Hemant Kumar Mishra

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sites.google.com/view/hemant1124/introduction

Experience

Assistant Professor — **Indian Institute of Technology (ISM) Dhanbad, INDIA**
October 2024 – present — *Department of Mathematics and Computing*

Postdoctoral Associate — **Cornell University, New York, USA**
July 2022 – September 2024 — *Department of Electrical and Computer Engineering*

- **Research Areas:** Matrix analysis, operator theory, functional analysis, and quantum information theory
- **Mentor:** Mark M. Wilde
- **Collaborators:** Mark M. Wilde, Samad Kh. Oskouei, Ludovico Lami, Prabha Mandayam, Michael Nussbaum

Research Associate — **Louisiana State University, Louisiana, USA**
February 2022 – June 2022 — *Department of Physics and Astronomy*

- **Research Projects:** Quantum teleportation in continuous-variable systems, Rains relative entropy for bosonic Gaussian states
- **Mentor:** Mark M. Wilde

Education

Doctor of Philosophy (Ph.D.) — **Indian Statistical Institute, New Delhi, INDIA**
July 2016 – October 2021 — *Theoretical Statistics and Mathematics Unit*

- **Research Area:** Matrix analysis
- **Ph.D. Thesis:** Differential and subdifferential properties of symplectic eigenvalues
- **Thesis Supervisor:** Tanvi Jain

Master of Science (M.Sc.) — **Indian Institute of Technology, Guwahati, INDIA**
June 2014 – May 2016 — *Department of Mathematics*

- **Courses:** Linear algebra, complex analysis, abstract algebra, real analysis, measure theory, functional analysis, operator theory, number theory, discrete mathematics, probability theory, numerical linear algebra, differential equations, computer programming (C), data structure and algorithms, partial differential equations
- **Project:** Representation Theory
- **Guide:** Anjan Chakrabarty
- **GPA:** 9.31/10

Bachelor of Science (B.Sc.) **D. G. Ruparel College, Mumbai, INDIA**
July 2011 – March 2014 *Major in Mathematics*

- **Courses:** Linear algebra, complex analysis, abstract algebra, real analysis, multivariable calculus, discrete mathematics, ordinary differential equations, topology of metric spaces
- **GPA:** 6.9/7

Higher Secondary School (12th Class) **Guru Nanak Khalsa College, Mumbai, INDIA**
July 2010 – March 2011 *Science*

- **Courses:** Physics, chemistry, biology, mathematics & statistics, hindi, english
- **Percentage:** 81.5%

Secondary School (10th Class) **Shri Sanatan Dharam High School, Mumbai, INDIA**
July 2008 – March 2009 *School Topper*

- **Courses:** Hindi, english, marathi, mathematics, science & technology, social sciences
- **Percentage:** 89.69%

Research Interests

My broad research interest is in matrix analysis, operator theory, functional analysis, and mathematical problems in quantum information theory, with a focus on the study of Gaussian states and channels. I have been actively studying qualitative and quantitative properties of the symplectic-eigenspectrum of positive definite matrices. I also conduct theoretical research in the areas of quantum teleportation, Gaussian measurements, entanglement measures of Gaussian states, and asymptotic error analysis in hypothesis testing.

Publications

1. Shaowu Huang and Hemant K. Mishra. Majorization in some symplectic weak supermajorization. *Linear Algebra and its Applications*, 703:1–10, 2024. DOI. arXiv.
2. Hemant K. Mishra, Michael Nussbaum, and Mark M. Wilde. On the optimal error exponents for classical and quantum antidistinguishability. *Letters in Mathematical Physics*, 114(76), 2024. DOI. arXiv.
3. Hemant K. Mishra, Ludovico Lami, Prabha Mandayam, and Mark M. Wilde. Pretty good measurement for bosonic Gaussian ensembles. *International Journal of Quantum Information*, 22(5):2440010, 2024. DOI. arXiv.
4. Gajendra Babu, and Hemant K. Mishra. Block perturbation of symplectic matrices in Williamson's theorem. *Canadian Mathematical Bulletin*, 67(1):201–214, 2024. DOI. arXiv.
5. Hemant K. Mishra, Samad Kh. Oskouei, and Mark M. Wilde. Optimal input states for quantifying the performance of continuous-variable unidirectional and bidirectional teleportation. *Physical Review A*, 107:062603, 2023. DOI. arXiv.
6. Tanvi Jain, and Hemant K. Mishra. Derivatives of symplectic eigenvalues and a Lidskii type theorem. *Canadian Journal of Mathematics*, 74(2):457–485, 2022. DOI. arXiv.
7. Hemant K. Mishra. First order sensitivity analysis of symplectic eigenvalues. *Linear Algebra and its Applications*, 604:324-–345, 2020. DOI. arXiv.

Under peer-review/preprint

1. Rudra R. Kamat, and Hemant K. Mishra. Simultaneous symplectic reduction of quadratic forms into normal forms. 2024. arXiv.
2. Tiju Cherian John, Hemant K. Mishra, and Saikat Guha. A complete classification of passive unitary normalizable (PUN) Gaussian states. 2024. Preprint.
3. Kaiyuan Ji, Hemant K. Mishra, Milán Mosonyi, and Mark M. Wilde. Barycentric bounds on the error exponents of quantum hypothesis exclusion. 2024. arXiv.
4. Theshani Nuradha, Hemant K. Mishra, Felix Leditzky, and Mark M. Wilde. Multivariate fidelities. 2024. arXiv.
5. Hemant K. Mishra. Equality in some symplectic eigenvalue inequalities. 2024. arXiv.
6. Hemant K. Mishra. On generalization of Williamson's theorem to real symmetric matrices. 2024. arXiv.

Teaching

1. Winter semester 2025 IIT (ISM) Dhanbad [*currently teaching*]: Engineering Mathematics II (NMCI102):
   - Solving system of linear equations using the Gaussian elimination method. [Notes].
   - Breakdown of the Gaussian elimination method and remedies [Notes].
   - Theory of Gauss-Jordan method for finding matrix inverse [Notes].
   - Worked out examples of the Gauss-Jordan method [Notes].
   - Vector space, examples [Notes].
   - More examples, subspace, examples [Notes].
   - Linear span, examples [Notes].
   - Linear independence, examples [Notes].
2. Winter semester 2025 IIT (ISM) Dhanbad [*currently teaching*]: Research Methodology (NMCC595/NMCC596/MCC500):
   - Meaning of research, its types, objectives, and significance [Slides].
   - Research methodology, writing research documents [Slides].
   - Reviewing the literature: how, where, what [Slides].
   - Research article search tools, journal rankings, and sources to evaluate journals [Slides].
   - Research ethics, presentation tools [Slides].
3. Calculus for Engineers at Cornell University (MATH 1910): Taught 3 classes during Aug 26-30, 2024.
   - Approximating and computing area [Notes].
   - The definite integral [Notes].
   - The indefinite integral [Notes].
4. Teaching Assistant at Indian Statistical Institute Delhi: Real Analysis course for MSQE-MStat in Fall 2017.
   - Prepared assignments based on each lecture, graded them, and discussed them in class [Assignments].

Invited talks

MAMM 2024 — **NIT Jalandhar, INDIA**
Matrix Applications and Mathematical Modeling — *30 November 2024*

- **Title:** Equality in some symplectic eigenvalue inequalities [Slides, Invitation]

QIQT 2023 **IISER Kolkata, INDIA**
Quantum Information and Quantum Technology *14 June 2023*

- **Title:** Pretty good measurement for bosonic Gaussian ensembles [YouTube, Slides]

QIQT 2022 **IISER Kolkata, INDIA**
Quantum Information and Quantum Technology *16 June 2022*

- **Title:** Analytical approach for quantifying the performance of continuous-variable unidirectional and bidirectional teleportation [YouTube, Slides]

ICLAA 2021 **MAHE, INDIA**
International Conference on Linear Algebra and its Applications *17 December 2021*

- **Title:** Derivatives of symplectic eigenvalues and a Lidskii type theorem [YouTube, Slides]

Public Seminars & Conferences

School of Natural Sciences **Shiv Nadar University, Delhi-NCR, INDIA**
Mathematics department seminar *19 September, 2024*

- **Title:** Equality in some symplectic eigenvalue inequalities [Slides]

Beyond IID in Information Theory 12 **University of Illinois, Urbana-Champaign, USA**
Beyond IID Conference 2024 *31 July, 2024*

- **Title:** On the optimal error exponents of classical and quantum antidistinguishability + Multivariate fidelities [Slides]

Innovare Advancement Center **Griffiss Institute, Rome New York, USA**
Conference *25-27 June, 2024*

- **Title:** Pretty good measurement of bosonic Gaussian ensemble [Poster]

Department of Analysis **Budapest University of Technology and Economics, HUNGARY**
Seminar talk *29 May, 2024*

- **Title:** On the optimal error exponents of classical and quantum antidistinguishability [Slides]

QuSoft **University of Amsterdam, NETHERLANDS**
Seminar talk *24 May, 2024*

- **Title:** On the optimal error exponents of classical and quantum antidistinguishability [Slides]

QuICS **University of Maryland, USA**
Special Seminar *24 April, 2024*

- **Title:** On the optimal error exponents of classical and quantum antidistinguishability [Link, Slides]

Mathematical and Physical Sciences **Ahmedabad University, INDIA**
Seminar talk *1 March, 2024*

- **Title:** Equality in some symplectic eigenvalue inequalities [Link, Slides, Flyer]

Mathematics Department **Indian Institute of Technology Delhi, INDIA**
Seminar talk *13 February, 2024*

- **Title:** Equality in some symplectic eigenvalue inequalities [Slides]

Oliver Club **Cornell University, Ithaca, USA**
Seminar talk *25 January, 2024*

- **Title:** Equality in some symplectic eigenvalue inequalities [Slides]

Wyant College of Optical Science **The University of Arizona, Arizona, USA**
Seminar talk *22 January, 2024*

- **Title:** Optimal input states for quantifying the performance of unidirectional and bidirectional teleportation [Slides]

Cornell QITD 2023 **Cornell University, Ithaca, USA**
Cornell Quantum Information Theory Day *7 July 2023*

- **Title:** Asymptotic error rates for classical and quantum antidistinguishability [Slides]

APS March Meeting 2023 **Las Vegas, Nevada, USA**
American Physical Society *7 March 2023*

- **Title:** Optimal input states for quantifying the performance of continuous-variable unidirectional and bidirectional teleportation [Slides]

YouQu 2023 **Harish–Chandra Research Institute, Prayagraj, INDIA**
Young Quantum *17 February 2023*

- **Title:** Continuous-variable Gaussian pretty good measurement [Poster]

QIP 2023 **Ghent University, Ghent, BELGIUM**
Quantum Information Processing *6 February 2023*

- **Title:** Optimal input states for quantifying the performance of continuous-variable unidirectional and bidirectional teleportation [Poster]

QMATH15 2022 **University of California, Davis, USA**
Mathematical Results in Quantum Information *15 September 2022*

- **Title:** The pretty good measurement of an ensemble of bosonic Gaussian states [Slides]

QuILT 2022 **Tulane University, Louisiana, USA**
Quantum Information Technologies in Louisiana Day *24 May 2022*

- **Talk Title:** Analytical approach for quantifying the performance of continuous-variable unidirectional and bidirectional teleportation [Slides]

Thesis Presubmission Talk **Indian Statistical Institute, Delhi, INDIA**
3 May 2021

- **Title:** Differential and subdifferential properties of symplectic eigenvalues [YouTube, Slides]

Seminar Talk **Indian Statistical Institute, Delhi, INDIA**
29 July 2020

- **Talk Title:** Fenchel subdifferentials and first-order directional derivatives of symplectic eigenvalues [YouTube, Slides]

Seminar Talk **Indian Statistical Institute, Delhi, INDIA**
18 September 2018

- **Talk Title:** Symplectic eigenvalues and a Lidskii type theorem

Seminar Talk **Indian Statistical Institute, Delhi, INDIA**
4 July 2018

- **Talk Title:** Symplectic eigenvalues and a Lidskii type theorem

Training

- MTTS 2015 (Mathematics Training and Talent Search): I was selected by MTTS for their highest level (Level: 2) mathematical training program held at SSN College of Engineering, Chennai in 2015. It was a rigorous more than three weeks training of developing critical thinking for solving mathematical problems involving expert faculty from various areas of mathematics.

Achievements

- NBHM (National Board for Higher Mathematics) Research Award, 2016.
- Joint CSIR-UGC Junior Research Fellowship, June-2018. All India Rank 4.
- Joint CSIR-UGC Junior Research Fellowship, December-2015. All India Rank 42.
- Joint CSIR-UGC Junior Research Fellowship, June-2015. All India Rank 58.

Memberships

- Associate Editor for JISST [Link, Invitation].
- Reviewer for American Journal of Applied Mathematics [Link].
- Reviewer for American Mathematical Society [Reviewer number-153199]

Services

- Program Committee Member of AQIS Conference 2023: Reviewed papers for talks/posters.
- Reviewed papers for the following journals: *Quantum*, *PMSc*, *LAA*, *RMP*, *IJPA*.

- Priyanka Dutta [LinkedIn] and I volunteered to help professors conduct online lectures at Indian Statistical Institute Delhi during COVID (2020-2021). We uploaded their recorded lectures to YouTube and shared the lecture links on Moodle for the students to access them (5 days a week, 2-3 lectures a day)

References

Prof. Tanvi Jain — **Indian Statistical Institute, New Delhi, INDIA**
tanvi@isid.ac.in — *Theoretical Statistics and Mathematics Unit*

Prof. Mark M. Wilde — **Cornell University, New York, USA**
wilde@cornell.edu — *Department of Electrical and Computer Engineering*

Prof. Prabha Mandayam — **Indian Institute of Technology, Madras, INDIA**
prabhamd@physics.iitm.ac.in — *Department of Physics*

Prof. Ludovico Lami — **University of Amsterdam, Amsterdam, Netherlands**
ludovico.lami@gmail.com — *KdVI, ITP, and QuSoft*

Prof. Rajendra Bhatia — **Ashoka University, Haryana, INDIA**
rajendra.bhatia@ashoka.edu.in — *Department of Mathematics*