Second Congress of Greek Mathematicians
Athens, July 4-8, 2022

Plenary Talks

	Monday	Tuesday	Wednesday	Thursday	Friday
11:30-12:30		D.Koukoulopoulos	G.Akrivis	M.Chlouveraki	Sp.Alexakis
12:30-13:30	C.Dafermos	E.Kalfagianni	D.Bertsimas	N.Frantzikinakis	P.Souganidis
15:00-16:00		I.Emiris	P.Sousi	I.Kontoyiannis	

Monday, July 4

11:30-12:30 C. Dafermos, Brown University
Title: Progress in Hyperbolic Conservation Laws
Abstract: The lecture will survey the state of the art in the theory of hyperbolic systems of conservation laws, emphasizing recent achievements and future challenges. The Euler equations of fluid dynamics will serve as prototypical example.

Tuesday, July 5

11:30-12:30 D. Koukoulopoulos, University of Montreal
Title: Random walks in number theory
Abstract: In this talk, we will stroll through various results in number theory that bear connections with the theory of random walks. There is a surprising number of such links, beginning with Billingsley's classical result that the sequence of prime factors, appropriately normalized, converges to a Brownian motion. More recently, Ford used a "ballot theorem" to obtain sharp estimates on the distribution of integers with a divisor in a given interval. Ballot theorems also appear in the theory of Branching Random Walks and, more generally, of log-correlated fields. These probabilistic objects have been featured in recent striking work by various authors on the distribution of the maximum of the Riemann zeta function in a randomly selected interval. Finally, in ongoing joint work with Louis-Pierre Arguin and Paul Bourgade, we have discovered that log-correlated fields can also be used to study the distribution of the maximum of the multiplicative Fourier transform of a random integer.

12:30-13:30 E. Kalfagianni, Michigan State University
Title: Geometric structures of 3-manifolds and quantum invariants
Abstract: The generalization of the Jones polynomial led to constructions of link and 3-manifold invariants as well as of representations of surface mapping class groups. The question of how much of the Thurston geometric picture of 3-manifolds is reflected in these invariants and structures is open. After introducing some background, I will survey open conjectures and recent progress in this direction.

15:00-16:00 I. Emiris, National Kapodistrian University of Athens
Title: On the number of Euclidean embeddings of rigid graphs
Abstract: Rigidity theory studies the embeddings of rigid graphs in a Euclidean space or, more generally, a manifold. Rigid graphs are distance graphs with a finite number of embeddings, and they are useful in the context of structural bioinformatics, robotics, architecture as well as machine learning. This talk introduces the setting and presents some fundamental results characterizing rigidity such as Laman's theorem. It then focuses on the question of enumerating embeddings and, more specifically, on establishing upper bounds on the maximal number of embeddings for graphs with a given number of vertices. We combine various tools from algebraic geometry and from combinatorics leading to the first nontrivial upper bounds. The former approach allows us to employ root bounds on the corresponding well-constrained algebraic

systems, while the latter viewpoint leads to algorithms for counting a relevant class of graph orientations of undirected graphs.

Wednesday, July 6

11:30-12:30 G. Akrivis, University of Ioannina
Title: Analysis of numerical methods in the maximal parabolic regularity framework
Abstract: We consider the discretization in time of differential equations satisfying the maximal parabolic L^p-regularity property in UMD Banach spaces by Radau IIA as well as by discontinuous Galerkin (dG) methods. The maximal L^p-regularity property of Radau IIA methods was established in 2016 by B. Kovács, B. Li and C. Lubich. We transferred this result to discontinuous Galerkin methods via a suitable interpretation of dG methods as modified Radau IIA methods; D. Leykekhman and B. Vexler proved *quasi*-maximal L^p-regularity estimates in arbitrary Banach spaces, with a logarithmic factor, for dG methods in 2017. We also derived optimal order a posteriori error estimates for the Radau IIA methods as well as optimal order a priori and a posteriori error estimates for the dG methods in the maximal regularity framework.

12:30-13:30 D. Bertsimas, Massachusetts Institute of Technology
Title: Machine Learning under a Modern Optimization Lens
Abstract: We use modern optimization methods to address a variety of Machine Learning problems:

1) We formulate sparse regression problems into convex mixed-integer optimization (MIO) problems, which we solve via cutting planes efficiently for problems with a number of points and factors in the 100,000s.
2) We propose Optimal Classification and Regression Trees (OCT, ORT) that use MIO to solve classification and regression problems generalizing and improving CART, proposed by Breiman in 1984.
3) We propose a robust optimization framework for optimally selecting training and validation sets for regression problems and show that it leads to lower prediction error and lower standard deviation for both the prediction and the coefficients compared to the usual randomization approach.

15:00-16:00 P. Sousi, University of Cambridge
Title: Picking a spanning tree at random
Abstract: Spanning trees in a connected graph are basic objects of great interest to mathematicians and computer scientists. What does a typical spanning tree look like? How can we pick one uniformly, as usually they are too numerous to list? A connection of spanning trees to electrical networks was found by Kirchhoff in 1847, and elegant sampling algorithms using random walks were found in the 1990's by Aldous, Broder and Wilson. These connections have yielded many insights on the geometry of uniform spanning trees. In my talk I will present some recent work with Tom Hutchcroft on the geometry of the uniform spanning tree in $\mathbf{Z}^4$, which can be thought of as the "uniform measure" on trees of $\mathbf{Z}^4$.

Thursday, July 7

11:30-12:30 M. Chlouveraki, University of Versailles-St Quentin
Title: The symmetric group: mysteries and miracles
Abstract: This talk will be about the representation theory of finite groups. Having the symmetric group as our starting point, we will move to discussing certain families of finite groups, such as Weyl groups, reflection groups and finite groups of Lie type. A wrong conjecture and the island of Spetses may come up during this discussion, as well as finite Hecke algebras and their applications to other mathematical theories.

12:30-13:30 N. Frantzikinakis, University of Crete
Title: Randomness properties of bounded sequences: An ergodic point of view

Abstract: How can we measure and utilize randomness properties of a bounded sequence? A construction due to Furstenberg from the 70's allows us to encode statistical properties of bounded sequences in a dynamical fashion using the language of ergodic theory. This offers a different point of view that has important advantages and has led to multiple breakthroughs in ergodic theory, combinatorics, and more recently in number theory. I will survey some of these advances with an emphasis on more recent developments.

15:00-16:00 I. Kontoyiannis, University of Cambridge
Title: Entropy in probability and additive combinatorics
Abstract: Information-theoretic ideas, tools and techniques have been influential in probability theory since at least the 1960s, and in the past 10-20 years Imre Rusza, Terry Tao and others have also developed deep connections between information-theoretic results and additive combinatorics. We will outline some of the milestones of this historical development and describe some of our recent results on the interface between information theory, probability, additive combinatorics, and high-dimensional convex geometry.

Friday, July 8

11:30-12:30 Sp. Alexakis, University of Toronto
Title: Reconstructing a Riemannian metric form geodesic data: The problem of lens rigidity
Abstract: We consider the problem of lens rigidity in two dimensions: Consider a Riemannian 2-manifold with boundary, (M, g). Assume the metric g in the interior is unknown, and we seek to reconstruct it from knowledge of geodesic data. We have access to the lens data of the metric g: Consider any point P in the boundary of M and any vector n at P pointing into M; consider the corresponding unit-speed geodesic γ_n and see where it exits the manifold, and the time it took. We ask whether one can uniquely identify the metric g from this information. We will also discuss local variants of this problem, as well as the question of reconstruction of the metric g. The relevance of this question to real-world applications (such as sound speed tomography) will be briefly presented and celebrated earlier analytic results will be reviewed. But the main emphasis will be a on a new, geometric approach to this question. Joint work with Matti Lassas.

12:30-13:30 P. Souganidis, University of Chicago
Title: Deterministic surface growth models
Abstract: This talk is about the asymptotic behaviour of large classes of (hyperbolically and parabolically) scaled deterministic surface growth models that are monotone and equivariant under translations by constants. The limits are solutions of degenerate elliptic partial differential equations which typically are discontinuous in some gradient directions consistent with Finsler metrics, such as the crystalline infinity Laplacian.