SCHEDULE

IMU Annual Meeting 25-28.5.17

Thursday

13:30-15:30
topology
algebra
discrete

16:00-16:45
plenary: Amos Nevo

17:00-19:00
probability
analysis
applied

19:00-20:30
dinner

20:30-22:00
posters

Friday

8:00-8:45
business meeting

9:00-11:00
education (in Hebrew)
analysis
discrete

11:15-11:30
Erdös, Levitzki and Nessyahu prizes

11:30-12:15
Erdös talk: Nir Lev

12:20-12:50
Levitzki talk: Chen Meiri

12:50-14:00
lunch

14:00-14:45
plenary: Edriss S. Titi

15:00-17:00
erogodic
algebra
Zeev@80

Sunday

9:00-11:00
optimization
topology
erogodic
probability

11:15-13:15
optimization
discrete
analysis
applied

Saturday

free time for discussions

PLACES

IMU Annual Meeting 25-28.5.17

Thursday
Abirim: algebra, plenary talk, analysis
Dekel: discrete, probability
Shahaf: topology, applied

Friday
Abirim: meeting, education, prizes & prize-talks, plenary, Zeev@80
Dekel: analysis, algebra
Shahaf: discrete, erogodic

Sunday
Abirim 4: optimization, optimization
Abirim 5: topology, analysis
Dekel: erogodic, discrete
Shahaf: probability, applied

PROGRAM

IMU Annual Meeting 25-28.5.17

Thursday 13:30-15:30

Algebra

13:30 Eli Matzri (Bar Ilan University)

Triple Massey products with weights and symbols in Galois cohomology

Fix an arbitrary prime p. Let F be a field containing a primitive p-th root of unity, with absolute Galois group G_F, and let H^n denote its mod p cohomology group $H^n(G_F, \mathbb{Z}/p\mathbb{Z})$. The triple Massey product of weight $(n, k, m) \in \mathbb{N}^3$ is a partially defined, multi-valued function $\langle \cdot, \cdot, \cdot \rangle : H^n \times H^k \times H^m \to H^{n+k+m-1}$. In this work we prove that for an arbitrary prime p, any defined Triple Massey product of weight $(n, 1, m)$, where the first and third entries are assumed to be symbols, contains zero; and that for $p = 2$ any defined Triple Massey product of the weight $(1, k, 1)$, where the middle entry is a symbol, contains zero. The main tool we will be using is Lemma 3.1 concerning the the annihilator of cup product with an H^1 element, and Theorem 4.2, generalizing a Theorem of Tignol on quaternion algebras.

14:30 Yaakov Karasik (Technion)

Graded algebras having a graded division form

Let $\mathbb{F}$ be an algebraically closed field of characteristic zero and let G be a finite group. Consider G-graded algebras A which are finite dimensional and central over $\mathbb{F}$, i.e. $Z(A)_e = \mathbb{F}$. In a recent work with Eli Aljadeff we were able to determine explicitly all such algebras which admit a G-graded division algebra twisted form. More precisely, we determine all such algebras A which admit a G-graded division algebra B over a field k, such that $B \otimes_k E$ and $A \otimes_F E$ are G-graded isomorphic. Here E is a large enough field which extends k and $\mathbb{F}$.
This result is deeply rooted in the theory of G-graded polynomial identities (PI). More specifically, one introduces G-graded strongly verbally prime T-ideals and classify them in the affine case (i.e. containing a Capelli polynomial). Then, one shows that these ideals are precisely the T-ideals represented

by finite dimensional G-graded division algebras. It turns out, that only by considering the interplay between the two notions one can solve the two classification problems.

In the talk I will explain the result and the main ideas which come into play in its proof.

15:00 David el-Chai Ben-Ezra (The Hebrew University)

The congruence subgroup problem for free metabelian groups

In its classical setting, the congruence subgroup problem (CSP) asks: Does every finite index subgroup of $G = GL_n(\mathbb{Z})$ contain a principal congruence subgroup, i.e. a subgroup of the form $G(m) = \ker(GL_n(\mathbb{Z}) \to GL_n(\mathbb{Z}/m\mathbb{Z}))$ for some $m \in \mathbb{N}$? This is equivalent to the question: Is the congruence map $\widehat{GL_n(\mathbb{Z})} \to GL_n(\hat{\mathbb{Z}})$ injective? So the modern version of the problem is: What is $C_n = \ker(\widehat{GL_n(\mathbb{Z})} \to GL_n(\hat{\mathbb{Z}}))$? It is known that there is a dichotomy between the case $n = 2$, in which the kernel $C_2 = \hat{F}_\omega$ is huge and equal to the free profinie group on countable number of generators, and the cases $n > 2$, in which the kernel is trivial.

Viewing $GL_n(\mathbb{Z}) = Aut(\mathbb{Z}^n)$ as the automorphism group of the free abelian group on n generators, one can generalize the CSP as follows: Let Δ be a finitely generated group. What is $C(\Delta) = \ker(\widehat{Aut(\Delta)} \to Aut(\hat{\Delta}))$? Considering this generalization, very few results are known when Δ is non-abelian. For example, only in 2001 Asada proved, using tools of algebraic geometry, that $C(F_2)$ is trivial, and the CSP for $F_{n>2}$ is still unsettled. On the talk, we will discuss the case in which Δ is a finitely generated free metabelian group, and will show that in this case we have a dichotomy between $n = 2, 3$ and $n > 3$.

Topology

13:30 Ruth Lawrence

An explicit symmetric DGLA model of the bi-gon

This is a continuation of work with Dennis Sullivan on DGLA models of cell complexes in which the cells generate freely the Lie algebra, with the differential structure a deformation of the topological boundary and such that vertices satisfy the Maurer-Cartan equation while edges generate a flow between their geometric endpoints. A dictionary correspondence with concepts in differential geometry allows an explicit construction for the first time of a symmetric model of the bi-gon. This is joint work with Nir Gadish and Itay Griniasty.

14:00 Yael Algom-Kfir

Non-planar sets in the boundaries of hyperbolic free-by-cyclic group

The Gromov boundary of a typical hyperbolic group is homeomorphic to the Menger curve. Using Euler characteristic considerations, M. Kapovich and B. Kleiner showed that this is the case for a hyperbolic free by cyclic group with fully irreducible monodromy. In this joint work with Hilion and Stark we produce non-planar sets in the boundaries of all hyperbolic free by cyclic groups. We are then able to show that if such a group has a parageometric monodromy then all monodromies of sections in the same fibered cone as the original one will have parageometric monodromies.

14:30 Ilan Barnea

The homology of inverse limit

I will describe joint work with Saharon Shelah that originated from a question of Emmanuel Farjoun. As is well known, the homology of a homotopy colimit of spaces and the homotopy of a homotopy limit are computable through a spectral sequence. However, the homology of a homotopy limit is harder to reach. Farjoun asked what can be said about the natural map from the homology of the homotopy limit to the limit of homologies. We consider 0- and 1-categorical formulations of this problem. In the 0-level (discrete space), homology of a space is replaced by the free abelian group on a set and in the 1-level (K(G,1) space) homology of a space is replaced by the abelianization of a group. In certain cases we are able to give restrictions on the kernel and cokernel of the natural map.

15:00 Michaeel Brandenbursdky

Concordance of certain 3-braids and Gauss diagrams

Let $\beta = \sigma^1\sigma_2^{-1}$ be a braid in B_3, where B_3 is the braid group on 3 strings and σ_1, σ_2 are the standard Artin generators. Using Gauss diagram formulas I will show that for each n not divisible by 3 the knot which is represented by the closure of the braid β^n is algebraically slice if and only if n is odd. As a consequence, I will deduce some properties of Lucas numbers.

Discrete

13:30 Natan Rubin (Ben Gurion)

Even more colorful Helly theorems: beyond point transversals

In early 1980s, Lovasz introduced the 'colorful' variant of the Helly Theorem: For any collection of convex sets in the Euclidean d-space colored with d+1 colors, so that any 'rainbow' (d+1)-tuple has a non-empty intersection, there is a color whose convex sets admit a non-empty intersection. The existing proofs are rather existential and give very few directions towards finding the intersecting family, and tell nothing of the remaining d colors. We study the intersection properties of set families which admit the Colorful Helly property and obtain surprising relations between transversals of various dimensions.

This is joint work with Leonardo Martinez-Sandoval and Edgardo Roldn-Pensado.

14:00 Dor Minzer (Tel Aviv University)

The Grassmann graph: PCP and expansion

The PCP theorem characterizes the computational class NP, so as to allow proving approximation problems are NP-hard. One of the fundamental open questions in PCP theory is whether a special type of PCP, namely 2-to-1 Games, is still NP-hard. This conjecture is a variant of Khot's well-known Unique Games conjecture.

In a recent line of study, the Grassmann Graph played a fundamental role towards a (positive) resolution of the 2-to-1 Games conjecture. The approach relies on unproven combinatorial hypothesis on the Grassmann Graph, regarding expansion-type properties in it. This, in turn, leads to the study of edge expansion in this graph. This talk discusses this line of study. In particular, it gives a characterization of small sets that do not have large edge expansion. These results can be viewed as an analog of the classical hypercontractive inequality on the noisy hypercube.

The talk is based on joint works with Irit Dinur, Subhash Khot, Guy Kindler and Muli Safra.

14:35 Dan Hefetz (Ariel University)

On the inducibility of cycles

In 1975 Pippenger and Golumbic proved that any graph on n vertices admits at most $2e(n/k)^k$ induced k-cycles. This bound is larger by a multiplicative factor of $2e$ than the simple lower bound obtained by a blow-up construction. Pippenger and Golumbic conjectured that the latter lower bound is essentially tight. In this talk I will discuss the notion of inducibility of graphs and digraphs, some of the few related known results and some of the many related open problems. I will also briefly indicate how M. Tyomkyn and I were able to improve the aforementioned upper bound of Pippenger and Golumbic.

15:05 Clara Shikhelman (Tel Aviv University)

Many T copies in H-free subgraphs of random graphs

For two fixed graphs T and H, let $ex(G(n,p),T,H)$ be the random variable counting the maximum number of copies of T in an H-free subgraph of the random graph $G(n,p)$. In this talk we will discuss the behavior of this variable, focusing mostly on the case where $T = K_m$ and H has a chromatic number at least $m+1$.

Let $m_2(H) = max(e(H')-1)/(v(H')-2)$ for $H' \subset H$, $|H'| > 2$. We will show that there are two main behaviors of $ex(G(n,p),T,H)$ depending on p. The phase transition between these behaviors depends on the value of $m_2(H)$ and whether it is greater or smaller than $m_2(T)$ (where both cases are possible when $T = K_m$ and $\chi(H) = m+1$).

Based on joint works with N. Alon, A. Kostochka and W. Samotij.

Thursday 16:00-16:45

Plenary Talk: Amos Nevo (Technion)

New directions in Diophantine approximation

Classical Diophantine approximation quantifies the denseness of the set of rational vectors in their ambient Euclidean space. A major extension of the classical theory aims to quantify the denseness of rational points in homogeneous algebraic varieties, for example the spheres, quadratic varieties such as ellipsoids and hyperboloids, or group varieties. This was raised as an open problem by Serge Lang already half a century ago, but progress towards it was achieved only in the special case of Abelian group varieties. A systematic approach to this problem for homogeneous varieties associated with simple groups has been developed in recent years, in joint work with A. Ghosh and A. Gorodnik. The methods involve ergodic theory and representation theory, particularly spectral estimates in the automorphic representation. They lead to derivation of uniform and almost sure Diophantine exponents, as well as analogs of Khinchin's and Schmidt's theorems, with some of the results being best possible. We will explain some of the main results and some of the main ingredients in their proof, focusing on the easily accessible examples mentioned above.

Thursday 17:00-19:00

Probability

17:00 Yinon Spinka (Tel Aviv University)

Long-range order in random colorings and random graph homomorphisms in high dimensions

Consider a uniformly chosen proper coloring with q colors of a domain in $\mathbb{Z}^d$ (a graph homomorphism to a clique). We show that when the dimension is much higher than the number of colors, the model admits a staggered long-range order, in which one bipartite class of the domain is predominantly colored by half of the q colors and the other bipartite class by the other half. The $q = 3$ case was previously known. The result further extends to homomorphisms to other graphs (covering for instance the cases of the hard-core model and the Widom-Rowlinson model), allowing also vertex and edge weights (positive temperature models). The results apply also in low dimensions $d \geq 2$ if one works with a sufficiently 'thickened' version of $\mathbb{Z}^d$. Joint work with Ron Peled.

17:40 Eliran Subag (Weizmann)

The geometry of the Gibbs measure of pure spherical spin glasses

How does a random function on a manifold of very high dimension typically look like? The talk will focus on aspects of this question for the pure spherical spin glass models of statistical mechanics – namely, random homogeneous polynomials restricted to the N-sphere. First, we will see how the second moment method can be applied to study the distribution of critical points at a given height. Then, we will describe the limiting distribution of the point process associated to critical values (a joint work with Ofer Zeitouni). Finally, we will describe a geometric picture for the Gibbs measure at low temperature: as the dimension tends to infinity, the measure concentrates on "bands" around the critical points of highest values.

18:20 Oren Louidor (Technion)

On the large values of logarithmically and genealogically correlated random fields

I will discuss some new results concerning extreme and large values of the 2D discrete Gaussian free field and branching Brownian motion as examples of logarithmically or genealogically correlated random fields. These include, time permitting, the fine structure of extreme level sets (confirming two conjectures by Brunet and Derrida), the structure of intermediate level sets and the asymptotic growth of the infinite volume 2D pinned DGFF. Joint work with M. Biskup, A. Cortines and L. Hartung.

Analysis

17:00 Ram Band (Technion)

Neumann Domains

A Laplacian eigenfunction on a two-dimensional manifold dictates some natural partitions of the manifold; the most apparent one being the well studied nodal domain partition. We present an alternative partition, which is based on the gradient field of the eigenfunction. This is called the Neumann domain partition. We point out the similarities and differences between nodal domains and Neumann domains and in particular concentrate on the so called ground state property.

The talk is based on joint works with Sebastian Egger, David Fajman and Alexander Taylor.

17:45 Gilbert Weinstein (Ariel University)

Bi-axisymmetric stationary solutions to the vacuum Einstein equation

In the last 15 years, there has been much progress on higher dimensional solutions to the Einstein equation, much of it from the physics community. They are particularly interesting as, unlike 4 dimensional spacetimes, the horizon is no longer restricted to being diffeomorphic to the sphere, as demonstrated by the celebrated black ring solution of Emparan and Reall. Using the Weyl-Papapetrou coordinates and harmonic map, we show the existence of stationary solutions to the 5 dimensional vacuum Einstein equation, which are bi-axisymmetric solutions with lens space horizons. This is a joint project with Marcus Khuri and Sumio Yamada.

18:30 Yosef Yomdin (Weizmann)

How Can Algebraic Geometry help in Reconstruction of Sparse Signals?

We provide an overview of some recent results on the “geometry of error amplification? in reconstructing of “sparse signals? from noisy Fourier or moments measurements. Main example is “spike-trains?, i.e. finite linear combinations of shifted delta-functions. This problem leads to a so-called “Prony system? of non-linear algebraic equations. In situations where the nodes near-collide, error amplification turns out to be governed by the “Prony foliations? S_q, whose leaves are “equi-moment surfaces? in the signal parameter space. We provide some results on the geometry of error amplification, as relates to the Prony leaves, as well as some results concerning explicit parametrization of the Prony leaves, and their behavior in singular and non-singular situations.

Applied

17:00 Amy Novick-Cohen (Technion)

Surface diffusion and related problems and flows

The concept of motion by surface diffusion was introduced by Mullins in 1957 to describe the evolution of the exterior bounding surface of solids; at sufficiently high temperatures the atoms within the first few atomic layers of the surface undergo diffusion, leading to parabolic smoothing of the exterior boundary of the domain, $\Gamma(t)$. This motion which may be prescribed $V_n = -B\Delta_s k$, where V_n denotes the normal velocity of $\Gamma(t)$, k denotes the mean curvature of $\Gamma(t)$, and Δ_s refers to the Laplace-Beltrami operator defined on $\Gamma(t)$). Motion by surface diffusion bears certain similarities to the extensively studied motion by mean curvature law, Vn = A, which was apparently also first formulated by Mullins, just a year earlier, in 1956.

Questions of interest in regard to surface diffusion include: maintenance and loss of convexity, existence, uniqueness and non-uniqueness (fatten- ing), and limiting motions. We give special emphasis to phenomena with physical implications; this includes certain self-similar solutions now in standard use in materials science measurements, and features such as void for- mation, which may accompany solid state wetting and dewetting.

Joint work with Vadim Derkach, Eugen Rabkin, Arcady Vilenkin.

17:30 Michal Pnueli (Weizmann)

Dynamics in an impact system

The field of Hamiltonian impact systems proves to be a rich and fascinating area of research. As the dynamics in impact systems are piecewise smooth by nature, many of the traditional tools used in the analysis of Hamiltonian systems cannot be applied to impact systems in a straightforward manner. In this talk, we consider the analysis of a simple 2 degrees-of-freedom impact system with a single wall and an underlying integrable, separable Hamiltonian. By investigating different projections of the conditions for impact into phase space, we develop tools for the initial classification and analysis of the different types of dynamics in the system. In particular, we extend the concept of an energy-momentum bifurcation diagram (EMBD) to impact systems, and show that one can analyze the different dynamics of the system by relying on the classification the EMBD provides, as well as locate various areas which are of interest dynamically. Results following this analysis will be shown, and generalizations to the methods presented will be proposed.

Joint work with Vered Rom-Kedar.

18:00 Valery Frumkin (Technion)

Elastic deformations driven by the thermocapillary effect

We investigate the localized deformations of a thin elastic sheet driven by thermocapillary flow in underlying thin liquid films. We distinguish between two cases, namely, a single fluidic layer model and two fluidic layers model. In the latter, the dynamics are governed by a Marangoni flow on the interface between the two liquids, while in the former the flow is possible only in the case of strong hydrophobic interaction between the membrane and the underlying liquid film. Using the long-wave approximation, we derive an evolution equation for the spatiotemporal nonlinear dynamics of the liquid-membrane interface, driven by thermocapillarity. We investigate numerically the dynamics of the elastic membrane and provide estimates for the onset of the long-wave Marangoni instability. Furthermore, we provide preliminary experimental results for both models, demonstrating the described phenomena.

Joint work with Moran Bercovici.

18:30 Gil Ariel (Bar Ilan University)

Effective temperature in a random network model of collective behavior

Ensembles of self-propelled units, from flocks of birds to active nematic particles, exhibit forms of collective behavior that still defy explanation. An analytical study of a simplified random network model, which has been proposed as a mean-field approximation for the collective motion of self-propelled particles, reveals a second-order phase-transition between an ordered and disordered phases. The critical behavior is controlled by a single parameter that determines the macroscopic phase of the system. A fluctuation-dissipation relation establishes that this parameter can be regarded as an effective temperature of collective behavior. The identification of an effective temperature of self-propelled particle systems is an important step towards explaining the order-disorder phase transition, developing consistent coarse-graining techniques and understanding the physics underlying the emergence of collective phenomena.

Friday 9:00-11:00

Math Education

⋆ **Sessions in this panel are in Hebrew**

9:00 Alon Pinto (Weizmann)

Lost in translation: what is research on mathematics education, and how can it help us?

9:30 Raz Kupferman (The Hebrew University)

Close encounters of the third kind: mathematicians meet elementary school teachers

10:00 Panel:
Uri Bader (Weizmann)
Jason Cooper (University of Haifa)
Boris Koichu (Weizmann Institute of Science)

Mathematics, mathematicians and mathematics education

10:30 *Open group discussion*

Analysis

9:00 Lev Buhovski (Tel-Aviv)

0.01% Improvement of the Liouville property for discrete harmonic functions on $\mathbb{Z}^2$

Let u be a harmonic function on the plane. The Liouville theorem claims that if $|u|$ is bounded on the whole plane, then u is identically constant. It appears that if u is a harmonic function on the lattice $\mathbb{Z}^2$,and $|u| < 1$ on $99,99\%$ of $\mathbb{Z}^2$, then u is a constant function. Based on a joint work (in progress) with A. Logunov, Eu. Malinnikovaand M. Sodin.

9:45 Sergey Bobkov (Minnesota)

An extended entropy power inequality

We will discuss extensions of the entropy power inequality (EPI) $N(X+Y) \geq N(X) + N(Y)$ to the more general Rényi entropies. However, the extension of the EPI cannot be of the sameform, sinceit turns out to be false in general (even when the random vector$X$ is normal and Y is nearly normal). Therefore, some modifications have to be done. As a natural variant, we consider proper powers of the Rényi entropy power.

Based on a joint work with Arnaud Marsligliettі.

10:30 Dan Mangoubi (The Hebrew University)

On harmonic functions sharing the same zeros

What can be said about the family of all harmonic functions sharing the same zero set inthe unit ball of $\mathbb{R}^n$? It turns out that an extension of the classical Harnack inequality gives the answer. This was recently stated and proved in two dimensions. Slightly later,A. Logunov and Eu. Malinnikova proved it in all dimensions. We describe these results and discuss the following problem: How can we construct interesting examples of such families in three dimensions? Do they really exist?

This is a report on a joint work with Adi Weller Weiser.

Discrete

9:00 Tali Kaufman (Bar Ilan University)

High dimensional expanders and PCPs

We define a new notion of high dimensional expansion called agreement expansion. This new notion is strongly related to the PCP agreement tests, which are an essential component in most PCP constructions. We show that there are bounded degree agreement expanders. This implies a linear de-randomization of the well-studied direct product tests. The main conceptual message of this talk is that high dimensional expanders are strongly related to PCPs. All notions will be explained in the talk. Based on joint work with Irit Dinur.

9:30 Vsevolod Lev (Haifa University)

Stability result for sets with $3A \neq Z_5^n$

As an easy corollary of Kneser's Theorem, if A is a subset of the elementary abelian group Z_5^n of density $5^{-n}|A| > 0.4$, then $3A = Z_5^n$ (the three-fold sumset of A is the whole group). I present the corresponding stability result: if $5^{-n}|A| > 0.3$ and $3A \neq Z_5^n$, then A is contained in a union of two cosets of an index-5 subgroup. Here the density bounds 0.4 and 0.3 are sharp. The argument combines combinatorial reasoning with a somewhat non-standard application of the character sum technique.

10:05 Ori Parzanchevski (The Hebrew University)

Ramanujan digraphs

Ramanujan graphs are finite graphs which behave spectrally like the inifinite tree, and they have been extensively studied in the last three decades. I will describe a directed analogue, namely, finite digraphs which behave like an infinite directed tree.

Based on joint works with Eyal Lubetzky, Alex Lubotzky, Doron Puder and Peter Sarnak.

10:35 Ron Aharoni (Technion)

Rainbow matchings and rainbow sets

I will discuss the following conjecture and its relatives: 2n matchings of size n in any graph have a rainbow matching of size n. (A "rainbow matching" is a matching obtained by choosing edges from distinct sets.)

Based in part on work with Berger, Chudnovsky, Howard and Seymour.

Friday 11:30-12:15

Erdös Prize Talk: Nir Lev (Bar Ilan University)

Fuglede's tiling-spectrality conjecture

We know by classical Fourier analysis that the unit cube in $\mathbb{R}^d$ has an orthogonal basis consisting of exponential functions. Which other domains admit such a basis? Fuglede conjectured (1974) that these so-called "spectral domains" could be characterized geometrically by their possibility to tile the space by translations. I will survey the subject and then discuss some recent results, joint with Rachel Greenfeld, where we focus on the conjecture for convex polytopes.

Friday 12:20-12:50

Levitzki Prize Talk: Chen Meiri (Technion)

First order rigidity of boundedly generated arithmetic groups

Two groups are said to be elementary equivalent if they satisfy the same first order theory. Zlil Sela's remarkable work implies that free groups, surface groups and hyperbolic groups have many finitely generated non-isomorphic groups which are elementary equivalent to them. In contrast, we will show that boundedly generated arithmetic groups are first order rigid. This means that if a finitely generated group G has the same first order theory as a boundedly generated arithmetic group H then G is isomorphic to H. In particular, every group which is commensurable to SL(n,Z) for n¿2 is first order rigid. This is joint work with Nir Avni and Alex Lubotzky.

Friday 14:00-14:45

Plenary Talk: Edriss S. Titi (Weizmann Institute and Texas A&M)

The Navier-Stokes, Euler and other related equations

In this talk I will present the most recent advances concerning the questions of global regularity of solutions to the three-dimensional Navier–Stokes and Euler equations of incompressible fluids. Furthermore, I will also present recent global regularity (and finite time blow-up) results concerning certain three-dimensional geophysical flows, including the three-dimensional viscous (non-viscous) "primitive equations" of oceanic and atmospheric dynamics.

Friday 15:00-17:00

Erogodic

15:00 Adrien Boyer (Weizmann Institute)

A new proof of property RD for hyperbolic groups via the boundary

I will give a new proof Property RD satisfied by hyperbolic groups. This result goes back to Jolissaint and de la Harpe.

The proof that I will discuss uses boundary representations. The main point of these new techniques, based on ergodic geometry, is to give a possible new approach to Valettes conjecture asserting that compact lattices in higher rank should satisfy property RD.

16:00 Arielle Leitner (Technion)

Affine buildings, group actions, and compactifications

Algebra

15:00 Lior Bary-Soroker (Tel Aviv University)

Arithmetic of polynomials

16:00 Ary Shaviv (Weizmann)

Schwartz functions on (possibly singular) real algebraic varieties

Schwartz functions are classically defined as smooth functions such that they, and all their (partial) derivatives, decay at infinity faster than the inverse of any polynomial. This was formulated on $\mathbb{R}^n$ by Laurent Schwartz, and later on Nash manifolds (smooth semi-algebraic varieties) by Fokko du Cloux and by Rami Aizenbud and Dima Gourevitch. In this talk I will define Schwartz spaces of (possibly singular) real algebraic varieties and discuss their properties. In particular I will present a very useful characterization of Schwartz functions on open subsets, in terms of Schwartz functions on the embedding space. This Theorem suggests the characterization of Schwartz functions by local means only, where the global conditions of ”rapid decaying at infinity” are translated to local conditions of ”flatness at all points added in infinity” in some compactification process. I will explain this point of view and make it precise. Joint work with Boaz Elazar.

16:30 Joachim Koenig and Francois Legrand (Technion)

Groups without finite parametric sets over $\mathbb{Q}$

Given a finite group G, we consider in this talk “parametric sets” (over $\mathbb{Q}$), i.e., sets S of (regular) Galois extensions of $\mathbb{Q}(T)$ with Galois group G whose specializations provide all the Galois extensions of $\mathbb{Q}$ with Galois group G. This relates to the Beckmann-Black Problem (which asks whether the strategy by specialization to solve the Inverse Galois Problem is optimal) which can be formulated as follows: does a given finite group G have a parametric set over $\mathbb{Q}$? We use two essentially different approaches (a “global” one and a “local” one) to show that many finite groups G have no finite parametric set over $\mathbb{Q}$.

Zeev@80

15:00 Zeev Schuss

The road to applied mathematics

The road to applied mathematics Abstract: I will describe my transition from analysis of partial differential equations by functional analysis and operator theory to problems that originate in science and technology. These include stochastic differential equations of statistical physics and chemical kinetics, filtering signals from noisy measurements, and new problems and solutions of problems in molecular and cellular biology.

15:30 Philip Rosenau

The Tale of two Tails

We discuss formation of patterns due to Fisher-KPP reaction with fast and slow diffusions ut=[D(u)ux]x+u(1-u) where D(u)=u, slow diffusion 1, Standard Fisher-KPP 1/u, fast (logarithmic)

In the logarithmic case the problem of travelling waves, TW, is mapped into a linear problem with propagation speed being selected by a boundary condition, b.c., imposed at the far away upstream. Thus Dirichlet b.c. relax the process into a steady state, whereas convective b.c.; $ux + hu = 0$ lead the system into a heating (cooling) TW for $h < 1$ ($1 < h$) and into an equilibrium if $h = 1$. We also present explicit solutions of both expanding lump formation and imploding formations which quench within a finite time. Both the need to append the problem with additional boundary condition and a possible collapse of the process are unique features of fast diffusion. In the Slow Diffusion case wherein $D(u) = u$ we map the problem into a purely diffusive process and thus demonstrate that the semi-compact Travelling Kinks and expanding formations are attractors of the respective initial excitations.

Rosenau(2002), Kamin and Rosenau (2003, 2004).

16:00 David Holcman

Reconstruction of molecular dynamics and cell organization from large ensembles of stochastic particle trajectories

Single particle trajectories acquired at the super-resolution limit reveal cellular organization below the diffraction limit. However, much more information can be obtained about membrane organization and dynamics of molecules in vivo from the large number and the redundancy of these trajectories. In this talk, I will summarize recent approaches and results based on the Langevin's equation as a model, perturbed by a measurement noise. It is possible to recover the drift, diffusion tensors, neuronal surface, but also new features such as long-range potential wells organized in rings. New statistics such as passage time distribution in microdomains can be generated from stochastic simulations performed on the acquired images and based on the reconstructed process. To conclude, the present stochastic reconstruction allows recovering fluxes of particles (receptors) and transport properties inside biological cells at a molecular level.

16:40 Amit Singer

Principal component analysis for high dimensional, non-Gaussian, and incomplete data

Despite enormous progress in recent years on PCA in high dimensions, current methods for PCA are either statistically suboptimal or are not computationally scalable for data that is corrupted by non-additive, non-Gaussian random effects, as is routinely encountered in problems involving missing data, image deconvolution, and Poissonian noise. These challenges arise in single-particle cryo-electron microscopy and X-ray free electron lasers, two emerging techniques in structural biology that require analyzing hundreds of thousands of extremely noisy images produced in each experiment. We will discuss computationally scalable and statistically sound methodology to address these problems.

17:10 Boaz Nadler

Unsupervised Ensemble Regression: Making accurate predictions while knowing (almost) nothing

Consider a regression problem where there is no labeled data and the only observations are the predictions $f_i(x_j)$ of m experts f_i over many samples x_j. With no knowledge on the accuracy of the experts, is it still possible to accurately estimate the unknown responses y_j? Can one still detect the least or most accurate experts? In this work we propose a framework to study these questions, based on the assumption that the m experts have uncorrelated deviations from the optimal predictor. Assuming the first two moments of the response are known, we develop methods to detect the best and worst regressors, and derive U-PCR, a novel principal components approach for unsupervised ensemble regression. We provide theoretical support for U-PCR and illustrate its improved accuracy over the ensemble mean and median on a variety of regression problems.

17:40 Gilad Lerman

A Well-Tempered Landscape for Non-convex Robust Subspace Recovery

We present a mathematical analysis of a gradient descent method for Robust Subspace Recovery. The optimization is cast as a minimization over the Grassmannian manifold, and gradient steps are taken along geodesics. We show that under a generic condition, the energy landscape is nice enough for the non-convex gradient method to exactly recover an underlying subspace. The condition is shown to hold with high probability for a certain model of data. This work is joint with Tyler Maunu and Teng Zhang.

Saturday free time for discussions

Sunday 9:00-11:00

Non-Linear Analysis and Optimization

9:00 Aviv Gibali (Ort Braude)

The Implicit Convex Feasibility Problem and Its Applications

In this talk we present the implicit convex feasibility problem which consists of finding a point in the intersection of a finite family of convex sets, some of which are not explicitly determined but may vary. We present both simultaneous and sequential projection methods for solving the problem and and demonstrate their applicability to Cooperative Wireless Sensor Network Positioning and Adaptive Image Denoising.

9:30 Yair Censor (Haifa University)

Sparsity constrained split feasibility for dose-volume constraints in inverse planning of intensity-modulated photon or proton therapy

A split feasibility formulation for the inverse problem of intensity-modulated radiation therapy (IMRT) treatment planning with dose-volume constraints included in the planning algorithm is presented. It involves a new type of sparsity constraint that enables the inclusion of a percentage-violation constraint in the model problem and its handling by continuous (as opposed to integer) methods. We propose an iterative algorithmic framework for solving such a problem by applying the feasibility-seeking CQ-algorithm of Byrne combined with the automatic relaxation method (ARM) that uses cyclic projections. Functionality of the algorithm was demonstrated.

This is joint work with Scott Penfold, Rafal Zalas, Margherita Casiraghi, Mark Brooke and Reinhard Schulte.

10:00 Yirmeyahu Kaminski (Holon Institute of Technology)

Equilibrium locus of the flow on circular networks of cells

We perform a geometric study of the equilibrium locus of the flow that models the diffusion process over a circular network of cells. We prove that when considering the set of all possible values of the parameters, the equilibrium locus is a smooth manifold with corners, while for a given value of the parameters, it is an embedded smooth and connected curve. For different values of the parameters, the curves are all isomorphic. Moreover, we show how to build a homotopy between different curves ob- tained for different values of the parameter set. This procedure allows the efficient computation of the equilibrium point for each value of some first in- tegral of the system. This point would have been otherwise difficult to be computed for higher dimensions. We illustrate this construction by some nu- merical experiments. Eventually, we show that when considering the parameters as inputs, one can easily bring the system asymptotically to any equilibrium point in the reachable set, which we also easily characterize.

10:30 Edriss S. Titi (Weizmann and Texas A&M)

Global regularity for the two-dimensional Boussinesq equations with anisotropic viscosity and without diffusion

In this talk I will present some recent results concerning the global regularity of the two-dimensional Boussinesq equations (Rayleigh-Benard problem) of incompressible flows with only anisotropic horizontal viscosity in the momentum equations and without any diffusion in the temperature transport equation. Notably, the two-dimensional Boussinesq equations, without any dissipation, is considered to be major open problem in applied analysis due to its close relation to the question of global regularity of the three-dimensional axi-symmetric Euler equations with swirl.

Topology

9:00 Tahl Nowik

Random knots

We introduce a new model for random knots and links, based on the petal projection developed by C. Adams et al. We study the distribution of various invariants of knots and links in this model, and ask about their limiting distribution as the number of petals goes to infinity. Joint work with Chaim Even-Zohar, Joel Hass, and Nati Linial.

9:30 Emily Stark

3-manifold structures on surface amalgams

I will describe a class of surface amalgams which in many ways resemble fundamental groups of 3-manifolds. We classify which of these amalgams is the fundamental group of a 3-manifold. I will explain the geometry of the resulting 3-manifold when such a structure exists. This is joint work with Chris Hruska and Hung Cong Tran.

10:00 Lior Yanovski

The l-adic analyticity of Morava-Euler Characteristics and (generalized) homotopy cardinality

Under suitable assumptions, the sequence of Euler characteristics of a pi-finite space with respect to the Morava K-theories of all heights is locally analytic as a function from the natural numbers to l-adic numbers. Moreover, analytic continuation of this function to n=-1 recovers the homotopy cardinality of the space. This transchromatic phenomena which is of interest by itself, can be used to define a numerical invariant which simultaneously generalizes both the Euler characteristic and the homotopy chardinality of a space and posses some of the additivity properties of the former and the multiplicativity of the later.

10:30 Tali Pinsky

The Berge conjecture for tunnel number one knots

I will discuss a new approach to identify tunnel number one knots that have lens space surgeries. This is an important step towards the resolution of the Berge conjecture, classifying all knots with lens space surgeries. The conjecture has been open since the nineties.

Erogodic

9:00 Oliver Sargent (Technion)

Random walks on homogeneous spaces of non-lattice type

This is joint work with Uri Shapira. We attempt to generalise the spectacular results of Y. Benoist and J.F. Quint to the homogeneous space consisting of unimodular rank-2 discrete subgroups of $\mathbb{R}^3$. I will discuss the problem of classifying stationary measures on this space. Under certain conditions on the acting group we can show that there is a unique stationary probability measure. We also have examples where (surprisingly) there is more than one stationary probability measure. I will explain our results in both of these situations.

10:00 Siegfried Beckus (Technion)

The topological space of dynamical systems

Recent developments show that the space of dynamical systems equipped with the Chabauty-Fell topology plays an important role in the spectral theory of Schrdinger operators. Specifically, we proved that the spectra of these operators behave continuous in the Hausdorff metric if and only if the underlying dynamical systems vary continuously in the Chabauty-Fell topology. This raises further questions concerning topological properties of the space of dynamical systems. In particular, can a specific dynamical system be approximated by dynamical systems where the corresponding Schrdinger operator can be analyzed explicitly. Additionally, it turns out that also further properties of the operator and other quantities of the system are preserved in this topology. The main advantage is that dynamical properties are encoded in the topology. This also leads to questions which dynamical properties are closed in the Chabauty-Fell topology. Throughout the talk we will discuss this questions and show their connection to the operators.

Probability

9:00 Eviatar Procaccia (Texas A&M)

Opting Into Optimal Matchings

We revisit the problem of designing optimal, individually rational matching mechanisms (in a general sense, allowing for cycles in directed graphs), where each player who is associated with a subset of vertices matches as many of his own vertices when he opts into the matching mechanism as when he opts out. We offer a new perspective on this problem by considering an arbitrary graph, but assuming that vertices are associated with players at random. Our main result asserts that, under certain conditions, any fixed optimal matching is likely to be individually rational up to lower-order terms. We will discuss the implications of our results for kidney exchange projects.

9:40 Yohai Maayan (Technion)

The Onsager-Machlup functional associated with a fractional Brownian motion

The Onsager-Machlup functional of a random process was introduced in physics as a means to characterize the most probable path of the process. It has since gone through a mathematical history: it was given a precise interpretation related to the probability of small balls (or "tubes"); and computations were done in the case that the process solves a stochastic differential equation driven by a Brownian motion. In this talk, we will assume that the underlying process is a fractional Brownian motion and discuss the resulting functional. This talk is based on the speaker's PhD thesis, done under the supervision of Eddy Mayer-Wolf.

10:20 Jonathan Hermon (Berkeley and Weizmann)

Cutoff for Ramanujan graphs via degree inflation

Recently Lubetzky and Peres showed that simple random walks on a sequence of d-regular Ramanujan graphs of increasing sizes exhibit cutoff in total variation. In this talk, an extremely simple alternative argument will be presented, under the assumption that for some r(n)1 the maximal number of simple cycles in a ball of radius r(n) in bounded.

Sunday 11:15-13:15

Non-Linear Analysis and Optimization

11:15 Arkady Poliakovsky (Ben Gurion)

On spaces of bounded q-variation in dimension N

About 15 years ago, Bourgain, Brezis and Mironescu proposed a new characterization of BV and $W^{(1,q)}$ spaces (for $q > 1$) using a certain double integral involving radial mollifiers.

We study what happens when one changes the power of $|x - y|$ in the denominator of the integrand from q to 1. It turns out that the resulting expression gives rise to a new space that we call "Space of q-bounded variation". Among other things, we show that this space contains the space of bounded BV-functions. We also present applications of this space to the study of singular perturbation problems of Aviles-Giga type.

11:45 Roman Polyak (Technion)

Complexity of the regularized newton method

Newton's method for finding unconstrained minimizer of a strictly convex functions, generally speaking, does not converge from any starting point. We introduce and study the damped regularized Newton method (DRNM). It converges globally for any strictly convex function, which has a minimizer. Locally DRNM converges with quadratic rate. We characterize the neighborhood of the minimizer, where the quadratic rate occurs. Based on it we estimate the number of DRNM's steps required for finding an ϵ-approximation for the minimizer.

12:15 Daniel Reem (Technion)

Solutions to inexact resolvent inclusion problems with applications to nonlinear analysis and optimization

Many problems in nonlinear analysis and optimization, among them variational inequalities and minimization of convex functions, can be reduced to finding zeros (namely, roots) of (usually nonlinear) operators. Hence numerous algorithms have been devised in order to achieve this task. A lot of these algorithms are inexact in the sense that they allow perturbations to appear during the iterative process, and hence they enable one to better deal with noise and computational errors, as well as superiorization. For many years a certain fundamental question has remained open regarding many of these known inexact algorithmic schemes in various finite and infinite dimensional settings, namely whether there exist sequences satisfying these inexact schemes when errors appear. We provide a positive answer to this question. Our results also show that various theorems discussing the convergence of these inexact schemes have a genuine merit beyond the exact case. As a byproduct we solve the standard and the strongly implicit inexact resolvent inclusion problems, introduce a promising class of functions (fully Legendre functions), establish continuous dependence (stability) properties of the solution of the inexact resolvent inclusion problem and continuity properties of the protoresolvent, and generalize the notion of strong monotonicity.

This is a joint work with Simeon Reich.

12:45 Rafal Zalas (Technion)

Convergence properties of fixed point algorithms in the presence of perturbations

Assuming that the absence of perturbations guarantees weak or strong convergence to a common fixed point, we study the behavior of perturbed products of an infinite family of nonexpansive operators. Our main result indicates that the convergence rate of unperturbed products is essentially preserved in the presence of perturbations. This, in particular, applies to the linear convergence rate of many projection methods. This is joint work with Christian Bargetz and Simeon Reich.

Discrete

11:15 Noam Lifshitz (Bar Ilan University)

The Junta method for hypergraphs and Chvatal's conjecture

Numerous problems in extremal hypergraph theory ask to determine the maximal size of a k-uniform hypergraph on n vertices that does not contain an "enlarged" copy H^+ of a fixed hypergraph H, obtained from H by enlarging each of its edges by distinct new vertices. We present a general approach to such problems, using a "junta approximation method" that originates in the analysis of Boolean functions. We show that any H^+-free hypergraph is essentially contained in a "junta" - a hypergraph determined by a small number of vertices - that is also H^+-free, which effectively reduces the extremal problem to an easier problem on juntas. Using this approach we obtain (for all $C < k < n/C$) a characterization of all hypergraphs H for which the maximal size of an H^+-free family is $\binom{n-t}{k-t}$, in terms of intrinsic properties of H.

We apply our method to the Chvatal's conjecture (1974), which asserts that for any $d < k < ((d-1)/d)n$, the maximal size of a k-uniform family that does not contain a d-simplex (i.e., $d+1$ sets with empty intersection such that any d of them intersect) is $\binom{n-d-1}{k-d-1}$. We prove the conjecture for all d and k, provided that $n > n_0(d)$.

Joint work with Nathan Keller.

11:45 Zilin Jiang (Technion)

On spherical Tarski's plank problems

A plank of width w is a part of the d-dimensional space $\mathbb{R}^d$ that lies between two parallel hyperplanes at distance w from each other. Given a convex body C, its width is the smallest w such that a slab of width w covers C. In 1932, Tarski posed the following attractive conjecture: If a convex body of width w is covered by a collection of planks in $\mathbb{R}^d$, then the total width of the planks is at least w. It took almost twenty years before Bang proved

Tarski's conjecture. Generalizations and variants of Tarski's plank problem were considered in various directions.

A zone of width ω on the unit sphere is defined as the set of points within spherical distance $\omega/2$ of a given great circle. Zones can be thought as the spherical analogue of planks. In this talk, we show that the total width of any (finite) collection of zones covering the unit sphere is at least π, answering a question of Fejes Tóth from 1973.

This is a joint work with Alexandr Polyanskii.

12:20 Noga Ron-Zewi (Ben Gurion)

Graph-based constructions of locally testable and locally decodable codes

Locally testable and locally decodable codes are special families of error-correcting codes that admit highly efficient algorithms that detect and correct errors in transmission in sublinear time, probing only a small number of entries of the corrupted codeword.

In recent years, there have been new developments on the construction of locally testable and locally decodable codes using graph-based/combinatorial constructions that exploit the power of expander graphs. These eventually led to the construction of asymptotically good locally testable and locally decodable codes with small (sub-polynomial) query complexity, and with near-optimal error-correction capabilities (approaching the Singleton and Gilbert-Varshamov bounds). In this talk I will survey some of these constructions and highlight the role of expander graphs in their development.

Based on joint works with Sivakanth Gopi, Swastik Kopparty, Or Meir, Rafael Oliveira and Shubhangi Saraf.

12:50 Yuval Filmus (Technion)

Twenty (simple) questions

Huffman coding has a search-theoretic interpretation as the optimal strategy for the twenty questions game.

In this game, Alice chooses $x \in \{1, ..., n\}$ according to a distribution μ, and Bob identifies x using yes/no questions. Bob's goal is to use the minimum number of questions in expectation. A strategy for Bob corresponds to a prefix code for $\{1, ..., n\}$, and this shows that Bob's optimal strategy uses a Huffman code for μ. However, this strategy could use arbitrary yes/no questions. What happens when we restrict the set of yes/no questions that Bob is allowed to use?

Joint work with Yuval Dagan, Ariel Gabizon, and Shay Moran.

Analysis

11:15 Vladimir Gol'dshtein (Ben Gurion)

Genenralized Quasiconformal Estimates of Neumann eigenvalues

In this talk will be explained how the geometric theory of composition operators for Sobolev spaces can be applied to lower estimates of the first non trivial Neumann eigenvalues of Laplace and p-Laplace operators in a large class of non-convex domains. This class of domainsincludes domains with Hölder singularities and planar domains with fractal boundaries (which Hausdorff dimension can be any number into the half-interval $[1, 2)$. Our estimates are better than classical ones even for ellipsoids. The composition operators are induced by conformal and generalized quasiconformal homeomorphisms.

Joint with A.Ukhlov.

12:00 Alex Samorodnitsky (The Hebrew University)

On the entropy of a noisy function

Let X be a uniformly distributed binary sequence of length n. Let Y be a noisy version of X, obtained by flipping each coordinate of X independently with probability ϵ. We want to come up with a one-bit function of Y which provides as much information as possible about X. Courtade and Kumar conjectured that the best one can do is to choose a coordinate function $f(Y) = Y_i$, for some i between 1 and n. We prove the conjecture for large values of ϵ ($\epsilon > 1/2 - \delta$, for some absolute constant $\delta > 0$).

The main new technical ingredient in the proof is the claim that if F is a real-valued function on the boolean cube, and G is a noisy version of F, then the entropy $\mathrm{Ent}(G)$ is upper-bounded by the expected entropy of a projection of F on a random coordinate subset of a certain size.

12:45 Michail Sodin (Tel Aviv University)

Spectra of stationary processes on $\mathbb{Z}$

The talk will be based on a joint work with Alexander Borichev and Benjamin Weiss, recently posted in the arXiv. In the talk, we will discuss a somewhat striking spectral property of finitely valued stationary processes on $\mathbb{Z}$ that says that if the spectral measure of the process has a gap then the process is periodic. We will give some extensions of this result and raise several related questions.

Applied

11:15 Yair Mau (The Hebrew University)

Stochastic dynamics of soil nutrients

The dynamics of soil nitrogen is driven by physical and biogeochemical mechanisms that depend on the soil hydrology. The interaction of slow processes, such as decomposition, mineralization, plant uptake and aerial deposition, with fast and random rainfall pulses determines the long-term statistical behavior of soil nitrogen cycling. Accurately predicting nitrogen leaching from the root zone to the groundwater is of particular interest for fertilizer use efficiency management in agro-ecosystems, and to the understanding of ecosystem function and its sensitivity to climate.

We model soil water and nitrogen dynamics as a system of differential equations forced by a marked Poisson process, representing rainfall. Under simplifying conditions regarding the hydrology, we derive the steady-state probability density function (pdf) of the soil nitrogen mass, mean first passage times of critical thresholds, and the dynamics of its moments (mean, standard deviation, etc). For the full model, we discuss the challenges of deriving analytically a joint water-nitrogen pdf, and we examine the role of noise propagation through the system (covariance between stochastic rainfall and state variables and their fluxes) on steady-state averages. Finally, we discuss the advantages and limitations of this approach to environmental modeling.

11:45 Chen Dubi (NCRN)

Modeling neutron fluctuation in a reactor core using stochastic differential equation

The dynamics of the neutron population in a nuclear reactor is typically studied in two scales: The mean field scale, describing the dynamic of the average population size when subjected to an external perturbations, and the "reactor noise" scale, describing the fluctuations of the neutron population around the mean field once the system has arrived at a steady state.

The two different scales are studied using two different mathematical settings: the first is typically studied via a set of ordinary differential equations, and the second is often described through a partial differential equation in terms of the probability generating function of the population size. In a trivial manner, the first can be obtained by implementing the Functional Law of Large Number (FLLN) on the second. From a practical point of view, the complexity of solving a PDE (Vs that of an ODE) restrict reactor noise analysis to very basic settings. In particular, the very basic problem of understanding the Input/Output response of a reactor core to a random (even Gaussian) fluctuation in the system is not understood in a complete fashion. This is true even when the system is linearized- let alone when nonlinear feedbacks are accounted for. In a recent ongoing study (with Prof. Rami Atar of the EE faculty at the Technion), a new modeling scheme for reactor noise was introduced. The new schemes studies an intermediate regime between the mean field and the full stochastic equation, obtained by implementation of the Functional Central Limit Theorem (FCLT) rather than the FLLN. Implementation of the FCLT on the stochastic model results in an approximated description of the neutron population in terms of a Stochastic Differential Equation (SDE).

In the talk, the basic SDE model for the neutron population (and the coupling with the detection process) will be described, and some basic analytical results will be discussed. In particular, we will first prove that the first two moments of the neutron count distribution is fully preserved by the FCLT approximation, and that higher moments can be easily approximated up to very high accuracy using the law of total cumulance. If time permits, more elaborated issues will be discussed. In particular, we will explain why the new formalism is very promising in terms of analyzing non-linear effects that were so far not treated.

12:15 Yuval Edri (Swiss Institute for Dryland Environmental and Energy Research & Ben Gurion)

Local and spatially extended frequency locking: distinguishing between additive and parametric forcing

The auditory system displays remarkable sensitivity and frequency discrimination, attributes shown to rely on an amplification process that involves a mechanical as well as a biochemical response. Models that display proximity to an oscillatory onset (a.k.a. Hopf bifurcation) exhibit a resonant response to distinct frequencies of incoming sound, and can explain many features of the amplification phenomenology. To understand the dynamics of this resonance, frequency locking is examined in a system near the Hopf bifurcation and subject to two types of driving forces: additive and parametric. Derivation of a universal amplitude equation that contains both forcing terms enables a study of their relative impact on the hair cell response. In the parametric case, although the resonant solutions are 1:1 frequency locked, they show the coexistence of solutions obeying a phase shift of , a feature typical of the 2:1 resonance. Different characteristics are predicted for the transition from unlocked to locked solutions, leading to smooth or abrupt dynamics in response to different types of forcing. The theoretical framework provides a more realistic model of the auditory system, which incorporates a direct modulation of the internal control parameter by an applied drive. The above seems to have fundamental implications to spatially localized resonances that known to arise in the cochlea.

12:45 Eli Minkov (Raphael)

Color vs. b/w image - what is better?

The performance of an optical system is defined as some function of resolution and signal to noise ratio. The resolution is usually defined by means of Point Spread Function (PSF) or Modulation Transfer Function (MTF). The extension of the PSF and MTF definition to digital camera is obvious in the engineering community, but its mathematical sense is not trivial. One of the confusing results in the electro-optical performance computation is the superiority of B/W sensors over color sensors with the same optics and same electronic parameters. We will describe briefly the current engineering practice in the electro-optical performance computation and discuss other ways to define resolution for B/W and color sensors that will hopefully lead to more intuitive results.