2ο ΣΥΝΕΔΡΙΟ ΕΛΛΗΝΙΔΩΝ ΣΤΑ ΜΑΘΗΜΑΤΙΚΑ

4 – 5 Ιουλίου 2024

Πρόγραμμα

Το συνέδριο θα πραγματοποιηθεί στο Αμφιθέατρο Καραθεοδωρή του Τμήματος Μαθηματικών του ΕΚΠΑ.

Πέμπτη 4 Ιουλίου

09:00 – 09:30 Προσέλευση συνέδρων
09:30 – 09:50 Καλωσόρισμα/Χαιρετισμοί
09:50 – 10:10 **Souzanna Papadopoulou (University of Crete):** *Κάποιες σκέψεις για την παρουσία των Ελληνίδων στα Μαθηματικά*

10:10 – 10:40 **Christina P. Filli (NKUA):** *Η Maria Gaetana Agnesi και η τιμητική της διάκριση ως «καθηγήτρια» της Ανάλυσης στο Πανεπιστήμιο της Bologna*

10:50 – 11:20 **Myrto Manolaki (UCD):** *Boundary behaviour of holomorphic functions*

11:20 – 11:50 *Coffee break*

11:50 – 12:20 **Sara Azzali (University of Bari):** *Index theory and the Novikov conjecture*

12:30 – 13:00 **Eleni Tzanaki (University of Crete):** *Real rootedness in algebraic and geometric combinatorics*

13:00 – 14:30 *Group photo & Lunch break*

14:30 – 15:00 **Eleni Agathokleous (Max Planck Institute, Bonn):** *The theory of Complex Multiplication and the Class group action in Cryptography*

15:10 – 16:35 **Short Talks** (V. Taroudaki, D. Chatzakos, D. Stergiopoulou, K. Psaromiligkos, A. Stavrianidi, R. Tsiavou)

16:35 – 17:00 **Coffee Break**

17:00 – 18:25 **Short Talks** (R. Tsiavou, M. Karakikes, K. Kalampogia-Evangelinou, P. Kostas, A. Bartatila, D. Noulas, V. Mavrogeorgou)

15:10 – 15:20 Victoria Taroudaki (Eastern Washington University): *Applications of Image Processing*
15:25 – 15:35 Dimitris Chatzakos (University of Patras): *Μια εισαγωγή στην Κβαντική εργοδικότητα*
15:40 – 15:50 Dimitra-Dionysia Stergiopoulou (NTUA): *On the action of the symmetric group on the free n-Lie algebra*
15:55 – 16:05 Kostas Psaromiligkos (Université Clermont Aubergne): *A space of simple modules*
16:10 – 16:20 Alexandra Stavrianidi (Stanford University): *The logarithmic correction for the fronts of a cascading family of Branching Brownian Motions*
16:25 – 16:35 Rafailia Tsiavou (AUTH): *A glimpse into Seiberg-Witten equations*

17:00 – 17:10 Miltiadis Karakikes (NKUA): *Recollements of Equivariant Categories*

17:15 – 17:25 Konstantina Kyriakoudi (University of Ioannina): *Magnetic Field Effects on Hemodynamics*

17:30 – 17:40 Katerina Kalampogia-Evangelinou (NKUA): *Some real-rooted polynomials in algebraic combinatorics*

17:45 – 17:55 Panagiotis Kostas (AUTH): *Gorenstein algebras and singularity categories in cleft extensions*

18:00 – 18:10 Areti Bartatila (NKUA): *Μία εισαγωγή στους p-αδικούς αριθμούς*

18:15 – 18:25 Veni Arakelian (Council of Economic Advisors, Ministry of Finance): *And Pythia said "Buy not sell"; An analysis of analyst recommendations betting on sparsity*

18:30 – 18:40 Dimitris Noulas (NKUA): *Η καμπύλη Heisenberg στην Αριθμητική Τοπολογία*

18:45 – 18:55 Vasiliki Mavrogeorgou (NKUA): *Βάζοντας στο παιχνίδι τους αλγορίθμους*

19:30 approx. **Reception in Villa Zografou** (kindly offered by the Mayor of Zografos Municipality)

Παρασκευή 5 Ιουλίου

09:30 – 10:00 **Maria Hadjinicolaou (Hellenic Open University):** *Mathematical modeling of blood flow: A non-invasive approach to treating medical issues*

10:10 – 10:40 **Marilena Mitrouli (NKUA):** *Direct methods for variable selection in statistical modeling*

10:40 – 11:10 *Coffee break*

11:10 – 11:40 **Despoina Ioannidou (Healthsage AI):** *Leveraging Diffusion and Generative Modeling Techniques for efficient Alzheimer's diagnosis*

11:50 – 12:20 **Angeliki Menegaki (Imperial College London):** *Recent Advances on Mathematical Wave turbulence*

12:30 – 13:30 **Επίσκεψη στην έκθεση Γεωμετρικών Στερεών της Βιβλιοθήκης ΣΘΕ**

13:30 – 15:00 *Lunch break*

15:00 – 15:30 **Ioanna Manolopoulou (UCL):** *Flexible regression methods in heterogeneous treatment effect modeling*

15:40 – 16:10 **Ilia Vonta (NTUA):** *On a Hypothesis Test of Fit for the Exponential Distribution*

16:20 - 16:50 **Theodora Bourni (University of Tennessee at Knoxville):** *Constructing solution to curve shortening and related flows.*

16:50 – 17:15 *Coffee break*

17:15 – 18:30 **Round Table Discussion** *Work-Life Balance*

18:30 Κλείσιμο Συνεδρίου

TITLES AND ABSTRACTS OF MAIN SPEAKERS

Eleni Agathokleous (Max Planck Institute, Bonn): *The theory of Complex Multiplication and the Class group action in Cryptography*

Abstract: I will give a short introduction to the theory of Complex Multiplication (CM), from the point of view of singular moduli and the corresponding elliptic curves with CM. These singular moduli are the roots of the Hilbert Class polynomial, which define abelian extensions of imaginary quadratic fields K. Each such polynomial corresponds in an explicit way to some order of the underlying quadratic field K. The ideal Class Group of such an order acts on the roots of the Hilbert Class polynomial freely and transitively. I will talk about how this class group action, which also extends over to finite fields, is currently being exploited in Post-Quantum Cryptography, and mainly in the area of *Isogeny-Based Cryptography*. Finally, time permitting, I will briefly discuss some of my related results, from collaborative as well as independent projects.

Sara Azzali (University of Bari): *Index theory and the Novikov conjecture*

Abstract: An index theorem is a relation between an analytic quantity (in its fundamental form, the 'number of solutions' of an elliptic equation Df = 0) and a topological data associated with the operator D and the underlying space. By their nature, index theorems can be used to study manifolds. Combined with techniques of operator algebras, index theory has successfully addressed profound questions including various cases of the Novikov conjecture about the homotopy invariance of higher signatures. In this talk, we shall introduce this classical subject and discuss some recent tools in operator K-theory.

Theodora Bourni (University of Tennessee at Knoxville): *Constructing solution to curve shortening and related flows.*

Abstract: We will discuss the construction of certain interesting solutions to curve shortening and related flows. Some of these lead to classification results for ancient solutions.

Christina P. Filli (NKUA): *Η Maria Gaetana Agnesi και η τιμητική της διάκριση ως «καθηγήτρια» της Ανάλυσης στο Πανεπιστήμιο της Bologna*

Abstract: Η Maria Gaetana Agnesi (1718- 1799) θυγατέρα του πλούσιου έμπορου μεταξωτών Pietro Agnesi και της Anna Fortunato Brivio , από την παιδική της ηλικία δείχνει τις εξαιρετικές ικανότητες . 11 ετών μιλά, (εκτός από τα γαλλικά, που έμαθε όταν ήταν 5 χρονών), λατινικά, ελληνικά, γερμανικά και εβραϊκά. Καθώς ο πατέρας της έδιδε μεγάλη σημασία στην μόρφωση , είχε προσλάβει οικοδιδασκάλους προκειμένου να διδαχθεί φιλοσοφία, μαθηματικά, φυσική ιστορία και μουσική .. Μελετά έργα των Fermat, Descartes, Newton, Euler, Bernoulli, de l' Hôpital. Για την σπουδή της στα μαθηματικά της εποχής της επιστρατεύεται ο βενεδεκτίνος μαθηματικός Ramiro Rampinelli (1697-1757), ο οποίος θα

την εισάγει στον κόμη   Jacopo Riccati (1676-1754). Με την ενθάρρυνση του Rampinelli καθώς   και τη   βοήθεια της οικογένειας των Riccati, για να διευκολύνει κατά το δυνατό τους νέους, το 1748 θα δημοσιεύσει   τη δίτομη πραγματεία της την οποίαν   αφιερώνει στην αυτοκράτειρα   της Αυστρίας Μαρία Θηρεσία . Αργότερα   το έργο της   αυτό   με τίτλο, Instituzioni Analytiche ad uso della goventù italiana (στα ιταλικά η λέξη instituzioni   σημαίνει στοιχειώδεις αρχές για τη διδασκαλία). Ο Πάπας Βενέδικτος ΚΔ', αναμορφωτής της καθολικής παράδοσης, καταγόμενος από την   Bologna, και   προστάτης της Ακαδημίας της, έχοντας διαβάσει την πραγματεία της της αποστέλλει επιστολή όπου υπογραμμίζει πως στο πρόσωπό της διαβλέπει μια από τις μεγάλες « καθηγήτριες » της ανάλυσης, και αυτό θα συμβάλει στη φήμη της Ιταλίας και της Ακαδημίας της Bologna . Λίγο καιρό αργότερα την διορίζει lectrix honoraria της ανάλυσης στο Πανεπιστήμιο της Bologna. Όμως μετά από όλες αυτές τις τιμές και τις αναφορές που έλαβε   η πραγματεία της, η Maria Gaetana, απαιτεί το μερίδιο της πατρικής της περιουσίας και αφιερώνεται στη φιλανθρωπία, διευθύνοντας ένα πτωχοκομείο για γυναίκες στο οποίο και διαμένει μέχρι το τέλος της ζωής της.

Maria Hadjinicolaou (Hellenic Open University): *Mathematical modeling of blood flow: A non-invasive approach to treating medical issues*

Abstract: The integration of mathematics into medicine is gaining significant importance, especially in understanding cardiovascular diseases, which are a leading cause of death for those over 65. As this demographic grows, comprehending the link between aging and cardiovascular health is crucial. Aging affects the cardiovascular system's structure and function, impacting blood supply consistency vital for neuronal function.

The development and application of mathematical models enable a deeper understanding of disease causes and progression, potentially leading to the discovery of methods for early diagnosis and treatment. In this talk, we will explore medical issues related to blood flow at both micro and macro levels using Partial Differential Equation-based models. These models have given rise to new mathematical concepts and techniques, thereby improving existing medical tools.

Keywords: blood flow, erythrocyte, mathematical model, Partial Differential Equations, semi-separation of variables

Despoina Ioannidou (Healthsage AI): *Leveraging Diffusion and Generative Modeling Techniques for efficient Alzheimer's diagnosis*

Abstract: Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) are pivotal in the early diagnosis and monitoring of Alzheimer's disease, each providing distinct insights into the anatomical and functional changes associated with the disease. PET imaging, particularly for the quantification of amyloid plaques, is a critical paradigm in understanding and tracking Alzheimer's pathology. However, PET acquisition can be resource-intensive, and clinical expertise in the quantification process remains generally limited. On the other hand, MRI T1 acquisitions, although easier and cheaper to obtain, do not contain the necessary information to diagnose a patient as amyloid positive.

We explored innovative methodologies for generating PET images directly from MRI data, namely degenerative approaches such as Generative Adversarial Networks (GANs) and diffusion models. By using paired T1-weighted brain MRI and amyloid -beta (αβ) PET maps, we aim to bridge the gap between these imaging modalities. Through empirical results and comparative analysis, we show how these cutting-edge techniques can potentially transform diagnostic workflows, improve early detection, and enhance monitoring of disease progression in Alzheimer's patients.

Myrto Manolaki (UCL): *Boundary behaviour of holomorphic functions*

Abstract: The study of boundary behaviour of holomoprhic functions is of significant importance in many areas in Analysis. In this talk I will present an overview of my research on this topic, focusing on two theorems which complement and strengthen some classical results. The first one concerns Abel's Limit Theorem, which connects the behaviour of a Taylor series as we approach the boundary from the interior with its behaviour on the boundary itself. The second one strengthens Plessner's and Spencer's theorems about the angular behaviour of homomorphic functions on the unit disc. We will also discuss how these results find applications to certain large classes of holomorphic functions with wild boundary behaviour.

Ioanna Manolopoulou (UCL): *Flexible regression methods in heterogeneous treatment effect modeling*

Abstract: Causal inference concerns the study of the effect of a factor (eg a treatment) on an outcome, aiming to isolate the effect of that factor independently of anything else it might be associated with. Causal inference can be challenging if the datasets do not have randomised treatment. For example, studying the effect of nutrition is notoriously challenging, because people with healthy eating habits typically also have other healthy habits, and it's impossible to separate the effect of each one. Additionally, the effect of treatment may vary across treatment units; for example, some treatments may be more/less beneficial for older people. This is commonly referred to as a "heterogeneous treatment effect". In this talk I will provide an overview of the use of non-parametric inference on heterogeneous treatment effect estimation, highlighting some recent research developments.

Joint work with Ilina Yozova, Alberto Caron, Gianluca Baio

Angeliki Menegaki (Imperial College London): *Recent Advances on Mathematical Wave turbulence*

Abstract: Wave Kinetic Theory aims to describe the effective behaviour and energy-dynamics of systems where many waves interact nonlinearly according to time-reversible dispersive or wave equations. It is a central component of wave turbulence theory and it has direct analogies with the, well-established, kinetic theory of particles. The theory predicts that the macroscopic behaviour of such nonlinear wave systems is described by a kinetic equation, the so-called Wave Kinetic Equation. For this equation we are going to present some recent stability and instability results. Parts of this talk are a joint work with M. Escobedo (Bilbao).

Marilena Mitrouli (NKUA): *Direct methods for variable selection in statistical modeling*

Abstract: In linear models usually the solutions are required to be sparse since they identify the most important factors that influence the response of the experiment. For this purpose, regularization techniques are employed and the choice of appropriate values for the added parameters becomes of dominant importance. However, most of the statistical models possess a well-conditioned design matrix and according to the discrete Picard condition, regularization is not necessary for their solution. In this work we study the properties of the design matrices which follow a specific correlation structure. According to their generalized condition number we can decide from the beginning if regularization is needed or not for the solution of the least squares problem. Furthermore, we will describe some direct methods which behave well for the under study statistical models in terms of the required sparsity in the computed solutions.

Eleni Tzanaki (University of Crete): *Real rootedness in algebraic and geometric combinatorics*

Abstract: The generating polynomial of many important sequences in combinatorics is known to be real rooted. In this talk we will present several instances where this occurs and we will particularly focus on chain polynomials of geometric lattices (these are partially ordered sets with nice properties). We will discuss how one can exploit the edge labelling of the lattice in order to recover its chain polynomial and we will present some standard techniques commonly used to prove real rootedness.

Ilia Vonta (NTUA): *On a Hypothesis Test of Fit for the Exponential Distribution*

Joint work with I. Mavrogiannis (University of Marseille), G. Papasotiriou (NTUA) & A. Karagrigoriou (University of Piraeus)

Abstract: Log-concavity and log-convexity play a key role in various scientific fields, especially in those where the distinction between exponential and non-exponential distributions is necessary for inferential purposes. In the present study, we introduce a testing procedure for the tail part of a distribution which can be used for the distinction between exponential and non-exponential distributions. The conspiracy and catastrophe principles are initially used to establish a characterization of (the tail part of) the exponential distribution, which is one of the main contributions of the present work, leading the way for the construction of the new test of fit. The proposed test and its implementation are thoroughly discussed, and an extended simulation study has been undertaken to clarify issues related to its implementation and explore the extent of its capabilities. A real data case is also investigated.

TITLES AND ABSTRACTS OF 10' TALKS

Veni Arakelian (Council of Economic Advisors, Ministry of Finance): *And Pythia said "Buy not sell"; An analysis of analyst recommendations betting on sparsity*

Abstract: The goal of this paper is to identify influential analysts who generate abnormal returns when issuing a new recommendation by building a model that bets on the sparsity of typical analysts' recommendation data. Based on Bayesian techniques, we estimate a regression model for the abnormal returns in conjunction with a time-varying Markov switching model for the analysts' recommendations, using the alpha--stable distribution as prior, and we find that the influential analysts are very few. Additionally, we identify publicly available information that contributes to the abnormal returns besides the analysts' recommendations. Moreover, we study the analysts' herding behavior as an application to exemplify the merits of our method. Our findings show that analysts' herding behavior is not pervasive when the model accounts for the deviation of the analysts' recommendations from the prevailing consensus. Finally, we show that our model performs better than LASSO, elastic net, and the horseshoe prior, both in-sample and out-of-sample.

Areti Bartatila (NKUA): *Μία εισαγωγή στους p-αδικούς αριθμούς*

Abstract: Στην ομιλία αυτή αρχικά θα παρουσιάσουμε το κίνητρο της εισαγωγής της έννοιας των p-αδικών αριθμών, στη συνέχεια θα οριστούν οι p-αδικοί αριθμοί και η νόρμα τους, θα δείξουμε ένα ενδιαφέρον αποτέλεσμα της αριθμητικής τους και, τέλος, θα μιλήσουμε για τη χρήση τους και ιδιαίτερα για τη σύνδεσή τους με τη φυσική.

Dimitris Chatzakos (University of Patras): *Μια εισαγωγή στην Κβαντική εργοδικότητα*

Abstract: Θα δώσουμε μία σύντομη επισκόπηση της ιστορίας του προβλήματος της κβαντικής εργοδικότητας σε πολλαπλότητες Riemann και θα αναφέρουμε κάποια πρόσφατα αποτελέσματα μας σε συμμετρικούς χώρους μεγάλου rank.

Katerina Kalampogia-Evangelinou (NKUA): *Some real-rooted polynomials in algebraic combinatorics*

Abstract: The coefficients of the chain polynomial of a finite poset (partially ordered set) enumerate chains in the poset by their number of elements. In this talk, we will explore the real-rootedness property of chain polynomials. The real-rootedness of a polynomial with nonnegative coefficients has strong implications, such as unimodality, log-concavity and (in case it is also palindromic) γ-positivity. We'll present positive results and discuss open problems in this domain. This is joint work with Christos Athanasiadis.

Miltiadis Karakikes (NKUA): *Recollements of Equivariant Categories*

Abstract: Equivariant categories arise naturally as the categorical structure related to a finite group acting on a category. Recollements of categories (abelian or triangulated) were introduced by Beilinson-Bernstein-Deligne and essentially, they are short exact sequences of categories with extra structure. In this talk, after reviewing these definitions, we will see how to lift recollements of abelian (resp. triangulated) categories into recollements of abelian (resp. triangulated) equivariant categories and we will mention a specific application related to recollements of module categories which arise from idempotents. If time permits, we will finish with a discussion on equivalences between the corresponding equivariant singularity categories.

Panagiotis Kostas (AUTH): *Gorenstein algebras and singularity categories in cleft extensions*

Abstract: Many important ring-theoretic constructions in representation theory, such as trivial extensions and tensor algebras, occur as split extensions of rings. We will motivate the study of such constructions via the notion of a cleft extension of abelian categories, due to Beligiannis. We will show that two algebras in a cleft extension, under natural homological properties, are effectively related in terms of Gorensteinness, their singularity categories and their big singularity categories in the sense of Krause.

Konstantina Kyriakoudi (University of Ioannina): *Magnetic Field Effects on Hemodynamics*

Abstract: This presentation discusses the implementation of advanced numerical methods for solving partial differential equations in the field of fluid mechanics. More specifically, a mathematical model is presented that describes the influence of a magnetic field on blood flow within a pathological vessel. Generalized curvilinear coordinates and the numerical method of the finite volume are utilized. The findings underscore the substantial influence of the magnetic field, particularly on parameters such as the velocity field $\bar q$ and pressure drop, Δp, offering valuable insights into the interplay between magnetic fields and blood flow dynamics.

Dimitris Noulas (NKUA): *Η καμπύλη Heisenberg στην Αριθμητική Τοπολογία*

Abstract: Η αριθμητική τοπολογία είναι ένας κλάδος που εστιάζει στην αναλογία των

πρώτων αριθμών με των κόμπων, ενώ η καμπύλη Heisenberg ορίζεται ως ένα τοπολογικό κάλυμμα της καμπύλης Fermat. Χρησιμοποιώντας εργαλεία της αριθμητικής τοπολογίας μπορούμε να καταλάβουμε καλύτερα την ομολογία της καμπύλης Heisenberg και με δράσεις των braids και Galois πάνω σε αυτήν μπορούμε να καταλάβουμε καλύτερα την ίδια την αναλογία.

Kostas Psaromiligkos (Université Clermont Aubergne): *A space of simple modules*

Abstract: We will construct the Lafforgue variety, a space providing a parametrization of the simple modules of noncommutative algebras with large centers.

Alexandra Stavrianidi (Stanford): *The logarithmic correction for the fronts of a cascading family of Branching Brownian Motions*

Abstract: In this talk, I will introduce the connection between some systems of Fisher-KPP type reaction-diffusion equations and a cascading family of Branching Brownian Motions. The location of the median of the rightmost particle of this particle system coincides with the location of the front of the equations, so the associated long time asymptotics can be studied from both a probability and a PDE point of view. I will present results on the long-time behavior of the system and analyze interesting applications and probabilistic connections.

Dimitra-Dionysia Stergiopoulou (NTUA): *On the action of the symmetric group on the free n-Lie algebra*

Abstract: Let K be a field of characteristic zero. An *n*-Lie algebra over K is a vector space equipped with an alternating *n*-form that satisfies the generalized Jacobi identity. This was introduced by Filippov in 1986. When *n* = 2 we have the usual notion of Lie algebra. *n*-Lie algebas have been studied by mathematicians and physicists.

Let $\rho_{n,k}$ be the representation of the symmetric group S_m, $m = (n-1)k + 1$, on the multilinear component $\text{Lie}_n(m)$ of the free *n*-Lie algebra generated by bracketed words containing k brackets. The decomposition of $\rho_{n,k}$ is an open problem.

Friedmann, Hanlon, Stanley and Wachs [1] have shown that for $k = 2$, the representation $\rho_{n,2}$ is irreducible. For $k = 3$ they stated without proof the decomposition of $\rho_{n,3}$. In this talk we will describe a proof of the later result. Joint work with M. Maliakas [2].

REFERENCES

[1]   Friedmann T., Hanlon P., Stanley R. P. and Wachs M. L., On a generalization of Lie(k): a CataLAnKe theorem, Adv. Math. **380** (2021), 107570.

[2]   Maliakas M. and Stergiopoulou D.-D., On the action of the symmetric group on the free LAnKe, arXiv:2401.09405.

Victoria Taroudaki (Eastern Washington University): *Applications of Image Processing*

Abstract: In this talk we will explain what a Digital Image is mathematically and present a simple model for Image corruption. We will then briefly show how we can use this model to reconstruct the image for different applications that involve images.

Rafailia Tsiavou (AUTH): *A glimpse into Seiberg-Witten equations*

Abstract: A Dirac operator D on a Riemannian manifold M may be thought of as the operator-square root of the Laplacian Δ. By considering solutions of $D\psi=0$, we examine the "harmonicity" of spinors ψ. Seiberg-Witten equations, originally stated in dimension 4, involve the kernel of a Dirac operator and an initial condition on the curvature of the line bundle of the complex spin-structure of M. We shed light to their emergence from Physics and pave the way towards their generalization in dimensions greater than 4 with a Representation Theory approach.