Mini Workshop on Nonlinear Analysis and Optimization

Department of Mathematics
National Taiwan Normal University

June 20, 2025

Sponsored by

College of Science, National Taiwan Normal University
Department of Mathematics, National Taiwan Normal University

Organized by

Jein-Shan Chen

Table 1: Schedule on June 20, 2025. Place: M212, Mathematics Department Building

	Chair	Speaker	Title
14:00 | 14:30	Jein-Shan Chen	M. Seetharama Gowda	Semi-FTvN systems
14:30 | 15:00	Jein-Shan Chen	Michael Orlitzky	Clans and homogeneous cones
15:00 | 15:30	Jein-Shan Chen	Wei-Shih Du	New existence results and applications functions for vector-valued with essential vectorial semicontinuity and adjustability convexity
15:30 | 15:50	*Tea Break*		
15:50 | 16:20	Jann-Long Chern	Chun-Yen Shen	Size estimates for polynomial images
16:20 | 16:50	Jann-Long Chern	Daniel Spector	Realistic Function Spaces for Physics
16:50 | 17:20	Jann-Long Chern	Juyong Jeong	Generalized convexity for spectral functions on Euclidean Jordan algebras
17:20 | 17:40	*Free Discussion*		

Semi-FTvN systems

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Abstract. A semi-FTvN system is a triple (V, W, λ), where V and W are real inner product spaces and $\lambda : V \to W$ is a map satisfying the conditions $||\lambda(x)|| = ||x||$ and $\langle x, y\rangle \leq \langle \lambda(x), \lambda(y)\rangle$ for all $x, y \in V$. Examples of semi-FTvN systems include Fan-Theobald-von Neumann systems (such as Euclidean Jordan algebras and normal decompostion systems) and systems induced by complete hyperbolic polynomials. In the broad framework of semi-FTvN systems, one can study automorphisms, majorization, and commutativity (principles). In this introductory talk, we describe some examples, concepts, and results.

Clans and homogeneous cones

Michael Orlitzky
Developer of Gentoo Linux
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Abstract. Vinberg showed that there is a one-to-one correspondence between homogeneous cones and clans with a unit element. We introduce the concept of a clan and walk through the construction. Afterwards we prove some results about their automorphisms.

New existence results and applications for vector-valued functions with essential vectorial semicontinuity and adjustability convexity

Wei-Shih Du

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Abstract. In this talk, we will establish new existence theorems for root-finding problem, eigenvector problem, fixed point problem and minimization problem by using essential vectorial lower semicontinuous and adjustability convex vector-valued functions in the weakly compact setting.

Size estimates for polynomial images

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Abstract. In this talk, I will first briefly review the history of sum-product estimates in the discrete setting and mention the applications of sum-product type problems. Then I will start introducing the celebrated result of Bourgain about the discretized sum-product estimates and their applications. Finally I will talk about our recent results about expanding polynomials in terms of Lebesgue measure and Hausdorff dimension.

Realistic Function Spaces for Physics

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Abstract. Modern mathematical physics models natural phenomena via the Calculus of Variations and Partial Differential Equations. The study of these energies and equations prompts the introduction of function spaces, where questions of interest are compactness, lower-semicontinuity, and estimates. While the original equations themselves are systems, for simplicity mathematicians first work with scalar analogues, where in certain regimes the natural compactness is insufficient to prove the desired estimates. The consideration of the failures of these estimates led to the introduction of function spaces where they are valid, which unfortunately are not physically motivated. In this talk I will discuss in more detail this history, and to introduce some function spaces which are physically motivated and also sufficiently robust to establish the desired properties. This talk is based on joint work with Dmitriy Stolyarov, "On dimension stable spaces of measures," https://arxiv.org/abs/2405.10728.

Generalized convexity for spectral functions on Euclidean Jordan algebras

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Abstract. In a Euclidean Jordan algebra $\mathcal{V}$, a spectral function $G : \mathcal{V} \to \mathbb{R}$ is defined as a function that depends solely on the eigenvalues of its argument. Formally, such a function takes the form $G = f \circ \lambda$, where $f : \mathbb{R}^n \to \mathbb{R}$ is a (symmetric) function and $\lambda : \mathcal{V} \to \mathbb{R}^n$ denotes the eigenvalue mapping. It turns out that spectral functions are invariant under algebra automorphisms of $\mathcal{V}$. Due to their simple yet elegant structure and wide applicability, spectral functions play a crucial role not only in matrix theory but also in convex analysis, optimization, and beyond. It has been observed that G is (strictly) convex if and only if so is the associated function f, which we call a transfer principle for (strict) convexity. In this talk, we will explore analogous transfer principle for generalized notions of convexity, including strong convexity, quasi-convexity, pseudo-convexity, and related concepts.