



Subhashree Patel, DST Inspire Fellow (SRF)

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<i>Registration Number</i>	53/2018/Mathematics
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<i>Name of the supervisor & Correspondence address</i>	Dr. Bijaya Laxmi Panigrahi Dept. of Mathematics, Gangadhar Meher University Amruta-Vihar, Sambalpur – 768004, ODISHA
<i>Details of the funding agency/scheme</i>	Department of Science and Technology Letter No: DST/INSPIRE Fellowship/[IF170638], Dated: 02/05/2018
<i>Title of the research topic</i>	Projection Methods for Integral Equations of the First Kind
<i>Abstract of the research work (max. 300 words)</i>	The main goal of my research work is to find the approximate solution of integral equations of the first kind which are generally ill-posed and to obtain the convergence rates using different numerical methods. For this, we consider the numerical approximation of the <u>Fredholm</u> integral equations of the first kind. First, we consider the <u>piecewise</u> polynomial based <u>multi</u> -projection methods including both <u>multi-Galerkin</u> and <u>multi-collocation</u> methods to approximate the <u>Tikhonov</u> regularized equations of the <u>Fredholm</u> integral equations of the first kind. We compute the convergence rates of the approximated solutions under both a <u>priori</u> parameter choice strategy and <u>Engl</u> -type discrepancy principle in infinity norm. Next, we consider Legendre polynomial based projection method to find the approximate solution of the <u>Tikhonov</u> regularized equations of the <u>Fredholm</u>

integral equations of the first kind and evaluate the convergence rates under both a priori parameter rule and Engl-type discrepancy principle in infinity norm. Further to enhance the convergence rates, we consider multi-projection method and obtain the convergence rates in both L^2 and infinity norm. Next, we discuss on the Jacobi polynomial based projection method to find the approximate solution of the Fredholm integral equations of the first kind. In this method, first we approximate the original first kind Fredholm integral equations and then apply the Tikhonov regularization technique to obtain the stable approximate solution. We obtain the convergence rates in both a priori parameter rule and Engl-type discrepancy principle in weighted L^2 norm. Next, we discuss the discrete projection and multi-projection methods to find the approximate solution of the Tikhonov regularized equations of the Fredholm integral equations of the first kind using Legendre polynomials as basis functions and obtain the convergence rates under both a priori parameter rule and Engl-type discrepancy principle in infinity norm. We illustrate our theoretical results by numerical examples.

<i>Progress of the research work</i>	Five papers have been published in SCI/Scopus indexed Journals, one paper has been accepted for publication in SCI indexed journals and revised version of one paper has been submitted in SCI indexed journal.
<i>Journal publications</i>	<ol style="list-style-type: none"> 1. S. Patel, B. L. <u>Panigrahi</u>, G. <u>Nelakanti</u>, Legendre spectral projection methods for <u>Fredholm</u> integral equations of the first kind, <i>J. Inverse Ill-posed Probl.</i>, 30(5) (2022), 677-691. (SCI) 2. S. Patel, B. L. <u>Panigrahi</u>, G. <u>Nelakanti</u>, <u>Multi</u>-Projection methods for <u>Fredholm</u> integral equations of the first kind, <i>Int. J. Comput. Math.</i>, (2022). (SCI) 3. S. Patel, B. L. <u>Panigrahi</u>, G. <u>Nelakanti</u>, Legendre spectral <u>multi</u>-projection methods for <u>Fredholm</u> integral equations of the first kind, <i>Adv. Oper. Theory.</i>, 7(4) (2022), 1-22. (Scopus) 4. S. Patel, B. L. <u>Panigrahi</u>, Legendre spectral projection methods for weakly singular Hammerstein integral equations of mixed type, <i>J. Anal.</i>, 28(2) (2020), 387-413. (Scopus) 5. S. Patel, B. L. <u>Panigrahi</u>, G. <u>Nelakanti</u>, Numerical solution of the <u>Fredholm</u> integral equations of the

	<p>first kind by using <u>multi-projection</u> methods, In <i>Mathematics and Computing: ICMC 2022</i> (2023), 655-668. (<u>Scopus</u>)</p> <p>6. S. Patel, B. L. <u>Panigrahi</u>, Jacobi spectral projection methods for <u>Fredholm</u> integral equations of the first kind, <i>Numer. Algorithms</i>, Accepted. (SCI)</p> <p>7. S. Patel, B. L. <u>Panigrahi</u>, Discrete Legendre spectral projection-based methods for <u>Tikhonov</u> regularization of the first kind <u>Fredholm</u> integral equations, Revision submitted. (SCI)</p>
<i>Internship</i>	1. Internship at Computational and Data Science(CDS), Indian Institute of Science, Bangalore during Nov 2022 - Mar 2023.
<i>Conference attended</i>	<ol style="list-style-type: none"> 1. Presented a paper in the “9th International Conference on Mathematics and Computing” organized by BITS, Goa during January 6-8, 2023. 2. Presented a paper in the “8th International Conference on Mathematics and Computing” organized by VIT, Vellore during January 6-8, 2022. 3. Presented a paper in the “International Conference on Mathematics and Computation” organized by the Department of Applied Sciences and Humanities, <u>Rajkiya Engineering College, Kannauj</u>, UP during October 22-23, 2021. 4. Presented a paper in the “International Conference on Mathematical Sciences” organized by the Department of Mathematics and Humanities, <u>Sardar Vallabhbhai National Institute of Technology, Surat</u> during October 7-9, 2021. 5. Presented a paper in “<u>Indo-German Conference on Computational Mathematics</u>” organized by the Department of Computational and Data Sciences, Indian Institute of Science, Bangalore during December 2-4, 2019. 6. Presented a paper in the “National Conference on Recent Advances in Mathematics and its Applications” organized by the Department of Mathematics, National Institute of Technology <u>Rourkela</u> during December 7-8, 2018. 7. Presented a paper in the International Conference on “Applied and Computational Mathematics” organized by the Department of Mathematics, Indian Institute of Technology <u>Kharagpur</u> during November 23-25, 2018.
<i>Workshop attended</i>	1. Participated in the “International workshop on Sampling and Approximation Theory” organized by the Department of Mathematics, SSN College of Engineering during December 10-11, 2020.

2. Participated in the six-day national level online workshop on “Programming Essentials for Mathematics using Python” organized by the Department of Mathematics, CHRIST (Deemed to be University), Bangalore during August 9-14, 2020.
3. Participated in the “International Webinar on the Role of Applied Mathematics in Present Global Crises” organized by the Department of Mathematics, Vidyasagar University, during August 5-7, 2020.
4. Participated in the One Week Online FDP on “Mathematical Modeling and Numerical Techniques 2020” organized by the Department of Mathematics and Humanities, Kakatiya Institute of Technology and Science, Warangal during July 27-31, 2020.
5. Participated in the Online Six Weeks Course on “Introduction to Sagemath” organized by ICT, Mumbai during May 20-June 29, 2020.
6. Participated in the Online Webinar on “Problem Solving Techniques using MATLAB” organized by Department of Mathematics, Don Bosco College on May 15, 2020.
7. Participated in the “Advanced Training School on Numerical PDEs and Inverse Problems” organized by the Department of Mathematics and Statistics, Indian Institute of Technology Tirupati during December 9-20, 2019.
8. Participated in the 2-Day Workshop on “Research Methodology” organized at Sambalpur University during August 9-10, 2019.
9. Participated in the “Indian Women and Mathematics – Regional Workshop on Research and Opportunities” organized at the National Institute of Science Education and Research Bhubaneswar during October 27-28, 2018.
10. Participated in Level-I of MTTTS Programme at SSN College of Engineering, Chennai during May 18 - June 23, 2015.

Awards

- 1) Award of INSPIRE fellowship from Department of Science and Technology, New Delhi for pursuing Doctoral Research on March, 2018.
- 2) University First Rank Holder and the GOLD MEDALIST in Masters Degree, Sambalpur University, Odisha, 2016.
- 3) Recipient of UGC Rank Holder Scholarship from July 2014 - May 2016.
- 4) University First Rank Holder in Bachelors degree, Sambalpur University, Sambalpur, India, 2014.