Unit Name

Analysis and Partial Differential Equations Unit

Research Personnel

Jan 2025 - Present	Haotian Xiao, Research Intern
Sep 2024 - Present	Denis Brazke, Postdoctoral Scholar
May 2024 - Present	Zetao Cheng, Postdoctoral Scholar
Jan 2023 - Present	Chenming Zhen, OIST Student
	Jose Rodrigues, Staff Scientist
Sep 2022 - Present	Daniel Tietz, Postdoctoral Scholar

Mentorship / Supervision

Jan 2025 - Present	Host (RI, SRS, VRS, VS), Haotian Xiao, Research Internship
Jan 2024 - Present	Thesis Supervisor, Chenming Zhen, OIST Student
Jan 2024 - Apr 2024	Host (RI, SRS, VRS, VS), Aye Chan May, Research Intern
Sep 2023 - Present	Mentor, Made Benny Prasetya Wiranata, OIST Student
	Mentor, Kyle Stanley Grant, OIST Student

Scholarly Contributions and Creative Productions

Journal Article

Completed/Published

Abdulla, U. G.; Iqbal, N. H.; Abdulla, M. U.; Abdulla, R. U. Classification of Second Minimal Orbits in the Sharkovski Ordering. *Axioms* **2025**, *14*, 30.

Abdulla, U. G.; Rodrigues, J.; Jimenez, P.; Zhen, C.; Martino, C. Bang-Bang Optimal Control in Coherent Spin Dynamics of Radical Pairs in Quantum Biology. *Quantum Science and Technology* **2024**, *9*, 19. https://iopscience.iop.org/article/10.1088/2058-9565/ad68a1

Abdulla, U. Removability of the Fundamental Singularity for the Heat Equation and Its Consequences. *Journal of Mathematical Physics* **2024**, *65*, 24. https://dx.doi.org/10.1063/5.0233490

Presentation at Conference

Completed/Published

Abdulla, U. G. Kolmogorov Problem and Wiener-Type Criteria for the Removability of the Fundamental Singularity for the Elliptic and Parabolic PDEs. *Joint Mathematics Meetings 2025* **2025**.

Abdulla, U. G. Kolmogorov Problem and Wiener-Type Criteria for Removability of Fundamental Singularity for the Elliptic and Parabolic PDEs. *1st OIST-Oxford-SLMath Summer Graduate School on Analysis & PDE* **2024**.

Abdulla, U. G. Kolmogorov Problem and Wiener-Type Criteria for the Removability of the Fundamental Singularity for the Parabolic PDEs. *American Mathematical Society 2024 Fall Eastern Sectional Meeting* **2024**.

Abdulla, U. G. Cancer Detection via Electrical Impedance Tomography and Optimal Control of Elliptic PDEs. *American Mathematical Society 2024 Fall Western Sectional Meeting* **2024**.

Seminars

Completed/Published

Abdulla, U. G. Cancer Detection via Electrical Impedance Tomography and Optimal Control of Elliptic PDEs, Mathematical Biology Seminar, University of Florida, February 11, 2025, 10:40-11:30. **2025**.
https://biomath.math.ufl.edu/event/ugur-abdulla-oist-analysis-and-partial-differential-equations-unit/

Abdulla, U. G. Kolmogorov Problem and Wiener-Type Critera for the Removability of the Fundamental Singularity for the Elliptic and Parabolic PDEs, PDE and Analysis Seminar, University of Pittsburgh, February 19, 2025, 15:30. **2025**.
https://www.mathematics.pitt.edu/content/ugur-abdulla-kolmogorov-problem-and-wiener-type-criteria-removability-fundamental

Abdulla, U. G. Bang Bang Optimal Control in Coherent Spin Dynamics of Radical Pairs in Quantum Biology, MIT, Mechanical Engineering Department Seminar, Wednesday, 4-5 Pm, April 24, 2024. **2024**.

We analyze optimal control of the external electromagnetic field for the maximization of the quantum triplet born singlet yield of radical pairs in biochemical reactions. The model is a Schrödinger system with spin Hamiltonians given by the sum of Zeeman interaction and hyperfine coupling interaction terms. The Pontryagin Maximum Principle in Hilbert space is proved, establishing the band-bang structure of the optimal controller. A new two-step algorithm for the calculation of the bang-bang optimal control is developed. Numerical simulations are pursued, demonstrating convergence and stability. The results contribute towards understanding the structurefunction relationship of the magnetoreceptor to manipulate and enhance quantum coherences at room temperature, and leveraging biofidelic function to inspire novel quantum devices.

Abdulla, U. G. Kolmogorov Problem and Wiener-Type Criteria for the Removability of the Fundamental Singularity for the Parabolic PDEs, Calderon-Zygmund Analysis Seminar, University of Chicago, Thursday, 4-5 Pm, March 28, 2024. **2024**.
https://math.uchicago.edu/~cz/

Scholarly Contributions (Unit Members)

Term 2 2025

Chenming Zhen, Presentation at Conference, Bang-bang optimal control in coherent spin dynamics of radical pairs in quantum biologyadical pairs , Joint Mathematics Meetings 2025, 2025, Completed/Published

Daniel Tietz, Presentation at Conference, Wiener's criterion at infinity for divergence form parabolic operators with C^1-Dini continuous coefficients , Joint Mathematics Meetings 2025, 2025, Completed/Published

Jose Rodrigues, Presentation at Conference, Cancer detection via Electrical Impedance Tomography and optimal control of elliptic PDEs, Joint Mathematics Meetings 2025, 2025, Completed/Published

External Service

Jan 2024 - Present	Member of the Editorial Board, American Institute of Mathematical Sciences (AIMS), Member of the Editorial Board of the journal AIMS Mathematics
	Semester Program at Simon Laufer Mathematical Sciences Institute, Simon Laufer Mathematical Sciences Institute, One of the organizers of the semester program "Singularities and Partial Differential Equations representing Natural Phenomena" at SLMath in spring of 2028.
Jan 2025 - Apr 2025	American Mathematical Society, Joint Mathematics Meeting (JMM) 2025, Organized AMS special session "Recent Advances in Potential Theory and Partial Differential Equations" at the JMM 2025, Jan 8-11, 2025, Seattle, Washington, USA
Jan 2025 - Present	OIST contact liaison for the University of Oxford

Workshops and Seminars (Organized and Hosted by Faculty/Units)

Sep 2024	Professor Ugur G. Abdulla, (MiS Seminar) Cancer Detection via Electrical Impedance Tomography and Optimal Control of Elliptic PDEs: invitation to interdisciplinary research, OIST
	Dr. Raphael Winter (Cardiff University), (Analysis and Partial Differential Equations Seminar) Recent progress on collisional kinetic PDEs, OIST
	Dr. Havva Yoldas , (Analysis and Partial Differential Equations Seminar) A cross-diffusion system obtained via (convex) relaxation in the JKO scheme, OIST
	Dr. Cintia Pacchiano (Calgary University), (Analysis and Partial Differential Equations Seminar) Regularity Results for Double Phase Problems on Metric Measure Spaces, OIST
May 2024	Professor Ugur G. Abdulla, Kolmogorov Problem and Wiener-type Criteria for the Removability of the Fundamental Singularity for the Elliptic and Parabolic PDEs , OIST
	Professor Ugur G. Abdulla, OIST-Oxford-SLMath Summer School 2024 Aug 1 Course : Perron's method and Wiener-type criteria in the potential theory of elliptic and parabolic PDEs, OIST
	Professor Ugur G. Abdulla, OIST-Oxford-SLMath Summer School 2024 July 31 Course : Perron's method and Wiener-type criteria in the potential theory of elliptic and parabolic PDEs , OIST
	Professor Ugur G. Abdulla, Kolmogorov Problem and Wiener-type Criteria for the Removability of the Fundamental Singularity for the Parabolic PDEs, OIST
	Professor Lawrence C Evans (University of Carfornia, Berkeley), Weak Convergence and Limits of Solutions to Nonlinear Differntial Equations, OIST
	Professor Lawrence C Evans (University of Carfornia, Berkeley), (Plenary Lecture) Streamlines and "Soft Shocks" for the Infinity Laplacian PDE, OIST
	Professor Juan J. Manfredi, University of Pittsburgh, Analysis and nonlinear PDE in the Heisenberg Group, OIST
	Professor Gui-Qiang C. Chen (University of Oxford), Entropy Analysis and Singularities of Solutions for Nonlinear Hyperbolic Conservation Laws, OIST
	Prof. Ugur G. Abdulla, Professor and Head of the Analysis & PDE Unit, Okinawa Institute of Science and Technology (OIST), Okinawa, Japan / Prof. Gui-Qiang G. Chen, Statutory Professor in the Analysis of PDEs, Director of the Oxford Centre for Nonlinear PDEs (OxPDE), University of Oxford, Oxford, United Kingdom / Prof. L. Craig Evans, University of California, Berkeley, USA / Prof. Juan Manfredi, University of Pittsburgh, Pittsburgh, USA, MRSI-OIST-OXFORD Summer Graduate School, OIST, Prof. Ugur G. Abdulla, Professor and Head of the Analysis & PDE Unit, Okinawa Institute of Science and Technology (OIST), Okinawa, Japan / Prof. Gui-Qiang G. Chen, Statutory Professor in the Analysis of PDEs, Director of the Oxford Centre for Nonlinear PDEs (OxPDE), University of Oxford, United Kingdom
Jan 2024	Professor Ugur G. Abdulla, Cancer Detection via Electrical Impedance Tomography and Optimal Control Theory: invitation to interdisciplinary research, OIST
Jan 2025	Professor Jean-Jacques Slotine, Massachusetts Institute of Technology, (Mathematics in the Sciences seminar series) Contraction analysis of nonlinear dynamical systems -- a tutorial survey, OIST