447-471, 2013, Springer, doi:10.1007/s12190-012-0611-7. ISSN No:1865-2085.
- [9] P. Das and S. Natesan, Higher order parameter uniform convergent schemes for Robin type reaction-diffusion problems using adaptively generated grid, *International Journal of Computational Methods*, 9(4), 2012, World Scientific, doi:10.1142/S0219876212500521. ISSN No:0219-8762.

SUBMITTED
JOURNAL
PUBLICATIONS

- [10] P. Das and V. Mehrmann, A posteriori error estimates for differential algebraic equations in singular perturbation context, *Communicated*.
- [11] P. Das, Optimal order a posteriori error analysis for a system of nonlinear singularly perturbed delay differential equations, *Communicated*.
- [12] P. Das, Parameter uniform higher order numerical method for parabolic initial boundary value problems with boundary layers on equidistributed grids, *Communicated*.
- [13] P. Das, A space-time higher order numerical method for boundary layer problems based on post processing on equidistributed meshes, *Communicated*.

CONFERENCE
PUBLICATIONS

- [14] P. Das and V. Mehrmann, Upwind based parameter uniform convergence analysis for two parametric parabolic convection diffusion problems by moving mesh methods, *International Conference "Gesellschaft für Angewandte Mathematik und Mechanik (GAMM-2015)" organized by International Association of Applied Mathematics and Mechanics on their 86th Annual Meeting, Universita del Salento, March 23-27th 2015, Lecce, Italy*.
- [15] P. Das, S. Natesan, Parameter-uniform numerical method for a system of singularly perturbed convection-diffusion boundary-value problems on adaptively generated grid. *Proceedings of the International Conference on Advances in Modeling, Optimization and Computing (AMOC-2011), IIT Roorkee, Roorkee, India, December 5-7, 779-790, 2011*.

POSTER
PRESENTATIONS

- [16] P. Das and V. Mehrmann, A posteriori error estimates for a class of differential algebraic equations in singular perturbation context. on "Numerical Algebra, Matrix Theory, Differential Algebraic Equations and Control Theory" at Technische Universität, Berlin, from 6-9th May, 2015, Berlin, Germany.

BOOK

- [17] P. Das, *Simulations of Hamilton-Jacobi Equation with Application on Finance*, 2011, Lambert Academic publishing, ISBN: 978-3659358357.

TEACHING
EXPERIENCE

IIT Patna, Patna, Bihar

Full Instructor

2016

- Autumn 2016 - M. Sc. MA 429: Ordinary Differential Equation
- Autumn 2016 - B. Tech. MA 201: Complex Analysis part

IISER Bhopal, Bhopal, Madhya Pradesh

Full Instructor

2015

- Autumn 2015 - BS-MS and MS-Ph.D. MTH 405 Partial Differential Equation

IIT Guwahati, Guwahati, Assam

Teaching Assistant

2009 – 2012

Taught B.Tech. students from all branches. Graded homework, quizzes, and exams. Held office hours, and participated in weekly Math Help Room open tutoring sessions. Specific courses taught:

- Autumn 2009- B. Tech. MA 101 Real Analysis
- Winter 2010-'11 - B. Tech. MA 102 Linear Algebra and Ordinary Differential Equation
- Autumn 2010-'12 - B. Tech. MA 201 Complex Analysis and Partial Differential Equation

Computer Lab Assistant

Helping to write MATLAB codes during lab session

- Winter 2012 - B. Tech. - MA 473 Computational Finance

INVITED TALKS

“Uniform error estimates for singularly perturbed differential equations: A priori and a posteriori approach” on 21st August, 2015 at IISER Mohali, India.

“A priori and a posteriori uniform error estimates based on moving meshes for singularly perturbed problems” on 23rd October 2014 at Technische Universität, Berlin, Germany.

“Parameter uniform error estimates for singularly perturbed differential equations on adaptive meshes” on 21st May 2013 at TIFR Bangalore

“A priori and a posteriori error estimates for singularly perturbed general system of reaction-diffusion boundary-value problems using grid adaptation” at 100th Indian Science Congress on 4th January, 2013 Calcutta

“Fixed Point Theorems” on 3rd April 2012, at IIT Guwahati

“From Linear towards Nonlinear Dynamics” on 9th November, 2010 at IIT Guwahati

WORKSHOPS
ATTENDED

“Model Order Reduction of Transport-dominated Phenomena”, a workshop sponsored by the Einstein Foundation, and Technische Universität Berlin with the collaboration of the European Model Reduction Network, EU-MORNET, May 19-20, 2015 at Einstein-Saal of the Berlin-Brandenburg Academy of Sciences, Germany.

“Past, Present and Future of PDEs”, a workshop cum conference on the occasion of Ralf Kornhubers 60th birthday, from April 27- 28, 2015 at Zuse Institute, Freie Universität, Berlin, at Berlin, Germany.

“1st GAMM Juniors’ Summer School” by Technische Universität, Ilmenau, from 14-20th September, 2014, at Elgersberg, Germany.

“Nonlinear Differential Equations: Dynamics of Complex Systems” by NPDE-TCA from 23rd- 28th September 2013 at University of Calcutta.

“Summer School on Numerics and Control of PDEs” by IFCAM from 22nd July -2nd August 2013 at IISC Bangalore.

“Current Trends in Computational Methods for PDEs” by CIMPA-NDPETCA-NBHM Research School, from 24th June- 19th July, 2013 at IISC Bangalore.

“Advanced Instructional School on Numerical Linear Algebra” from 2-22 December, 2010 at IIT Guwahati.

Quality Improvement Programme short term course on “Mathematical Methods, Modeling and Optimal Control” -2009, “Mathematical Methods in Electrical Engineering” -2009 and “Computational Fluid Dynamics for Chemical and Petroleum Engineers” -2009 at IIT Guwahati.

“PDE and Related Analysis”-2009 workshop organized by IISC-IMI at IISC Bangalore.

“Advanced Numerical Analysis”-2009 Workshop at Banaras Hindu University.

“Advanced Instructional School in PDE” workshop -2008 at TIFR Bangalore.

Summer course on advanced C++ and advanced Linux workshop “PRABHAT”-2007 at IIT Bombay.

“Instructional school on Modern Theory of PDEs”, May 27-June 23, 2007, IIT Bombay.

CONFERENCES
ATTENDED AND
PAPER PRESENTED

National Conference “Recent Developments in Numerical Techniques and its Applications (RDNTA 2016)” at Department of Mathematics, NIT Patna, India, from 7-8 April, 2016.

International Conference “Numerical Algebra, Matrix Theory, Differential Algebraic Equations and Control Theory” at Technische Universitat, Berlin, Germany, May 6-9th, 2015.

International Conference “Gesellschaft für Angewandte Mathematik und Mechanik (GAMM-2015)” organized by International Association of Applied Mathematics and Mechanics on their 86th Annual Meeting, Università del Salento, March 23-27th, 2015, Lecce, Italy.

“100th Indian Science Congress” on January 3-7, 2013 at Calcutta University, Kolkata

National conference on “Frontiers in Analysis and Differential Equations (NCFADE-2012)” on December 19-20, 2012 at Bharathidasan University, Tiruchirappalli

International conference on “Advances in Modeling, Optimization and Computing (AMOC-2011)” on December 5-7, 2011 at IIT Roorkee

International conference on PDE on January 7-9, 2009 at TIFR Bangalore

PROFESSIONAL
SERVICE

Referee or/and Editor

- *Journal of Computational and Applied Mathematics*
- *Mathematical Reviews* (American Mathematical Society- MathSci Net)
- *Numerical Algorithms*
- *Applied Mathematics and Computation*
- *Applied Mathematics and Information Sciences*
- *Journal of Modern Methods in Numerical Mathematics*
- *Bioinfo Computational Mathematics*

ARTICLES IN
DEPARTMENTAL
MAGAZINE-
ANANTHA

- Some Paradoxes and Interesting Logics.
- A Walk with the History of Infinity.

PROFESSIONAL
EXPERIENCE

- Vice Chairman, Sports Committee, IIT Patna
- Institute library committee member at IIT Patna from Department of Mathematics.
- Organizing committee member at the “Workshop on Fluid Mechanics: Modelling, Analysis and Computation” from July 14-17th, 2016 organized by Department of Mathematics, Chemical and Mechanical Engineering, IIT Patna.
- Organizing committee of *MATH OLYMPIAD-2007 and 2008, IIT BOMBAY*
- Involved in *Innovation of Science Pursuit for Inspired Research - a winter science camp for school children, December 15-21, 2009 IIT Guwahati.*
- Involved in *QIP-Short Term Course on Analytical and Numerical Solutions of Differential Equations, December 6 - 10, 2010, IIT Guwahati.*
- Involved in Workshop on *Mathematical Finance (WMF 2012 -An IIT Guwahati - IISc Mathematics Initiative Event) Department of Mathematics, IIT Guwahati, October 29 - November 03, 2012.*

PROFESSIONAL MEMBERSHIPS	Society of Industrial and Applied Mathematics (2010–present) American Mathematical Society (2009–present) Indian Science Congress Association (2012–present)
EXTRACURRICULAR ACTIVITIES	Got 2nd position (Silver medal) in post graduate Intra IIT Guwahati Athletics Event 2012
HARDWARE AND SOFTWARE SKILLS	Computer Programming: <ul style="list-style-type: none"> • C, C++, MATLAB, Maple, Mathematica Productivity Applications: <ul style="list-style-type: none"> • $\text{T}_{\text{E}}\text{X}$ ($\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$, $\text{BIB}\text{T}_{\text{E}}\text{X}$, PSTricks), Operating Systems: <ul style="list-style-type: none"> • Microsoft Windows family, Linux
EXPERTISE	Mathematics: <ul style="list-style-type: none"> • Applied Mathematics, Numerical Analysis, Ordinary and Partial Differential Equation, Real and Complex Analysis, Linear Algebra, Optimization,
MORE INFORMATION	http://www.sciencecongress.nic.in/html/young_scientists_awards12-13.php http://www.iitg.ac.in/math/research/thesis.php http://www.math.iitb.ac.in/acad/project06-07.htm
INTRODUCTION OF MY RESEARCH WORK	<p>My doctoral research was on the theoretical analysis and its corresponding numerical simulation for singularly perturbed problems. As an example one can look at the water flow modeling. The general partial differential equation discussing the water flow, velocity and its pressure can be given by Navier-Stokes Equation, which falls under this category. These problems are called as singularly perturbed since their solutions have multi-scale phenomena, i.e., the solution vary rapidly within a small region, (called boundary layers) and behave smoothly away from it. Several other applications of these problems can be also seen in fluid flows, control theory and gas dynamics, energy and environmental system. When a fluid moves through a channel, it observes zero velocity at the body of the channel.</p> <p>For Navier Stoke’s equation, it can be characterized through the presence of Reynolds Number (whose inverse is a very small quantity/parameter). The classical approach based on uniform meshes leads to an unexpected large system solver to produce a convergent numerical solution for an arbitrary small parameter. Hence the computational time also increases with the dimension of the PDE. Moreover, the convergence on these approaches (specially followed by engineers) mainly depends on the perturbation parameter. Therefore it is desirable to produce parameter independent efficient numerical methods (alternatively- adaptive meshes) defined on a fixed number of mesh points, whose convergence analysis is mathematically and numerically acceptable. The aim of my research was to develop the parameter uniform error estimates by adaptively moving a fixed number of mesh points (so called <i>r</i>-refinement strategy) to achieve high accuracy.</p> <p>In last few decades, several <i>a priori</i> defined meshes (for e.g., Shishkin mesh and Bakhvalov mesh) are proposed for the adaptivity. But, their construction are not a straightforward extension for a general two dimensional nonlinear problems. In particular, it needs <i>a priori</i> information of the exact solution, for e.g., the location of the solution’s rapid variation and its width, which are not always available in general. Another drawback of these methods is: they are very low accurate. My research mainly focused on the moving mesh methods based on mesh equidistribution without using the <i>a priori</i> nature of</p>

the solution. The algorithm starts with a fixed number of user chosen mesh points and generates an adaptive mesh by equally distributing the total error at each cell/interval. Therefore at each iteration, it moves the previously positioned mesh points in more physical way to maintain the geometry of the unknown solution. The objective of my thesis was to produce highly accurate numerical solution via r-refinement strategy.

A notable work during my doctoral study includes the *a priori* and *a posteriori* error estimates generation for a system of reaction-diffusion problems. This work bought me ‘**Young Scientist Award**’ from the hand of eminent scientist M.S. Swaminathan (Father of Green Revolution in India) at 100th Indian Science Congress. The parameter uniform convergence analysis for a general system of convection and reaction dominated flows is also addressed in my thesis. Another part of my research was on the development of highly accurate numerical solutions for a system of convection and reaction dominated nonlinear problems using post processing- Richardson Extrapolation and Defect Correction methods. The numerical analysis for a hybrid scheme based on cubic spline is proposed in my doctoral thesis. My master thesis at IIT Bombay was on the numerics of Hamilton Jacobi equation arises in Hyperbolic PDEs.

During my postdoctoral research (as an Einstein Foundation Fellow) at Technische Universität, Berlin, Germany, I have worked on the convergence analysis for two parametric parabolic problems with Prof V. Mehrmann. This work is published at BIT Numer. Math. My second work (with Prof. V. Mehrmann) is on the linear and higher order *a posteriori* error estimates generation for differential algebraic equation. I have also developed an *a posteriori* error estimate for a system of quasilinear delay differential equations with him. Prior to this position, I was a NBHM postdoctoral fellow at Supercomputer Education Research Center, IISc Bangalore, where I have worked on the comparative research study of *a priori* defined meshes and proposed *a posteriori* error estimates for nonlinear problems. I am happy to announce that this work is published at J. Comput Appl. Math. as a SINGLE author. Right now, I am working on the higher order numerical methods for parabolic problems at IIT Patna and I have already communicated two works as a single author.