Conference Report

Of

The Indian Women and Mathematics (IWM) Annual Conference 2022-2023

Held at

Indian Institute of Science Education and Research Pune

(IISER Pune),

Dr Homi Bhabha Road, Pashan, Pune 411008, Maharashtra.

during

December 27-29, 2022.

Summary

The IWM Annual Conference 2022-2023 was held at the Indian Institute of Science Education and Research Pune from 27th December to 29th December, 2022. The following people were involved in organising this conference.

Scientific Committee:

Anisa Chorwadwala, IISER Pune

Riddhi Shah, Jawaharlal Nehru University

Sachi Srivastava, University of Delhi

Vijaylaxmi Trivedi (Chair), TIFR Mumbai

Organising Committee:

Anisa Chorwadwala (Convener), IISER Pune

Neha Prabhu, S. P. Pune University

Haripada Sau, IISER Pune

Riddhi Shah, Jawaharlal Nehru University

Vijaylaxmi Trivedi (IWM-EC Chair), TIFR Mumbai

The Executive Committee and the International Advisory Committee of IWM at the start of the conference were as follows:

Executive Committee:

Amber Habib : Shiv Nadar University

Anita Naolekar : Indian Statistical Institute, Bangalore Centre

Anisa Chorwadwala : IISER Pune

Archana Morye : University of Hyderabad

Gautam Bharali : Indian Institute of Science

Geetha Venkataraman : Dr. B.R. Ambedkar University Delhi

Gurmeet Kaur Bakshi : Panjab University

Nikita Agarwal : Indian Institute of Science Education and Research, Bhopal

Pooja Singla : Indian Institute of Technology - Kanpur

Riddhi Shah : Jawaharlal Nehru University

Sachi Srivastava : University of Delhi

Sanoli Gun : Institute of Mathematical Sciences

Shreemayee Bora : Indian Institute of Technology - Guwahati

Vijaylaxmi Trivedi (Chairperson): TIFR, Mumbai

International Advisory Committee:

Mythily Ramaswamy : Tata Institute of Fundamental Research, Bangalore
Nalini Joshi : University of Sydney
Sujatha Ramdorai : University of British Columbia

Details of Talks:

There were three plenary talks, three invited talks and six talks by mathematicians at an early-stage in their research career. In addition to this, there were twenty four contributory talks and around twenty six poster presenters.

Plenary Speakers:

	Name	Affiliation	Talk Title
1.	Shreemayee Bora	IIT Guwahati	*Some Distance Problems for Matrix Polynomials via Block Toeplitz Matrices*
2.	Nutan Limaye	IIT Bombay and IT-University of Copenhagen	*Proving limits of computation: an algebraic complexity perspective*
3.	Kavita Ramanan	Brown University	*On Tales of Random Projections: Where Probability Meets Geometry*

Invited Speakers:

	Name	Affiliation	Talk Title
1.	Ranjana Jain	University of Delhi	Closed Lie ideals of certain Banach algebras
2.	Hemangi Shah	HRI Allahabad	The generalization of the Hopf Conjecture
3.	V Uma	IIT Madras	K-theory of certain varieties with torus actions

Early-stage Career Speakers:

	Name	Affiliation	Talk Title
1.	Sayani Bera	IACS Kolkata	Dynamics of non-autonomous families
2.	Eshita Mazumdar	Ahmedabad University	An Introduction to Zero-sum Problems
3.	Moumanti Podder	IISER Pune	A confluence of discrete probability, combinatorics, graph theory and game theory
4.	Parangama Sarkar	IIT Palakkad	Analytic spread of filtrations
5.	Mubeena T.	University of Calicut	Quasi isometries and Twisted Conjugacy
6.	Sheela Verma	IIT BHU	Szegö-Weinberger inequality and its developments

Contributory Speakers:

	Name	Affiliation	Student/ Postdoc/ Faculty	Talk title
1	Deepika Sharma	Jawaharlal Nehru University	PhD Student	Value of Interior Angle between intermediate C* subalgebras
2	Jyoti	Panjab University, Chandigarh	PhD Student	A Constructive Proof Of Brauer-Witt Theorem
3	Geethika Sebastian	IISc Bangalore	Postdoc	A Multiplicative Spectral Characterization of Characters on C* algebras
4	Jyoti Dasgupta	TIFR Mumbai	Postdoc	Seshadri constants of equivariant vector bundles on toric varieties
5	Promod Sharma	IIT BHU	PhD Student	Inductive algebras for the affine group of a finite field
6	Tapatee Sahoo	Manipal Institute of Technology, Bengaluru	Faculty	Lattice with superfluous elements and related graphs
7	Apoorva Singh	Shiv Nadar Institute of Eminence	PhD Student	Invariance in the general class of Hardy spaces
8	Sonam	Indian Institute of Technology, Ropar.	PhD Student	q-Analogue of Euler-Stieltjes Constants
9	Rati Ludhani	Indian Institute of Technology Bombay	PhD Student	Purity of minimal free Resolutions associated to affine and projective Reed-Muller Codes
10	Manideepa Saha	Presidency University, Kolkata, India	PhD Student	On Graphs Defined on Groups
11	Aparna Pradeep V K	Cochin University of Science and Technology	PhD Student	Comparison of Petrov's odd elementary hyperbolic unitary group and Dickson-Siegel-Eichler-Roy elementary orthogonal group
12	Sushmita Rawat	Indian Institute of Technology Delhi	PhD Student	Critical growth fractional Kirchhoff elliptic problems

13	Aditi Savalia	IIT Gandhinagar	PhD Student	An induction principle for the Bombieri-Vinogradov theorem over Fq[t] and a variant of the Titchmarsh divisor problem
14	Kalsariya Nayna Govindbhai	The Maharaja Sayajirao University of Baroda	PhD Student	Generalized Absolute Convergence of Single and Double Vilenkin-Fourier Series and Related Results
15	Pinkimani Goswami	University of Science and Technology, Meghalaya	Faculty	Applications of Braid Group in context of Cryptography
16	Rimpi	University of Delhi	PhD Student	Classification of Constraint Qualification for Nonsmooth Programming Problems
17	Arusha C	TIFR Mumbai	Postdoc	Minimal Rational Curves in the Moduli Spaces of Vector Bundles on Nodal Curves
18	Kavita Samant	Shiv Nadar University	PhD Student	Generating Graphs of Finite Dihedral Groups
19	Shruthi Subhash	ICT Mumbai	PhD Student	Compounding of Permutation matrices using compound matrices
20	Apeksha Sanghi	IISER Mohali	Postdoc	Infinite metacyclic subgroups of the mapping class group
21	Namrata Arvind	IISER Pune	PhD Student	On Zn $\rtimes$ Z2-Hopf-Galois structures
22	Nupur Patanker	IISER Pune	Postdoc	Generalized Hamming weights of toric codes over hypersimplices and squarefree affine evaluation codes
23	Dr. Priyanka Kumari	MIT WPU Kothrud	Faculty	Polynomial Criterion for Abelian Difference Sets and its Applications
24	Bivas Khan	IISER Pune	Postdoc	Logarithmic connections on principal bundles over normal varieties

Poster Presenters:

Sr. No.	Name	Affiliation	
1	Laxmi	Shiv Nadar University	
2	Sreeja K.U.	Maharaja's College	
3	Thalmi B	University of Kerala	
4	Aakriti Sharma	Central University of Jammu	
5	N. Annapoorani	Bharathiar University	
6	Nitisha Yadav	MNNIT, Prayagraj	
7	Saranya Rayappan	Bharathiar University	
8	Shubham Hooda	JNU	
9	Shivani Valecha	IIT Bhilai	
10	Raksha Devi	IIT Roorkee, Roorkee	
11	MEGHA P M	K K T M Govt College, Thrissur	
12	Mohit Dhanda	University of Delhi	
13	Anusree Sreedharan	CUSAT	
14	Ayantika Laha	IIT Ropar	
15	Priyanka Magar	Indian Institute of Technology, Bombay	
16	Sudipta Priyadarshini	VIT-AP University, Andhra Pradesh	
17	Siddhi Balu Ambhore	Indian Institute of Technology Gandhinagar	
18	Dadi Dimple Satya Sree	University of Hyderabad	
19	Swati Bhardwaj	Panjab University, Chandigarh	
20	Manika Bag	IISER-TVM	
21	Anveksha Moar	University of Delhi	
22	Bhumika Mundiya	Marwadi university	
23	Arpita Maji	NIT Andhra Pradesh	
24	Sumant Kumar	DIAT Pune	
25	Deepika Parmar	DIAT Pune	
26	Priyanka T M C	VIT Vellore	

Details of Participants

The IWM annual conference organisers had received around 290 applications for participation at the conference. Out of these applications, 74 outstation participants and 24 local participants were selected to attend the conference. Out of these selected ones, 5 outstation participants and 6 local participant did not show up at the conference. There were however walk-in registrations by two local and one outstation participant. The walk-in registrations are marked in blue colour in the following two tables.

In all, there were 70 outstation and 20 local participants who attended the conference. In addition to this, there were **12 speakers, 8 IWM Executive Committee members and 3 local organisers** present at the conference. This means that **a total of around 113 mathematics fraternity members attended the conference.** This included MSc students, PhD students, Teaching Assistants, postdocs and faculty members at all levels.

Outstation Participants:

	Name	Affiliation	
1	Ayantika Laha	IIT Ropar	PhD Student
2	Aditi Savalia	IIT Gandhinagar	PhD Student
3	Aishwarya Jaiswal	IIT (BHU)	PhD Student
4	Aleena Thomas	Indian Institute of Space Science and Technology	PhD Student
5	Ankita Sharma	IIT(BHU)	PhD Student
6	Anusree Sreedharan	Cochin University of Science and Technology	PhD Student
7	Anveksha Moar	University of Delhi	PhD Student
8	Aparna Pradeep V K	Cochin University of Science and Technology	PhD Student
9	Apeksha Sanghi	IISER Mohali	Postdoc
10	Apoorva Singh	Shiv Nadar Institute of Eminence	PhD Student
11	Arpita Maji	NIT Andhra Pradesh	PhD Student
12	Arusha C	TIFR Mumbai	Postdoc
13	Bhumika Mundiya	Marwadi university	Masters Student
14	Dadi Dimple Satya Sree	University of Hyderabad	PhD Student
15	Debamita Chatterjee	JNU, Delhi.	PhD Student
16	Deepika Sharma	Jawaharlal Nehru University	PhD Student

17	Devangi Dhakan	Marwadi University	Masters Student
18	Dipak Sandu Jadhav	Smt. Chandibai Himathmal Mansukhani College	Faculty
19	Geethika Sebastian	IISc Bangalore	Postdoc
20	Haritha C	TIFR Mumbai	Postdoc
21	Himanshu Lekharu	JNU, Delhi.	PhD Student
22	Jyoti Dasgupta	TIFR Mumbai	Postdoc
23	Jyoti Garg	Panjab University, Chandigarh	PhD Student
24	Kalsariya Nayna Govindbhai	The Maharaja Sayajirao University of Baroda	PhD Student
25	Kavita Samant	Shiv Nadar University	PhD Student
26	Laxmi	Shiv Nadar University	PhD Student
27	M Sundari	Chennai Mathematical Institute	Faculty
28	Mahinshi	JNU, Delhi.	PhD Student
29	Manideepa Saha	Presidency University, Kolkata, India	PhD Student
30	Manika Bag	IISER Thiruvananthapuram	PhD Student
31	Megha P M	K K T M Govt College, Thrissur	Faculty
32	Meghana Bhat	Indian Institute of Technology Dharwad	PhD Student
33	Mohit	University of Delhi	PhD Student
34	N. Annapoorani	Bharathiar University	Faculty
35	Niraj Rathore	Central University of Karnataka	PhD Student
36	Nitisha Yadav	MNNIT, Prayagraj	PhD Student
37	Pinkimani Goswami	University of Science and Technology, Meghalaya	Faculty
38	Pooja Rani	IIT BHU	PhD Student
39	Priyanka T M C	Vellore Institute of Technology	PhD Student
40	Promod Sharma	IIT BHU	PhD Student
41	Raksha Devi	IIT Roorkee, Roorkee	PhD Student
42	Ranjani Amrapali Vishwanath	RV University	MPhil Student

43	Rati Ludhani	Indian Institute of Technology Bombay	PhD Student
44	Ratna Pal	IISER Mohali	Faculty
45	Ravi Prakash	JNU, Delhi.	PhD Student
46	Renu Shekhawat	Indian Statistical Institute, Bangalore	PhD Student
47	Rimpi	Department of Mathematics,University of Delhi	PhD Student
48	Sabna K S	K. K. T. M Government College, Pullut	Faculty
49	Sakshi	IIT Bombay	PhD Student
50	Saranya Rayappan	Bharathiar University	PhD Student
51	Sharvari Tikekar	TIFR Mumbai	Postdoc
52	Sherin Jose T	St. Joseph's College (Autonomous) Irinjalakuda	Faculty
53	Shivani Sundriyal	Kumaun University, Nainital	PhD Student
54	Shivani Valecha	Indian Institute of Technology, Bhilai	PhD Student
55	Shruthi Subhash	Institute of Chemical Technology, Mumbai	PhD Student
56	Shubham	JNU, Delhi.	PhD Student
57	Shyamsunder	Malaviya National Institute of Technology Jaipur	PhD Student
58	Siddhi Balu Ambhore	Indian Institute of Technology Gandhinagar	PhD Student
59	Sonam	Indian Institute of Technology, Ropar.	PhD Student
60	Sonia	BML Munjal University Gurgaon	PhD Student
61	Sreeja K.U.	Maharaja's College	Faculty
62	Sreelakshmi	NIT Manipur	Masters Student
63	Sudipta Priyadarshini	VIT-AP University, Andhra Pradesh	PhD Student
64	Sumit Kumar	JNU, Delhi.	PhD Student
65	Sushmita Rawat	Indian Institute of Technology Delhi	PhD Student
66	Swati Bhardwaj	Panjab University, Chandigarh	PhD Student
67	Tapatee Sahoo	Manipal Institute of Technology, Bengaluru	Faculty
68	Thalmi B	University of Kerala	Faculty
69	Aakanksha Jain	IISc Bangalore	PhD Student
70	Sushil Singla	IISc Bangalore	Postdoc

Local Participants:

	Name	Affiliation	Student/Postdoc/ Faculty
1	Anurakti Gupta	IISER Pune	Masters Student
2	Bhavana Musunuri	IISER Pune	Masters Student
3	Bivas Khan	IISER Pune	Postdoc
4	Deepika Parmar	DIAT Pune	PhD Student
5	Divyasree C R	IISER Pune	PhD Student
6	Dr. Priyanka Kumari	MIT-WPU	Faculty
7	Harshada Hanumant Mote.	NCL Pune	Masters Student
8	Jeetendrasingh Maan	MIT-WPU Pune	Faculty
9	Namrata Arvind	IISER Pune	PhD Student
10	Nupur Patanker	IISER Pune	Postdoc
11	Priyanka Majumder	IISER Pune	Postdoc
12	Sawant Rutuja Vilas	S P Pune University	Masters Student
13	Shruti Barapatre	IISER Pune	Masters Student
14	Sreedev Manikoth	IISER Pune	PhD Student
15	Srijjan Das	IISER Pune	PhD Student
16	Sumant Kumar	DIAT Pune	PhD Student
17	Sushma Kumari	DIAT Pune	Faculty
18	T I Darsan	IISER Pune	Masters Student
19	Abhay Jayrajan	IISER Pune	Teaching Assistant
20	Rama Mishra	IISER Pune	Faculty

Conference Poster

Conference Website: https://sites.google.com/view/iwm-dec-2022

https://www.iiserpune.ac.in/events/3456/indian-women-and-mathematics-iwm-annual-conference-2022-2023

Conference Schedule at a glance:

The registration started at 9 am on December 27th, 2022. This was followed by opening words by Chair of the Executive Committee of IWM (Professor Vijaylaxmi Trivedi) and by the Chair of Mathematics Department of IISER Pune (Professor Mainak Podar) at 9:50 am. The lectures were held from 10 am to 5:35 pm on all days except the third day. The last day ended at around 3:05 pm.

	10:00 - 10:55		**11:25 - 12:00**	**12:05 - 12:50**		**2:30 - 4:05**	**4:10 - 4:55**	**5:00 - 5:35**
27 Dec	**Plenary** Kavita Ramanan	**TEA**	**Early-Stage** Sayani Bera	**Invited** Ranjana Jain	**LUNCH**	**Three Parallel Sessions** **Each Talk 20 Minutes**	**Posters Presentations** With Tea/Coffee	**Early-Stage** Eshita Mazumdar
28 Dec	**Plenary** Shreemayi Bora	**TEA**	**Early-Stage** Parangama Sarkar	**Invited** V Uma	**LUNCH**	**Three Parallel Sessions** **Each Talk 20 Minutes**	**Posters Presentations** With Tea/Coffee	**Early-Stage** Mubeena T
29 Dec	**Plenary** Nutan Limaye	**TEA**	**Early-Stage** Sheela Verma	**Invited** Hemangi Shah	**LUNCH**	2:30 - 3:05 **Early-Stage** Moumanti Podder		

The EC meeting of IWM was held on December 27, 2022 at 6 pm. There was an open discussion with all the attendees of the conference at the end of Day 2 of the conference. A banquet dinner was arranged on December 28, 2022. The poster presentations were held during the longer tea breaks of the first two days of the conference.

There were three parallel sessions of contributory talks on December 27th and December 28th, 2022.

Parallel Sessions

Tuesday, December 27

	02:30-02:50	2:55-3:15	3:20-3:40	3:45-4:05
Lecture Hall 101	Arusha C	Jyoti Garg	Geethika Sebastian	Bivas Khan
Lecture Hall 106	Jyoti Dasgupta	Apoorva Singh	Deepika Sharma	Apeksha Sanghi
Lecture Hall 107	Promod Sharma	Kavita Samant	Nupur Patanker	Tapatee Sahoo

Wednesday, December 28

	02:30-02:50	2:55-3:15	3:20-3:40	3:45-4:05
Lecture Hall 101	Namrata Arvind	Aparna Pradeep V K	Priyanka Kumari	Pinkimani Goswami
Lecture Hall 106	Sushmita Rawat	Aditi Savalia	Kalsariya Nayna Govindbhai	Shruthi Subhash
Lecture Hall 107	Sonam	Rati Ludhani	Manideepa Saha	Rimpi

Book of Abstracts

Plenary Talks

On Tales of Random Projections: Where Probability Meets Geometry

Kavita Ramanan

Brown University

https://www.brown.edu/academics/applied-mathematics/faculty/kavita-ramanan/home

Abstract: In several areas of mathematics, including probability theory, statistics and asymptotic convex geometry, one is interested in high-dimensional objects, such as measures, data or convex bodies. One common theme is to try to understand what lower-dimensional projections can say about the corresponding high-dimensional objects. I will describe several results that address this, starting with classical results, then discussing more recent breakthroughs and finally touching upon open questions.

Some Distance Problems for Matrix Polynomials via Block Toeplitz Matrices

Shreemayee Bora

Department of Mathematics, Indian Institute of Technology Guwahati

https://www.iitg.ac.in/shbora/

Abstract: Two important distance problems associated with square matrix polynomials are considered. The first one is the distance to a nearest regular matrix polynomial with an elementary divisor of specified minimal length. The second one is the distance to a nearest rank deficient matrix polynomial with a specified upper bound on its rank. Both problems pose theoretically intriguing questions of very significant practical importance [1, 2, 4]. In fact, a special case of the second problem is finding the distance to a nearest rank deficient matrix polynomial and obtaining a practical numerical method for computing it is a long standing open question [1].

Jordan chain structures and minimal index structures of the desired nearest matrix polynomials are used to show that certain block Toeplitz matrices play an important role in the computation of both the distances. This suggests a strong connection between the two problems. The reformulations result in optimizations that may be computed via BFGS and Matlab's globalsearch algorithms. They are also shown to be equivalent to computing generalized versions of certain structured singular values or μ-values [3]. Several upper and lower bounds on the distances are also presented. Numerical experiments show that the bounds are tight and comparisons with ones in the literature are quite favourable.

This is joint work with Dr. Biswajit Das of the Department of Mathematical Sciences, Tezpur University.

References

[1] R. Byers, C. He, and V. Mehrmann. Where is the nearest non-regular pencil?, *Linear Algebra and its Applications*, 285 (1998), pp. 81–105.

[2] R. Byers and N. K. Nichols. On the stability radius of a generalized state-space system. *Linear Algebra and Its Applications*, 188 (1993), pp. 113–134.
[3] M. Karow. *Geometry of spectral value sets.* PhD thesis, University of Bremen, June 2003.
[4] A. Varga. On stabilization methods of descriptor systems. *Systems & Control Letters*, 24 (1995), pp. 133–138.

Proving limits of computation: an algebraic complexity perspective

Nutan Limaye
Computer Science and Engineering, Indian Institute of Technology, Bombay
https://www.cse.iitb.ac.in/~nutan/

Abstract: Complexity theory attempts to understand the limits of efficient computation. Efficiency is measured in terms of resources such as time or space. And the notion of computation is formalised by specifying the rules of computation. The central question that drives the area is: how hard is it to compute certain important and computationally and mathematically interesting functions? In this talk, we will approach this question from the algebraic complexity perspective.

Specifically, we will study how hard it is to compute certain polynomials. Polynomials are mathematical objects that arise naturally in many areas of computer science such as coding theory, cryptography, and algorithm design. Valiant in 1979 formalised models of computation of polynomials and started their systematic study. He posed the following fundamental questions.

- Are there explicit polynomials that cannot be computed efficiently? This is the famous VP vs. VNP question.
- Are there explicit polynomials that are easy to compute by sequential algorithms that have no efficient parallel algorithms? This is the VP vs. VNC question.

Over the last decade, my research has provided partial answers to some of these fundamental questions. In this talk, I will present an overview of my research contributions. I will end with some compelling research directions that emerge from my work.

Invited Talks

Closed Lie ideals of certain Banach algebras

Ranjana Jain
Department of Mathematics, University of Delhi
http://maths.du.ac.in/Staff/CV/ranjana/rj.html

Abstract: An associative algebra A inherits a canonical Lie algebra structure via the Lie bracket $[x, y] = xy - yx$. A subspace L of A is said to be a *Lie ideal* if $[x, a] \in L$ for all $x \in L, a \in A$. In this talk, we shall discuss the structure of closed Lie ideals of Banach algebras emerging from certain tensor products of C^*-algebras. We shall also present an interesting characterization of closed Lie ideals of generalized group algebra $L^1(G, A)$ in terms of left and right actions by G and A, where G is a locally compact group and A is any Banach algebra.

This talk is based on joint works with Ved Prakash Gupta and Bharat Talwar.

K-theory of certain varieties with torus actions

V Uma
Department of Mathematics, Indian Institute of Technology Madras
https://iitm.irins.org/profile/69291

Abstract: In this talk we shall discuss the equivariant and ordinary K-rings of some algebraic varieties with torus actions.

The generalization of the Hopf Conjecture

Hemangi M. Shah
Harish-Chandra Research Institute
https://www.hri.res.in/people/Mathematics/hemangimshah

Abstract: We will prove the Generalization of the Hopf Conjecture in the settings of homogeneous asymptotically harmonic manifolds satisfying Euclid's Parallel Postulate. A long-standing open conjecture in the theory of simply connected, complete Riemannian manifold without conjugate points is the Generalization of the Hopf Conjecture. The Conjecture states that, if (M^n, g) is a simply connected, complete Riemannian manifold without conjugate points satisfying Euclid's parallel postulate, then M is flat. The Conjecture is established by affirming the property that, (M, g) satisfies Euclid's parallel postulate if and only if the Busemann function B_v for a unit tangent vector v of M satisfies $B_v + B_{-v} = 0$ in all directions.

Early-stage mathematician talks

Dynamics of non-autonomous families

Sayani Bera

School of Mathematical and Computational Science, Indian Association for the Cultivation of Science, Kolkata

https://sites.google.com/view/sayanibera/home

Abstract: Dynamics of Non-autonomous families of endomorphisms of $\mathbb{C}^k$, $k \geq 1$ arise naturally while studying the stable sets of iterative holomorphic dynamical systems. The goal of this talk is to introduce the non-autonomous setup.

Also, we discuss a few dynamical properties of non-autonomous families of Hénon maps in $\mathbb{C}^2$, which in turn answers a particular case of a conjecture, attributed to Bedford.

An Introduction to Zero-sum Problems

Eshita Mazumdar

School of Arts and Sciences, Ahmedabad University

https://sites.google.com/view/eshitamazumdar

Abstract: Zero-sum problems deal with the condition which ensures that a given sequence over a finite group has a zero-sum subsequence with some prescribed property. Such problems are motivated while studying the problem of non-unique factorization domain over number fields. There are several group invariants associated with zero-sum theory. Study of these invariants have great impact over public key cryptography also. In this talk I will be discussing about different zero-sum invariants and their behaviour. Mainly I will be focusing on two most important invariant i.e. Davenport and Erdős-Ginzburg-Ziv constant and will be discussing about their generalizations. I will introduce several exciting combinatorial problems and related results regarding zero-sum theory. If time permits I would like to talk about my ongoing projects.

Analytic spread of filtrations

Parangama Sarkar

Department of Mathematics, Indian Institute of Technology Palakkad

https://sites.google.com/site/parangamasarkar/home

Abstract: We will define analytic spread of a filtration generalizing the classical defi- nition of analytic spread of an ideal and discuss some basic properties of analytic spread of an ideal which extend to filtrations, even when the filtration is non-Noetherian. We will illustrate some interesting differences between analytic spread of an ideal and analytic spread of a non-Noetherian filtration with examples.

Quasi isometries and Twisted Conjugacy

Mubeena T.

Department of Mathematics, University of Calicut

https://mathematics.uoc.ac.in/index.php/people/mubeena

Abstract: Given an automorphism $\varphi : \Gamma \to \Gamma$ of an infinite group Γ, we have an action of Γ on itself given by $g.x := gx\varphi(g^{-1})$. The orbits of this action are the φ-twisted conjugacy classes. $R(\varphi)$ denotes the number of distinct φ-twisted conjugacy classes, called the Reidemeister number of φ. Γ is said to have the R_∞-*property* if $R(\varphi) = \infty, \forall \varphi \in Aut(\Gamma)$. The problem of determining which class of group have the R_∞-property is an active area of research. We will see some class of groups in which this property is invariant under quasi-isometry.

Szegö-Weinberger inequality and its developments

Sheela Verma

Department of Mathematical Sciences, Indian Institute of Technology (BHU) Varanasi

https://www.iitbhu.ac.in/dept/mat/people/sheelamat

Abstract: A very famous question in spectral geometry is "can one hear the shape of a drum?" In mathematical formulation, this question corresponds to finding a relation between the Laplacian eigenvalues and geometric structure of the domain under consideration. In general, eigenvalues cannot be computed explicitly except in some special cases. However, some estimates of these eigenvalues can be obtained in terms of geometric invariants of the domain like volume, curvature, etc. In this talk, We shall first discuss Szegö-Weinberger inequality, which provides an isoperimetric bound for the first nonzero Neumann eigenvalue of the Laplacian, and then talk about some of its recent developments.

A confluence of discrete probability, combinatorics, graph theory and game theory

Moumanti Podder

Indian Institute of Science Education and Research Pune

https://www.iiserpune.ac.in/research/department/mathematics/people/faculty/regular-faculty/moumanti-podder/317

Abstract: Two primary fields of study that come under the purview of discrete probability are:

(1) *random graphs*, often serving as models for real-life networks,
(2) random processes, also known as *stochastic processes*, such as random walks, on deterministic as well as random structures.

My research encompasses both these aspects. In particular, I am often keenly fascinated by *two-player combinatorial games*, a class of *perfect information* games, played on random graphs. These also have close connections with *automata theory* that lies at the interface of mathematics and theoretical computer sciences, and frequently asked questions pertaining to*ergodicity* of automata are, in turn, intimately related to questions of *spatial mixing* of *Gibbs measures* in statistical physics. In my talk, I shall try to give an

overview of the various objects I investigate in my research, the connections they exhibit with one another, and the questions I try to answer in these areas.

LIST OF ABSTRACTS OF CONTRIBUTED TALKS
IWM Annual Conference 2022-2023

DAY 1, 27 December

Venue: LHC 101

2:30 p.m. **Speaker:** Arusha C, TIFR Mumbai
Title: Minimal Rational Curves in the Moduli Spaces of Vector Bundles on Nodal Curves
Abstract: Rational curves inside an algebraic variety (morphisms from the projective line) have been studied since the 1980s. In the late 1990s, V.S. Kilaru initiated their study in the moduli space of stable vector bundles on smooth curves. The Hecke modification of a vector bundle on a curve, introduced by Narasimhan and Ramanan, gives rise to another vector bundle on the curve. The rational curves that arise from the Hecke modification, called Hecke curves, are known to satisfy some minimality conditions. On the other hand, X. Sun proved that the rational curves in the moduli space of stable vector bundles that satisfy these minimality conditions are Hecke Curves.

Following their methodologies, we study the rational curves in the moduli space of stable vector bundles over nodal curves and provide a similar classification. As a corollary, we also obtain the non-abelian Torelli theorem. This is a joint work with I. Biswas.

2:55 p.m. **Speaker:** Jyoti Garg, Panjab University
Title: A Constructive Proof Of Brauer-Witt Theorem
Abstract: A classical theorem due to Brauer and Witt implies that every simple component of the rational group algebra $\mathbb{Q}G$ of a finite group G is Brauer equivalent to a cyclotomic algebra containing $\mathbb{Q}$ in its centre. The precise description of this cyclotomic algebra is not available from the proof of the Brauer-Witt theorem and it has been a problem of interest to determine the same in view of its central role in the study of central simple algebras. Herein we report an approach using Shoda pair theory which is quite efficient from computational perspective.

3:20 p.m. **Speaker:** Geethika Sebastian, IISc Bangalore
Title: A Multiplicative Spectral Characterization of Characters on $C^\star$-algebras
Abstract: We consider a multiplicative version of the classical Kowalski-Słodkowski Theorem which identifies the characters among the collection of all functionals on a complex and unital Banach algebra A. In particular, we prove: If A is a $C^\star$-algebra, and if $\phi : A \to \mathbb{C}$ is a function satisfying $\phi(x)\phi(y) \in \sigma(xy)$ for all $x, y \in A$ (where σ denotes the spectrum), then either ϕ is a character of A or $-\phi$ is a character of A, if and only if ϕ is continuous.

3:45 p.m. **Speaker:** Bivas Khan, IISER Pune
Title: Logarithmic connections on principal bundles over normal varieties

Abstract: Let X be a normal algebraic variety over an algebraically closed field of characteristic zero. Let D be a reduced Weil divisor on X. Let G be a linear algebraic group. We formalize the notion of a logarithmic connection on a Zariski locally trivial principal G-bundle over X, which is singular along D. We show that a torus equivariant principal bundle over a toric variety admits an integrable logarithmic connection singular along the boundary divisor. We consider the notion of residue of a logarithmic connection on a vector bundle over a toric variety, and show that for a toric vector bundle, the residue encodes the equivariant structure of the vector bundle. This is based on joint work with Jyoti Dasgupta and Mainak Poddar.

Venue: LHC 106

2:30 p.m. **Speaker:** Jyoti Dasgupta, TIFR Mumbai
Title: Seshadri constants of equivariant vector bundles on toric varieties
Abstract: Seshadri constants measure the local positivity of an ample line bundle. They were introduced by Demailly. Later, Hacon generalized the notion of Seshadri constants to vector bundles. We consider torus equivariant vector bundles on toric varieties. Assuming certain conditions on the vector bundle, we compute precise values of Seshadri constants at arbitrary points on projective spaces and Bott towers of height at most 3. This is based on joint work with Bivas Khan and Aditya Subramaniam.

2:55 p.m. **Speaker:** Apoorva Singh, Shiv Nadar Institute of Eminence
Title: Invariance in the general class of Hardy spaces
Abstract: The classical Beurling-Helson-Lowdenslager theorem characterizes all the shift-invariant subspaces of the Hardy space H^2 over the unit disc and the Lebesgue space L^2 on the unit circle. The shift-invariant subspace theorem has also been extended to the L^p spaces, $1 \leq p \leq \infty$. Recently, Chen defined the continuous $\|.\|_1$-dominating normalized gauge norm α on the space of all complex-valued measurable functions on the unit circle. The closure of L^∞ with respect to the norm α is called the general Lebesgue space and is denoted by L^α and the closure of H^∞ under α is called the general Hardy space H^α. A Beurling-Helson-Lowdenslager type result for the operator of multiplication by the coordinate function $e^{i\theta}$ on L^α as well as H^α has also been proved.

In this work, we study the invariance in a broader class of Hardy spaces H^α equipped with continuous $\|.\|_1$-dominating normalized gauge norms. Our main result is that we characterize the closed subspaces of H^α invariant under the operator of multiplication by finite Blaschke factor $B(z)$. We also derive the common invariant subspaces of H^α under multiplication by all the natural powers of $B(z)$ except the first power which is equivalent to characterizing invariance under the algebra $H_1^\infty(B) = \{f(B(z)) : f \in H^\infty \text{ and } f'(0) = 0\}$. We obtained the sharp descriptions of the invariant and common invariant subspaces for a special class of continuous rotationally symmetric norms. For this case, the underlying Blaschke factor is the monomial $B(z) = z^n$.

3:20 p.m. **Speaker:** Deepika Sharma, JNU Delhi
Title: Value of Interior Angle between intermediate C^*-subalgebras
Abstract: We show that all values in the interval $\left[0, \frac{\pi}{2}\right]$ can be attained as the interior angle between intermediate subalgebras of a certain inclusion of unital C^*-algebras.

3:45 p.m. **Speaker:** Apeksha Sanghi, IISER Mohali
Title: Infinite metacyclic subgroups of the mapping class group
Abstract: For $g \geq 2$, let $\mathrm{Mod}(S_g)$ be the mapping class group of the closed orientable surface S_g of genus g. In this talk, we discuss a complete characterization of the infinite metacyclic subgroups of $\mathrm{Mod}(S_g)$ up to conjugacy. In particular, we discuss equivalent conditions under which a pseudo-Anosov mapping class generates a metacyclic subgroup of $\mathrm{Mod}(S_g)$ with another mapping class. As application to our main results, we describe some examples of infinite metacyclic subgroups of $\mathrm{Mod}(S_g)$. Finally, we derive bounds on the order of a periodic generator of an infinite metacyclic subgroup of $\mathrm{Mod}(S_g)$.

Venue: LHC 107

2:30 p.m. **Speaker:** Promod Sharma, IIT (BHU)
Title: Inductive algebras for the affine group of a finite field
Abstract: We show that each irreducible representation of the affine group of a finite field has a unique maximal inductive algebra, and it is self-adjoint.

2:55 p.m. **Speaker:** Kavita Samant, Shiv Nadar Institute of Eminence
Title: Generating Graphs of Finite Dihedral Groups
Abstract: Let X_n be the generating graph of a dihedral group D_n, of order $2n$. We explored various graph parameters of it like connectedness, diameter, eulerian graphs, independence number, clique number etc. We also studied the adjacency matrix of X_n and gave it a block form with the help of an equivalence relation on the vertex set, and discussed its spectrum. Further we explored a generalised form of the generating graphs for finite dihedral groups. In conclusion, we will compare both versions of the graphs.

3:20 p.m. **Speaker:** Nupur Patanker, IISER Pune
Title: Generalized Hamming weights of toric codes over hypersimplices and squarefree affine evaluation codes
Abstract: Linear codes form a large family of error-correcting codes. Due to their algebraic properties, these are the most studied codes from the mathematical point of view. Recently, Jaramillo, Pinto and Villarreal introduced various linear codes called toric codes over hypersimplices and squarefree affine evaluation codes and calculated their basic parameters. In this talk, we will give an overview of our work on the generalized Hamming weights of these codes.

At the beginning of this talk, we will define linear code and its basic parameters. Then we will see the construction of toric codes over hypersimplices and squarefree affine evaluation codes and the results on their

basic parameters. Then we will answer the questions on the number of zeroes of squarefree polynomials of a certain degree in the affine torus. This, in turn, answers our question on the generalized Hamming weights of toric over hypersimplices and squarefree affine evaluation codes under certain cases. This is a joint work with Dr. Sanjay Kumar Singh.

3:45 p.m. **Speaker:** Tapatee Sahoo, Manipal Institute of Technology, Bengaluru
Title: Lattice with superfluous elements and related graphs
Abstract: We consider a bounded lattice with bounds 0 and 1, and consider superfluous elements in a lattice. We introduce various types of graphs such as: superfluous element graph (S(L)), join intersection graph (JI(L)), and investigate their properties. Furthermore, in a distributive lattice, we define superfluous intersection graph. We find connections between the latticetheoretic properties and those of corresponding graph-theoretic properties using dual atoms in a lattice. Some important equivalent conditions of graphs involving the cardinality of dual atoms are derived in a lattice. Finally, we prove properties such as bounds of diameter, girth and cut vertex of these graphs.

Day 2, 28 December

Venue: LHC 101

2:30 p.m. **Speaker:** Namrata Arvind, IISER Pune
Title: On $\mathbb{Z}_n \rtimes \mathbb{Z}_2$-Hopf-Galois structures
Abstract: Let K/F be a finite Galois extension of fields with $\mathrm{Gal}(K/F) = G$. The Hopf algebra $F[G]$ is an example of a Hopf-Galois structure on the extension K/F. Cornelius Greither and Bodo Pareigis gave a bijection between the set of possible Hopf-Galois structures on K/F and regular subgroups N of $\mathrm{Perm}(G)$ normalized by $\lambda(G)$.

In our recent work we enumerated the number of Hopf-Galois structures with Galois group G of type N, where G, N are groups of the form $\mathbb{Z}_n \rtimes_\phi \mathbb{Z}_2$ when radical of n is a Burnside number. In this talk we will give an overview of this result, with some applications to skew braces. This is a joint work with Saikat Panja.

2:55 p.m. **Speaker:** Aparna Pradeep V K, Cochin University of Science and Technology
Title: Comparison of Petrov's odd elementary hyperbolic unitary group and Dickson-Siegel-Eichler-Roy elementary orthogonal group
Abstract: Let R be a commutative ring with unity in which 2 is invertible. For a quadratic space Q and a hyperbolic space $\mathbb{H}(P)$, where P is a finitely generated projective R-module, A. Roy defined certain elementary transformations on $Q \perp \mathbb{H}(P)$ and proved that they are orthogonal transformations. The subgroup of $\mathrm{O}_R(Q \perp \mathbb{H}(P))$ generated by these transformations is called Roy's elementary orthogonal group or Dickson-Siegel-Eichler-Roy (DSER) elementary orthogonal group and is denoted by $\mathrm{EO}_R(Q, \mathbb{H}(P))$.

3:20 p.m. **Speaker:** Priyanka Kumari, MIT WPU Pune
Title: Polynomial Criterion for Abelian Difference Sets and its Applications
Abstract: Difference sets are special subsets of a group having certain combinatorial property with respect to the group operation. We develop polynomial criterion for a subset of a finite abelian group G to be a difference set with specified parameters. We provide some applications of a polynomial criterion for difference sets. These include counting the difference sets with specified parameters in terms of Hilbert functions, in particular a count of bent functions.

3:45 p.m. **Speaker:** Pinkimani Goswami, University of Science and Technology, Meghalaya
Title: Applications of Braid Group in context of Cryptography
Abstract: Artin's Braid groups are one of the promising non-Abelian groups for applications to cryptography. It provides difficult computational problems and it can be implemented quite efficiently. In this paper, we have proposed a new public key encryption scheme based on two hard problems: the conjugacy search problem and p-th root problems on Braid group. We also studied the security and efficiency of the proposed scheme.

Venue: LHC 106

2:30 p.m. **Speaker:** Sushmita Rawat, IIT Delhi
Title: Critical growth fractional Kirchhoff elliptic problems
Abstract: The focus of this talk would be to share some new results on Kirchhoff Choquard non-linearity. For the singular problem in a bounded domain, we have obtained the existence and multiplicity of positive solutions by minimizing the argument and truncating the singular term. Further, we bridged a few gaps for the Kirchhoff-Choquard problem with the sub-critical perturbation term. Using the variational method, we analyzed the problem for different values of q when it is either convex-concave or when $2 < q < 2^{*,s}$. Here $2^{*,s}$ is the critical term for a fractional problem.

2:55 p.m. **Speaker:** Aditi Savalia, IIT Gandhinagar
Title: An induction principle for the Bombieri-Vinogradov theorem over $\mathbb{F}_q[t]$ and a variant of the Titchmarsh divisor problem
Abstract: The Bombieri-Vinogradov theorem establishes that the primes are equidistributed in arithmetic progressions "on average" for moduli q in the range $q \leq x^{1/2-\epsilon}$ for any $\epsilon > 0$. Let $\mathbb{F}_q[t]$ be the polynomial ring over the finite field $\mathbb{F}_q$. For arithmetic functions $\psi_1; \psi_2 : \mathbb{F}_q[t] \to \mathbb{C}$, we establish that if a Bombieri-Vinogradov type equidistribution result holds for ψ_1 and ψ_2, then it also holds for their Dirichlet convolution $\psi_1 * \psi_2$. As an application, we obtain an asymptotic for the average behavior of the divisor function over shifted products of two primes in $\mathbb{F}_q[t]$. This is joint work with Sampa Dey.

3:20 p.m. **Speaker:** Kalsariya Nayna Govindbhai, MSU Baroda
Title: Generalized Absolute Convergence of Single and Double Vilenkin-Fourier Series and Related Results
Abstract: We consider the Vilenkin orthonormal system on a Vilenkin group G and the Vilenkin-Fourier coefficients $\hat{f}(n)$, $n \in \mathbb{N}$, of functions $f \in L^p(G)$ for some $1 < p \leq 2$. We obtain certain sufficient conditions for the finiteness of the series $\sum_{n=1}^{\infty} a_n |\hat{f}(n)|^r$, where $\{a_n\}$ is a given sequence of positive real numbers satisfying a mild assumption and $0 < r < 2$. We also find analogue conditions for the double Vilenkin-Fourier series. These sufficient conditions are in terms of (either global or local) moduli of continuity of f and give multiplicative analogue of some results due to F. Móricz, F. Móricz and A. Veres, Golubov and Volosivets, and Volosivets and Kuznetsova.

3:45 p.m. **Speaker:** Shruthi Subhash, ICT Mumbai
Title: Compounding of Permutation matrices using compound matrices
Abstract: A general method developed for constructing elements of determinantal compound of permutation matrices and permanental compound of permutation matrices using permutations. The method extends to the immanantal compound of permutation matrix.

Venue: LHC 107

2:30 p.m. **Speaker:** Sonam, IIT Ropar
Title: q-Analogue of Euler-Stieltjes Constants
Abstract: In 2003, Kurokawa and Wakayama defined a q-analogue of the Euler constant and proved the irrationality of certain numbers involving q-Euler constant. In this presentation, we improve their results and prove the linear independence result involving q-analogue of the Euler constant. Further, we derive the closed-form of a q-analogue of the k-th Stieltjes constant $\gamma_k(q)$. Using a result of Nesterenko, we also settle down a question of Erdős regarding the arithmetic nature of the infinite series $\sum_{n\geq 1} \sigma_1(n)/t^n$ for any integer $t > 1$. Finally, we discuss the transcendence nature of some infinite series involving $\gamma_1(2)$.

2:55 p.m. **Speaker:** Rati Ludhani, IIT Bombay
Title: Purity of minimal free Resolutions associated to affine and projective Reed-Muller Codes
Abstract: Following Johnsen and Verdure (2013), we can associate to any linear code C an abstract simplicial complex and in turn, a Stanley-Reisner ring R_C. The ring R_C admits a graded minimal free resolution and the resulting graded Betti numbers are known to determine the generalized Hamming weights of C and several other classical parameters of the code. Thus, explicitly determining the Betti numbers of a code is interesting and useful. However, it is in general, a difficult problem. But this problem becomes easy when the corresponding minimal free resolutions are known to be pure. We complete the work of Ghorpade and Singh (2020) of characterizing when the resolutions associated to (generalized or affine) Reed-Muller codes of an arbitrary order are pure. Next, we consider the family of projective Reed-Muller codes and give a complete characterization of the purity of minimal free resolutions of these codes of an arbitrary order. This is a joint work with Sudhir R. Ghorpade.

3:20 p.m. **Speaker:** Manideepa Saha, Presidenccy University, Kolkata
Title: On Graphs Defined on Groups
Abstract: Associating graphs with groups dates back to Arthur Cayley. Cayley graphs play an important role in various fields of mathematics, ranging from geometric group theory to algebraic combinatorics, from representation theory to discrete mathematics, from operator algebras to coding theory. In this talk, we discuss about another such graph defined on groups, called *comaximal subgroup graph* $\Gamma(G)$ of a group G whose vertices are non-trivial proper subgroups of G and two vertices H and K are adjacent if $HK = G$. Though the definition allows the possibility of G to be infinite, in our discussion, we will focus mainly on finite groups. We discuss various graph parameters like diameter, connectedness, girth, bipartiteness etc. Finally, we will highlight some problems on realizability and graph isomorphisms, and some partial solutions to those questions in terms of properties of G. The results presented in the talk can be found in[1-3].

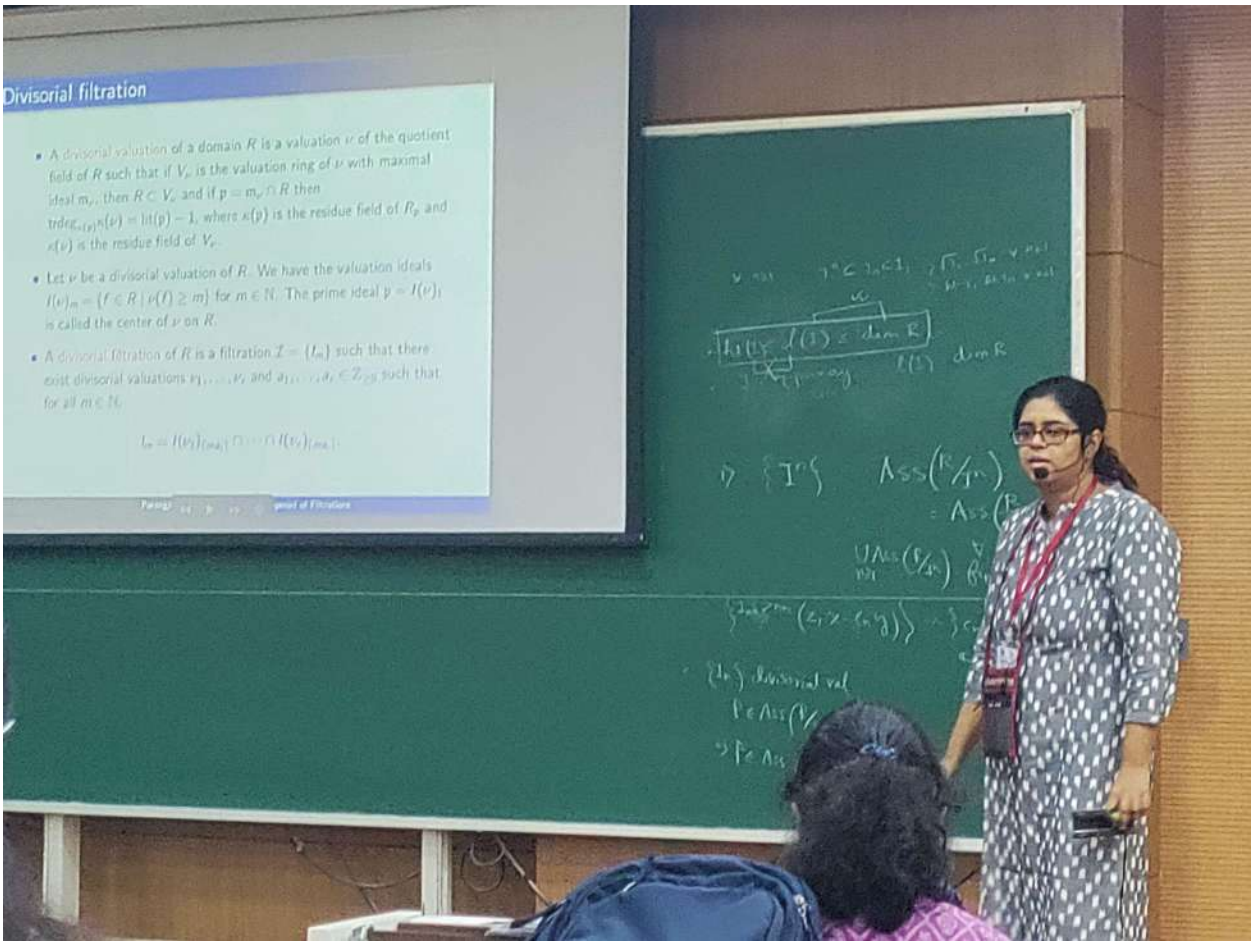
3:45 p.m. **Speaker:** Rimpi, University of Delhi

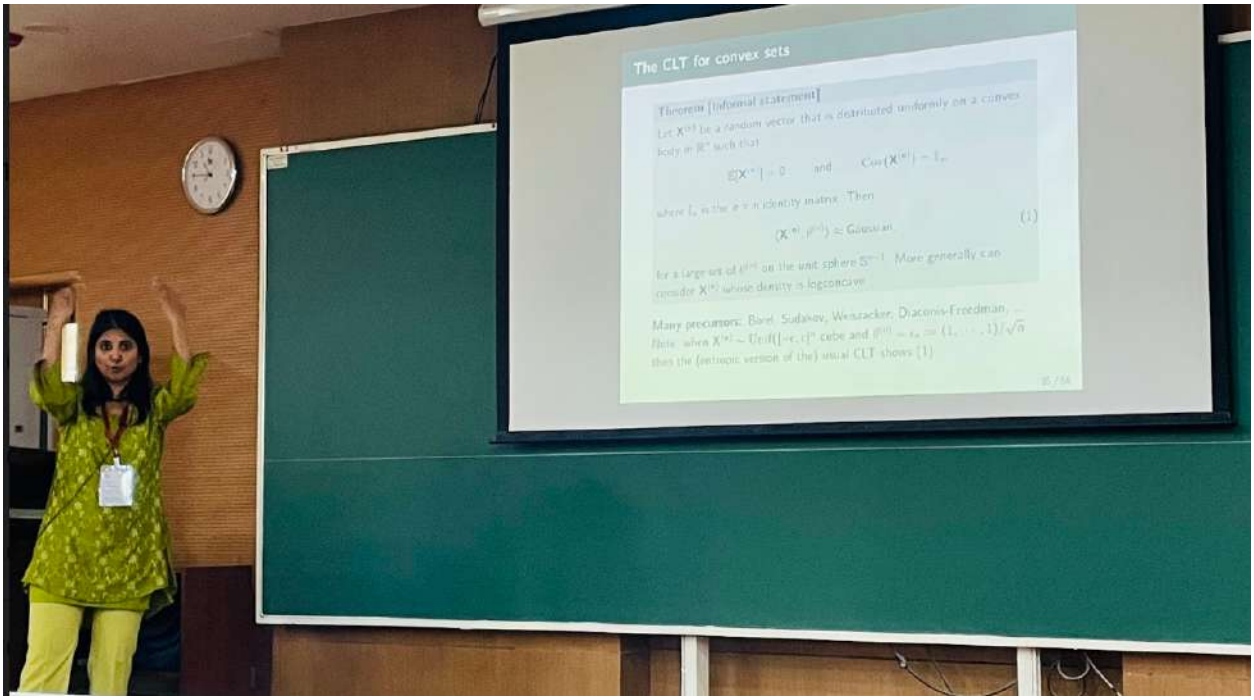
Title: Classification of Constraint Qualification for Nonsmooth Programming Problems

Abstract: We have categorized almost all existing constraint qualifications for an inequality constrained nonsmooth problem into four levels in terms of Clarke subdifferential. This work is motivated by the classification of constraint qualifications established by Wang et al. for smooth problems using the inclusion relations among various cones of directions. However, we observed a flaw in the classification given by the authors and consequently identified two new constraint qualifications which were not considered in the literature before. Numerous inter-relations between these constraint qualifications are illustrated through a schematic diagram.

A Group Photo at the Conference:

Some more photos:


Divisorial filtration
A divisorial valuation of a domain R is a valuation ν of the quotient field of R such that if V_ν is the valuation ring of ν with maximal ideal $\mathfrak{m}_\nu$, then $R \subset V_\nu$ and if $\mathfrak{p} = \mathfrak{m}_\nu \cap R$ then $\mathrm{trdeg}_{\kappa(\mathfrak{p})}\kappa(\nu) = \mathrm{ht}(\mathfrak{p}) - 1$, where $\kappa(\mathfrak{p})$ is the residue field of $R_\mathfrak{p}$ and $\kappa(\nu)$ is the residue field of V_ν.
Let ν be a divisorial valuation of R. We have the valuation ideals $I(\nu)_m = \{f \in R \mid \nu(f) \geq m\}$ for $m \in \mathbb{N}$. The prime ideal $\mathfrak{p} = I(\nu)_1$ is called the center of ν on R.
A divisorial filtration of R is a filtration $\mathcal{I} = \{I_m\}$ such that there exist divisorial valuations $\nu_1, \ldots, \nu_r$ and $a_1, \ldots, a_r \in \mathbb{Z}_{\geq 0}$ such that for all $m \in \mathbb{N}$,
$I_m = I(\nu_1)_{(ma_1)} \cap \cdots \cap I(\nu_r)_{(ma_r)}$.


The CLT for convex sets
Theorem (Informal statement)
Let $\mathbf{X}^{(n)}$ be a random vector that is distributed uniformly on a convex body in $\mathbb{R}^n$ such that
$\mathbb{E}[\mathbf{X}^{(n)}] = 0$ and $\mathrm{Cov}(\mathbf{X}^{(n)}) = \mathbb{I}_n$
where $\mathbb{I}_n$ is the $n \times n$ identity matrix. Then
$\langle \mathbf{X}^{(n)}, \theta^{(n)} \rangle \approx$ Gaussian (1)
for a large set of $\theta^{(n)}$ on the unit sphere $\mathbb{S}^{n-1}$. More generally can consider $\mathbf{X}^{(n)}$ whose density is logconcave.
Many precursors: Borel, Sudakov, Wenzacker, Diaconis-Freedman, ... Note: when $\mathbf{X}^{(n)} \sim \mathrm{Unif}([-\epsilon, \epsilon]^n$ cube and $\theta^{(n)} = e_n := (1, \cdots, 1)/\sqrt{n}$ then the (entropic version of the) usual CLT shows (1)

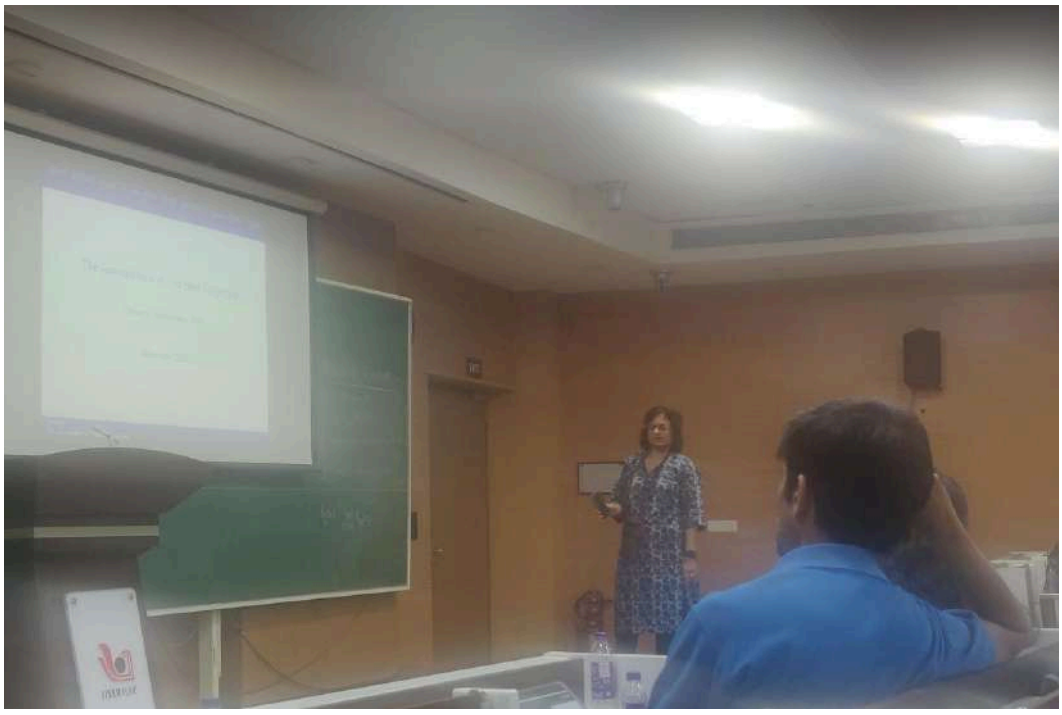

EXIT


Thank
You!


EXIT


Applications in modeling disease / rumour spread
$p(n) = c(n)\, n^{-\alpha}$


Government of India
National Board for Higher Mathematics
IISER PUNE
Welcome
to the
Indian Women and Mather
(IWM)
Annual Conference
2022-2023
27th-29th December, 2

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