# Workshop on Optimization Theory with Applications

Department of Applied Mathematics

National Chiayi University

# Workshop on Optimization Theory with Applications

主辦單位: 國立嘉義大學應用數學系

經費補助單位: 科學推展中心數學組

日期: 2024 年 10 月 19 日

地點: 國立嘉義大學(蘭潭校區)理工大樓 A16-808 多功能視聽教室

Aim and Scope:

The Workshop on Optimization Theorem with Applications aims to bring together researchers, practitioners, and students from various disciplines to explore and discuss recent advancements in optimization theory and its applications. This workshop provides a platform for participants to present their latest research findings, exchange ideas, and foster collaborations. The scope of the workshop includes the following topics: Optimization Theory, Algorithms and Methods, and Applications.

Expected Outcomes:

Through this workshop, we expect to achieve the following outcomes: First, we aim to foster in-depth exchanges and collaborations among participants in the fields of optimization theory and its applications, which will inspire new research ideas and innovations. Second, by sharing and discussing the latest research findings, we intend to enhance the academic standards and practical skills of the attendees in this field. Lastly, the workshop is expected to establish a sustainable academic network that will encourage ongoing collaboration among participants, ultimately driving the advancement of optimization theory and its applications, and leaving a positive and lasting impact on various related fields.

Invited Speakers:

1. 林來居教授(彰化師範大學數學系)
2. 陳界山教授(臺灣師範大學數學系)
3. 許瑞麟教授(成功大學數學系)
4. 張毓麟教授(臺灣師範大學數學系)
5. 洪宗乾教授(屏東科技大學工業管理系)
6. 黃同瑤副教授(逢甲大學應用數學系)
7. 梁惟捷助理教授(屏東大學應用數學系)
8. 陳宏益助理教授(東海大學智慧計算暨應用數學系)
9. 李信儀助理教授(嘉義大學應用數學系)

# Workshop on Optimization Theory with Applications

Date: October 19, 2024

Location: 國立嘉義大學(蘭潭校區)理工大樓 A16-808 多功能視聽教室

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|---|---|
| 9:20-9:50 | Registration |
| 9:50-10:00 | Opening Ceremony |
| 10:00-10:45 | 林來居教授(彰化師範大學數學系)<br>Existence Theorem for Generalized Maximal Problems and Generalized Coincidence Problems with Applications |
| 10:45-11:30 | 許瑞麟教授(成功大學數學系)<br>Quadratic optimization problems with non-crossover and non-separable constraint boundaries |
| 11:30-11:40 | Break |
| 11:40-12:05 | 洪宗乾教授(屏東科技大學工業管理系)<br>A Process of The Objective Selection for The Project to Optimize The Operation Parameters and The Optimization Method |
| 12:05-12:30 | 黃同瑤副教授(逢甲大學應用數學系)<br>Second-ordered Free Type Duality Models for The Complex Multi-objective Fractional Programming |
| 12:30-14:00 | Lunch |
| 14:00-14:45 | 陳界山教授(臺灣師範大學數學系)<br>Smoothing Strategy in Optimization and Data Science |
| 14:45-15:10 | 張毓麟教授(臺灣師範大學數學系)<br>Mean Inequalities Associated with Circular Cones |
| 15:10-15:20 | Break |
| 15:20-15:45 | 梁惟捷助理教授(屏東大學應用數學系)<br>Comprehensive Evaluation of Distributed Compressive Sensing Performance with Various Signal Ensembles |
| 15:45-16:10 | 陳宏益助理教授(東海大學智慧計算暨應用數學系)<br>The additivity violation of a random quantum channel: non-white Wishart-type |
| 16:10-16:35 | 李信儀助理教授(嘉義大學應用數學系)<br>Global Classical (C^1) Solutions for Non-isentropic Gas in Nozzle Flows |
| 16:35-17:00 | 討論 |
| 17:00 | 晚宴 |

# Existence Theorem for Generalized Maximal Problems and Generalized Coincidence Problems with Applications

林來居(Lai-Jiu Lin)

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Abstract:

In this paper, we first establish an existence theorem for common solutions to systems of generalized maximal element problems and systems of coincidence problems. As applications of our findings, we examine existence theorems for several problems, including: simultaneous systems of variational relation problems, nonempty intersection problems for two families of multivalued mappings, generalized weakly efficient solutions for systems of set-valued vector optimization problems and systems of variational inclusion problems, and a new minimax theorem for two functions. The results and methodologies presented in this paper differ from those found in existing literature, and we believe these findings will have broad applications in nonlinear analysis and optimization.

## Smoothing Strategy in Optimization and Data Science

陳界山(Jein-Shan Chen)

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Abstract:

In this talk, we present smoothing strategies to some popular problems in optimization and data science, including signal reconstruction problem and image deblurring. We demonstrate how smoothing functions can be involved or constructed to fit in these types of problems. In general, for each problem, it requires to employ some certain algorithm to work along with the proposed smoothing functions. Numerical experiments and comparisons affirm that our strategies are efficient approaches.

# Quadratic optimization problems with non-crossover and non-separable constraint boundaries

許瑞麟(Ruey-Lin Sheu)

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This is a joint work with Professor Huu Quang Nguyen (Vinh University, Vietnam).

Abstract:

In this talk, we are interested in a special class of non-convex quadratic programming with two quadratic inequality constraints, abbreviated as [Non-Cro/Sepa], to which the global minimum solution can be solved. The class is defined geometrically that the two constraint boundaries neither cross over, nor separate, each other (to be specified analytically in the talk). We first formulate the geometrical idea of the feasible domain with set-inclusion relations with which the unsolvability of two quadratic inequalities (having no common solution in R^n) is studied. Then, we establish a new version of S-procedure involving three quadratic functions and compute the optimal value via solving an SDP. Furthermore, with the same unsolvability result, either we can obtain an optimal solution or conclude the optimal value is indeed unattainable. As the scheme developed in the paper is very fundamental in mathematics, we expect that it can be generalized to solve other types of non-convex quadratically constrained quadratic programming.

# Mean Inequalities Associated with Circular Cones

張毓麟(Yu-Lin Chang)

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Abstract:

In this talk, we propose two types of decompositions associated with circular cones, and establish their own mean inequalities correspondingly. These inequalities are ground bricks for further study regarding circular cone optimization.

# Second-ordered Free Type Duality Models for The Complex Multi-objective Fractional Programming

黃同瑤(Tone-Yau Huang)

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Abstract:

We consider a complex multi-objective fractional programming problem(CMFP). Duality problem is an important role on optimization theory. The goal of this paper is to formulate some second ordered free type dual problems. We aim to establish the second ordered Wolfe type and second ordered Mond-Weir duality problems of (CMFP), and then prove that the duality theorems: the weak, strong and strictly converse duality theorem.

Key words: multi-objective fractional programming, generalized convexity, duality theorems.
MSC 2010: 49K35, 90C29, 26A51, 90C46

# A Process of The Objective Selection for The Project to Optimize The Operation Parameters and The Optimization Method

洪宗乾(Chung-Chien Hong)

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Abstract:

There are many situations that can cause a producing process stop or rework, leading to increased costs. This is especially true for factories that often lack labor, materials, and machinery. Effectively addressing process stop and rework is a key task for rapidly enhancing a company's competitiveness. An operation is stopped or require rework due to various abnormal phenomena. Therefore, it is important to fully list representative anomalies. Then, eliminating these anomalies becomes the objectives for subsequent improvements. There are often several different improvement objectives, and then effectively reducing the occurrence of these anomalies through identifying a better operational parameters, thereby significantly decreasing the frequency of stop or rework.

This study explores the issues of stop or rework in the diode vibration feeder operation. Initially, a field expert interview approach is used to list the phenomena that could potentially cause stoppages in the operation. Due to multiple improvement objectives, a multi-objective decision-making method is required to find the optimal parameters. Subsequently, interviews with field experts identify several easily adjustable operational parameters that influence stop or rework. The study then combines the Analytic Hierarchy Process (AHP) and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) methods to determine the optimal settings for these operational parameters.

Through several months of empirical research, the study has achieved a reduction in stopping time of over 1,000 hours per month and an average increase in the main product yield by 5.76%.

# Comprehensive Evaluation of Distributed Compressive Sensing Performance with Various Signal Ensembles

梁惟捷( Wei-Jie Liang)

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Abstract:

Distributed Compressive Sensing (DCS) is a framework that leverages joint sparsity across signal ensembles and multiple measurement vectors (MMVs). However, existing theoretical limits on the probability of exact recovery for MMVs remain similar to those for single measurement vectors (SMVs). In this presentation, I will introduce two critical factors—'Euclidean distances between signals' and the 'decay rate of the signal ensemble'—to conduct a performance analysis of a deterministic signal model within the MMV framework.

# Global Classical (C^1) Solutions for Non-isentropic Gas in Nozzle Flows

李信儀(Hsin-Yi Lee)

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( This is joint work with Shih-Wei Chou, John M. Hong, and Shih-Ming Wang. )

Abstract:

In this talk, we aim is to prove the global existence of classical solutions for non-isentropic gas in nozzle flows. We achieve this by solving three problems: the initial value problem, the initial-boundary value problem, and the two-point boundary value problem. The governed equations are full Euler equations with the geometric source in Lagrangian coordinates. Our analysis mainly depends on the local existence theorem and uniform a priori estimates, which can be obtained by using the method of characteristics and introducing generalized Lax transformations. The study of global classical solutions gives the key identity involving the entropy and geometry of a duct. Under the assumption of the key identity, we obtain the necessary and sufficient conditions for global classical solutions.

# The additivity violation of a random quantum channel: non-white Wishart-type

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This is a joint work with Professor Hao-Wei Huang (National Tsing Hua University).

Abstract:

The additivity problems of the minimum output entropy of quantum channels have been one of the core issues in quantum information theory. In this talk, we will review the additivity problems of quantum channels and investigate the violations of additivity and multiplicativity of a quantum channel that consists of non-white Wishart ensembles for the minimum output entropy and maximum output p-norm, respectively.