

Amrik Sen

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Current Affiliation

Jan. 2023 - **Associate Professor**, *Applied Mathematics*,
current Plaksha University, India.

Jul. 2022 - **Lead**, *Metaverse Research Program*, Plaksha University, India.
current

Education

May 2014 **Ph.D**, *Applied Mathematics*, University of Colorado, Boulder, and National Center for Atmospheric Research, Boulder, USA.

Thesis Title: *A Tale of Waves and Eddies in a Sea of Rotating Turbulence*.

Advisor: Annick Pouquet.

Dec. 2009 **Master of Science**, *Applied Mathematics*, University of Colorado, Boulder, USA.

May 2006 **Bachelor of Technology**, *Electrical Engineering*, National Institute of Technology, Silchar, India.

Publications

Peer Reviewed Books

In press **Amrik Sen**, *Play of Chance and Purpose: An invitation to Probability, Statistics, and Stochasticity using simulations and projects*, **Cambridge University Press** (first edition).
exp. November 2023

Peer Reviewed Journal Articles

2020 **Amrik Sen** and Carlos Perelman, *A Hamiltonian model of the Fibonacci quasicrystal using non-local interactions: simulations and spectral analysis*, **Eur. Phys. J. B**, 93, 67. <https://doi.org/10.1140/epjb/e2020-100544-y>.
(Impact factor: 1.5, Indexing: SCI)

2017 **Amrik Sen**, *Anisotropic Wave Turbulence for Reduced Hydrodynamics with Rotationally Constrained Slow Inertial Waves*, **Fluids**, 2, 28. <https://doi.org/10.3390/fluids2020028>.
(CiteScore: 2.3, Indexing: ESCI)

2017 **Amrik Sen**, Raymond Aschheim, and Klee Irwin, *Emergence of an Aperiodic Dirichlet Space from the Tetrahedral Units of an Icosahedral Internal Space*, **Mathematics**, 5, 29. <https://doi.org/10.3390/math5020029>.
(Impact factor: 2.6, CiteScore: 2.9, Indexing: SCI)

- 2013 Annick Pouquet, **Amrik Sen**, Duane Rosenberg, Pablo Mininni, and Julien Baerenzung, *Inverse cascades in turbulence and the case of rotating flows*, **Phys. Scr.**, T155, 014032. DOI 10.1088/0031-8949/2013/T155/014032.
(Impact factor: 3.1, CiteScore: 3.1, Indexing: SCI)
- 2012 **Amrik Sen**, Pablo Mininni, Duane Rosenberg, and Annick Pouquet, *Anisotropy and non-universality in scaling laws of the large-scale energy spectrum in rotating turbulence*, **Phys. Rev. E**, 86, 036319. DOI: 10.1103/PhysRevE.86.036319.
(Impact factor: 2.6, CiteScore: 4.3, Indexing: SCI)
- 2010 **Amrik Sen**, *Analysis of fractal representation of genetic sequences - Essays in Chaotic Dynamics (editor: Elizabeth Bradley)*, **Technical Report CUCS**, CU Boulder, 106610.
- 2009 **Amrik Sen**, Gopal Ananthakrishnan, Suresh Sundaram, and Angarai Ganesan Ramakrishnan, *Dynamic Space Warping of Strokes for Recognition of Online Handwritten Characters*, **Intl. Jour. of Patt. Recog. and Art. Intell.**, 23, 5. <https://doi.org/10.1142/S0218001409007375>.
(Impact factor: 1.3, CiteScore: 2.8 Indexing: SCI)

Popular Press

- 2021 **Amrik Sen**, *Developing AI based predictive technologies for epidemic management and preparedness*, **Financial Express**.
([weblink](#))

Conference Proceedings

- 2023 **Amrik Sen**, ... by *The Order of Simulacra*, **International Congress on Industrial and Applied Mathematics, ICIAM**, Session: New Trends in Education of Applied Mathematics, Industry, Technology and Knowledge Transfer, Tokyo, Japan.
https://iciam2023.org/author_index.
- 2013 **Amrik Sen**, and Kieth Julien, *Hamiltonian wave turbulence theory on the genesis of eddies from waves in rotating flows*, **American Geophysical Union, Spring Meeting**, Denver, Colorado, USA.
Bibcode: 2013AGUSMNG52A..02S.
- 2009 **Amrik Sen** and Manuel Lladser, *Poisson Approximation and its Application in Pattern Matching Problems*, **Fields-MITACS meet, School of Applied Probability**, Fields Institute and Carleton University, Canada.
<http://www.fields.utoronto.ca/programs/scientific/08-09/appliedprobSS/>.
- 2007 Gopal Ananthakrishnan, **Amrik Sen**, Suresh Sundaram, and Angarai Ganesan Ramakrishnan, *Dynamic Space Warping of Sub-Strokes for Recognition of Online Handwritten Characters*, **13th IGS conference of the International Graphonomics Society**, Melbourne, Australia.
<https://graphonomics.net/igs-2007-program/>.
(Chairperson: Réjean Plamondon)

Talks, Presentations, and Symposia

- Aug. 2023 ... by **The Order of Simulacra**, presented at the *International Congress on Industrial and Applied Mathematics, ICIAM*, Tokyo.
Invited talk
Video link: <https://www.youtube.com/watch?v=Hp5x2H7fTFk>.
- Oct. 2022 **Gamification and Metaverse**, presented at the *Metaverse Catalyst Conference*, IE University, Madrid, Spain.
Invited talk
- Feb. 2020 **New Directions Program: Developing Student Centered Learning**, presented at the *Centre for Academic Practices and Student Learning (CAPSL) convention on academic best practices*, Thapar University, Patiala and Trinity College, Dublin.
Invited talk
- Oct. 2019 **Number Theory, Combinatorics and Special Functions: symposium on Applied Mathematics and Engineering Applications**, co-organiser of the conference and the symposium held to honor Prof. A. K. Agarwal on his 70th birth anniversary, School of Mathematics, Thapar Institute of Engineering & Technology, Patiala, India.
Co-organiser
([conference weblink](#))
- Sept.-Oct. 2019 **General Relativity: Basics and Advances**, organiser of the special lecture series by eminent scientist Dr. Carlos Perelman, School of Mathematics, Thapar University, India.
Organiser
(Featured in [lecture series noticeboard](#), [university newsletter article](#))
- Apr. 2017 **Scattering amplitudes: from gauge theory to gravity**, participated in a mini-symposia hosted as part of the conference at the *Kavli Institute for Theoretical Physics*, University of California, Santa Barbara, USA.
Participant
- Nov. 2015 **A Tale of Waves and Eddies in a sea of Rotating Turbulence**, presented at the *Institute of Mathematical Sciences*, Chennai, India.
Colloquium talk
- Aug. 2015 **Symmetry breaking and the onset of turbulence in multi-phase flows**, presented at the *Center for Interdisciplinary Studies, Tata Institute of Fundamental Research*, Hyderabad, India.
Dept. seminar
- Jan. 2013 **Hamiltonian wave dynamics on the genesis of eddies from waves in rotating flows**, presented poster at the *Dynamics Days conference*, Denver, USA.
Poster presentation
- May 2012 **Inverse Cascades at Small Rossby Number**, presented at *Theme Of the Year (TOY) conference*, University of Colorado, Boulder & NCAR, Boulder.
Invited talk
- Jul. 2011 **Physics of rapidly rotating fluid flow with helical forcing at small scales**, presented at *ANISO 2011 - Morphology and dynamics of anisotropic flows*, Institute of Theoretical Physics, Corsica, France.
Invited talk
- Nov. 2010 **Flow past an airfoil via conformal mapping and elliptic grid generators**, presented at the *computational mathematics seminar*, Dept. of Applied Mathematics, University of Colorado, Boulder, USA.
Dept. seminar

Grants & Awards

- Feb. 2022 **DaveAI-Plaksha fellowship**, *INR 60,00,000 (equivalent to USD 72508)*.
PI[†] This is an industry sponsored grant by DaveAI that will support the work of one doctoral student to develop an AI-powered Metaverse over the next five years.
- Sept. 2021 **Start-up research grant**, *INR 26,40,000 (USD 31903)*.
PI This grant supports the development of a new computational facility at Plaksha University for modelling complex systems in the atmosphere (eg., pollution dispersion) and for investigating symmetries in quasicrystals.
- Dec. 2020 **Inter-institute research grant** by Ministry of Science & Technology
PI & Project (DBT), *INR 42,21,760 (USD 51018)*.
Coordinator This grant was awarded to me at Thapar University and supports the development of a COVID pandemic management technology for contamination of hospitals.
- Oct. 2020, PI **Seed grant** by Thapar University, *INR 4,50,000 INR (USD 5438)*.
- Mar. 2020, co-PI **Thapar-Virginia Tech. consortium grant**, *INR 25,10,000 (USD 30332)*.
- Nov. 2019 **DST-SERB Early Career Research Award**, *INR 32,91,520 (USD 39776)*.
PI This grant was awarded to me at Thapar University and supports research to investigate the role of wave turbulence in dispersion of atmospheric pollutants in the Stable Atmospheric Boundary Layer (SABL).
- Jul. 2011 **Summer school fellowship - ANISO 2011**, *USD 2450*, Inst. of Theoretical Physics, Corsica, France, and NCAR, Boulder.
- May 2009 **Fields-MITACS summer school fellowship**, *USD 1500*, Fields Institute and Carleton University, Canada.

Leadership and Administrative Services

- Fall 2021, **Director of Undergraduate Studies**.
Spring 2022, In this role, I was responsible for drafting the inaugural undergraduate academic
Summer 2022 policy of Plaksha University and subsequently implementing the policy. I was
UG program responsible for conducting all academic activities including examinations and
mentorship of students, mapping of credits to courses for all common-core courses
for all programs, creating academic support roles like advertising and hiring of
TAs and instructional managers, budgeting of UG academic activities, etc.
- Sept. 2021 - **Founding member - Board of Management**.
current I am currently serving as one of the founding members of the board of management
University at Plaksha University that overlooks the broad administrative and management
Management of the university including strategic decisions, budget reviews, academic and
administrative counsel, and regulatory compliances.

[†]PI refers to Principal Investigator of a research grant.

Teaching Credentials

Instructor - Plaksha University, India

Fall 2021, 2022 **Engineering Mathematics in Action.**

UG[†] course Designed and lectured this first semester undergraduate course to a student cohort of size one hundred from all engineering majors at Plaksha University. The course encompassed both theoretical lectures and computational laboratories, engaged students in four team projects during the semester that were designed to offer experiential learning opportunities to the students. The topics covered in this course spanned basics of matrices to more advanced topics in linear algebra and ordinary differential equations.

One of the unique and innovative aspects of this course is the *Mathematics Innovation Laboratory* that constitutes 50% of the course grades where students are required to complete an innovation project on any area of science and engineering. The two best teams are selected for a summer immersion program which is mentored by me and my collaborator from the industry (DaveAI). Under this program, students develop digital simulations and games anchored on mathematics and engineering principles. This program has been showcased at the International Congress on Industrial and Applied Mathematics, Tokyo, 2023.

Spring 2022, **Mathematics of Uncertainty.**

2023 UG course Designed and lectured this second semester undergraduate course to a student cohort of size one hundred from all engineering majors at Plaksha University. The course encompassed both theoretical lectures and computational laboratories, engaged students in five team projects during the semester. The topics covered in this course spanned basics of probability, statistics, and stochastic processes that included training students to use the Viterbi algorithm, the Monte-Carlo simulation technique, Analysis of Variance tests, etc. to model and analyse engineering problems and design efficient solutions. A novel aspect in the practical component of this course encourages students to design computer based games and visual simulations to aid learning and peer evaluations.

Several students who graduated from this course interned with me at the *Mathematics Innovation Laboratory* during the summer break and received advanced training in metaverse and game development. A recent iteration of this program was showcased at the World Congress on Applied Mathematics in Tokyo (2023).

Instructor - Thapar University, India

Fall 2018, 2019, **Statistical Methods and Algorithms.**

2020 PG course Re-designed and lectured this course that is offered to first year masters (M.Tech.) students of all engineering majors. The novel aspect in the restructuring of the syllabus for this course was to incorporate computational laboratories based on real world engineering problems and actual data sourced from open-source repositories. The topics covered in this course included basics of probability theory, Markov chains, hypothesis tests, regression models, and principal component analysis.

[†]UG refers to undergraduate, and PG refers to postgraduate.

Spring 2019, **Research Methodology.**

2020, 2021 LECTURED a semester-long course on advanced statistical techniques and analytical methods to a cohort of first semester Ph.D students from the applied sciences programs.

Spring 2019, **Complex Analysis.**

2020 DESIGNED and lectured a masters level course to a cohort of mathematics majors in the university's M.Sc. program. The topics included introduction to complex variables, Clifford algebra, multi-valued functions, Cauchy-Riemann theory, Taylor and Laurent series, holomorphic functions, singular points, Complex integration and residue calculus, transformations and conformal maps. The lectures included both theory and tutorials.

Spring 2019, 2021 **Numerical Analysis.**

UG course LECTURED a course on numerical methods to solve systems of equations with a special emphasis on solving ordinary differential equations. The course involved both theoretical lectures as well as leading practical classes in a computer laboratory where students were coached to solve equations using the Matlab programming language.

Fall 2018 **Engineering Mathematics.**

UG course LECTURED a multi-group student cohort from different engineering majors. The course covered single and multi-variable calculus and included both theoretical lectures and tutorials.

Instructor - University of Colorado, Boulder, USA

Summer 2010 **Vector Calculus.**

UG course RESPONSIBILITIES included lecturing a five credit hour course, re-designing a regular semester course work to suit the requirements of a eight week long summer program, constructing a typographical booklet in \LaTeX for the course that included well organised lecture notes, writing exams and creating grading schemes for the summer program, and co-ordinating with the laboratory instructor for designing project modules of the course.

Instructor - Front Range Community College, Westminster, USA

Fall 2010 **Engineering Mathematics.**

UG course LECTURED a five credit hour course to freshmen and sophomore year students, wrote exams and created grading schemes, evaluated examinations and provided feedback to students.

Summer 2010 **Probability and Statistics.**

UG course LECTURED a five credit hour course to students from the bachelors and masters program in the nursing school, wrote exams and created grading schemes, evaluated examinations and provided feedback to students.

Teaching Assistant & Tutor - University of Colorado, Boulder, USA

Fall 2009-2013 **Mathematics.**

UG courses CONDUCTED tutorial recitations and computational laboratories for many undergraduate courses in the engineering programs. Assisted in course design, conducted office hours and examination reviews for students, and evaluated answer sheets.

Fall 2009-2013 **Mathematics and Physics.**

UG courses Tutored students at the Student Academic and Success Center (SASC), University of Colorado, Boulder. In addition to this, I also tutored at the Skyline High School in Longmont, Colorado and volunteered to help students who were preparing for their advanced placement tests.

Student Supervision and Mentorship

Ph.D supervision **Sandeep Kumar** (Plaksha University)

- Second year doctoral student.
- Currently working on a wave turbulence theory of pollution dispersion in the Stable Atmospheric Boundary Layer (SABL).

Ph.D committee Served in two Ph.D committees at Thapar University, Patiala, India.

M.Sc. supervision **Gurleen Kaur** (Thapar University)

- Worked on a review paper on hydrodynamic equations with different boundary conditions as part of her masters thesis.
- Graduated with a MSc degree in Mathematics and Computing, Thapar University, Patiala, India.

UG supervision **Vishal Paudel, Chandan Yadav, Samyuckhta G., Abhigyan Mehrotra, Tanya Shravan, Tejaswi Birdh, Shubham Jalan** (Plaksha University)

- Currently working on gamification of educational content on a metaverse platform.
- Preliminary work presented at the Metaverse Catalyst Conference in Madrid in October 2022.

PUMA[†] **Niranjani A., Abhigyan Mehrotra, Anshika Srivastava, Rishi Sharma, Prashant Tiwari, Anushka Desai** (Plaksha University)

- Currently, I am serving as their faculty mentor during their tenure in the four year undergraduate program and mentoring them on academic matters, career options, and campus life as a student.

Past Professional Affiliations

2021 - 2022 Applied Mathematics, **Plaksha University**, Mohali, India.

Asst. Professor Served as the founding faculty of mathematics and the founding director of undergraduate studies.

2018 - 2021 School of Mathematics, **Thapar University**, Patiala, India.

Asst. Professor Served as a faculty member - taught UG and PG courses, conducted research. I was instrumental in setting up an advanced computational research laboratory - a first of its kind in Thapar University - using my DST-SERB research grant.

[†]PUMA stands for Plaksha Undergraduate Mentorship in Action.

- 2016 - 2017 **Quantum Gravity Research**, Los Angeles, USA.
Sr. Scientist I worked in this California-based start-up company and was responsible for developing mathematical models of quasicrystals with the objective of finding novel applications of quasicrystals with eco-friendly and sustainable energy signatures.
- Apr. - Nov. 2015 Center for Interdisciplinary Studies, **Tata Institute of Fundamental Research**, Hyderabad, India.
Post-doc. Fellow Worked on a high performance code to investigate symmetry breaking in multi-phase flows at the onset of turbulence based on the Cahn-Hilliard model.
- 2014 **California State University**, Northridge, Los Angeles, USA.
Post-doc. Fellow Developed computer simulations of swarm models with birth and death and studied phase transition in swarm patterns.
- Jan. - Mar. 2014 **Laboratory for Atmospheric and Space Physics**, Boulder, USA.
Visiting Scholar Worked on a perturbation model of atmospheric dynamics of Jupiter.
- Jun. - Nov. 2013 **Dassault Systèmes Inc.**
Intern (R&D) Worked in the Computational Geometric Modelling (CGM) team on instrumentation and development of a geometric modelling software kernel. Developed an automatic software suite in Python based on the MediaWiki environment.
- Jan. 2011 - May. 2013 Institute for Mathematics Applied to Geosciences,
National Center for Atmospheric Research, Boulder, USA.
Ph.D Scholar Served as a research scholar in the turbulence numerics team performing high resolution simulations for turbulent flows, analysing data generated by simulations, and developing theoretical models of wave turbulence.
- Aug. 2008 - Dec. 2013 Dept. of Applied Mathematics, **University of Colorado**, Boulder, USA.
Grad. Res. Asst. Served in different capacities as a teaching assistant for UG courses as well as a research assistant tasked with performing doctoral research work.
- Jun. 2006 - Jun. 2007 Dept. of Electrical Engg., **Indian Institute of Science**, Bangalore, India.
Project Engineer Worked on a project at the MILE Laboratory that involved developing algorithms in image processing and pattern recognition with application in online hand writing recognition and optical character recognition.

References

Dr. G. Ananthkrishnan

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Dr. Carlos Perelman

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