Thematic Talk

1: Title: Quasidifferential Analysis and Its Application in Interval-Valued Multiobjective Optimization

All Authors' Names and Affiliations:

1) Prashant Jaiswal, Department of Mathematics, Institute of Science, Banaras Hindu University;

2) Akriti Dwivedi, Department of Mathematics, Institute of Science, Banaras Hindu University;

3) Vivek Laha, Department of Mathematics, Institute of Science, Banaras Hindu University

Presenter's Name: Prashant Jaiswal

Abstract: The aim of this talk is to investigate approximate solutions in an interval-valued multiobjective optimization problem with inequality constraints involving quasidifferentiable functions, which is denoted by QIVMOP. We establish the Karush-Kuhn-Tucker (KKT)- type necessary optimality conditions to identify a type-2 E−quasi weakly Pareto solution of the QIVMOP under the assumption of a suitable constraint qualification. We also deduce the conditions under which the necessary optimality conditions become sufficient under the assumptions of generalized convexity in terms of quasidifferentials. The effectiveness and applicability of these conditions are demonstrated through several numerical examples.

Keywords: Quasidifferentiability; Interval-valued programming; Multiobjective optimization; Optimality conditions

2: Title: Approximate Stationarity Conditions for Nonsmooth Interval-Valued Multiobjective Optimization with Vanishing Constraints

All Authors' Names and Affiliations:

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4) Andrei-Dan Halanay, Department of Mathematics, Bucharest University, 14 Academiei Street, 010014 Bucharest, Romania.
Presenter's Name: Akriti Dwivedi

Abstract: The purpose of this research is to develop approximate weak and strong stationary conditions for interval-valued multiobjective optimization problems with vanishing constraints (IVMOPVC) involving nonsmooth functions. In many real-world situations, the exact values of objectives are uncertain or imprecise; hence, interval-valued formulations are used to model such uncertainty more effectively. The proposed approximate weak and strong stationarity conditions provide a robust framework for deriving meaningful optimality results even when the usual constraint and data qualifications fail. We first introduce approximate variants of these qualifications and establish their relationships. Secondly, we establish some approximate KKT type necessary optimality conditions in terms of approximate weak strongly stationary points and approximate strong strongly stationary points to identify type-2 E-quasi weakly Pareto and type-1 E-quasi Pareto solutions of the IVMOPVC. Lastly, we show that the approximate weak and strong strongly stationary conditions are sufficient for optimality under some approximate convexity assumptions.

Keywords: interval-valued multiobjective optimization; vanishing constraints; approximate constraint qualifications; approximate stationary conditions; approximate efficient solutions

3: Title: Data-Driven Discovery of a Refined Dynamical Model for Ocean Internal Solitary Waves

All Authors' Names and Affiliations: Saheya Baribtag, Xia Ren
Presenter's Name: B. Saheya

Abstract: Internal solitary waves (ISWs) are a typical form of nonlinear wave phenomena in the ocean, characterized by large amplitudes and high energy, and they play a critical role in both marine engineering safety and ecosystem stability. Accurately characterizing their propagation properties and evolutionary mechanisms is essential for understanding ocean dynamic processes. Although traditional theoretical models have yielded certain achievements, their applicability in complex marine environments is limited due to reliance on numerous idealized assumptions. At present, constrained by the scarcity of in-situ observational data, it remains challenging to directly identify and validate the governing equations under realistic oceanic conditions. In light of the above considerations, this preliminary study proposes a data-driven modeling approach that employs sparse regression techniques to automatically discover the structural form of the governing equations for ISWs, while ensuring physical interpretability. Additionally, the Levenberg-Marquardt (LM) algorithm is introduced to optimize model parameters, thereby enhancing prediction accuracy and stability. The governing equations derived through this method are further solved numerically to enable high-precision simulation of the propagation process of ISWs. This study synthesizes laboratory observations and numerical simulations spanning a wide range of ocean stratification regimes and ISW generation scenarios. By imposing multiple physical constraints, this paper establish a comprehensive ISW dynamics database that enables systematic investigation of wave evolution characteristics and the associated dynamical mechanisms under diverse environmental conditions. The results show that, when multi-source data and physical constraints are jointly incorporated, the proposed method significantly outperforms traditional models in both equation identification accuracy and propagation-process prediction. Compared with traditional models, the proposed method improves the overall amplitude-prediction accuracy in numerical simulations by approximately 0.3 m. For physical experimental data, when the prediction horizon exceeds 10 steps, the proposed method achieves at least a 0.02 m improvement in amplitude-prediction accuracy over theoretical models such as KdV and mKdV. While conventional approaches require selecting an appropriate model based on the specific physical setting, the proposed method relies solely on data and thus enables dynamical-process prediction without presupposing physical conditions.

Keywords: Internal solitary wave(ISW),data-driven modeling, machine learning, Levenberg-Marquardt (LM), system identification

4: Title: Outer Approximation Algorithm for Mixed-Integer Nonlinear Programming

Presenter's Name: Zhou Wei

Abstract: This talk introduces the outer approximation algorithm for solving mixed-integer nonlinear programming (MINLP) problems. The talk begins by revisiting the key concepts of the outer approximation algorithm for solving convex MINLP problems. For nonsmooth convex MINLP problems, the original problem is reformulated as an equivalent mixed-integer linear programming (MILP) problem using subgradients and KKT optimality conditions. An outer approximation algorithm is then established to solve the MILP problem and obtain the optimal solution to the original problem, with proof of finite termination of the algorithm. Furthermore, the talk explores the outer approximation algorithm for a class of pseudo-convex MINLP problems, extending the application of the outer approximation method to the pseudo-convex case.

Keywords: Outer Approximation; MINLP; KKT; MILP; pseudo-convexity

5: Title: A Relaxation Method for Nonsmooth Nonlinear Optimization with Binary Constraints

All Authors' Names and Affiliations:

1) Lianghai Xiao, Jinan University;

2) Yitian Qian, The Hong Kong Polytechnic University;

3) Shaohua Pan, South China University of Technology

Presenter's Name: Lianghai Xiao

Abstract: We study binary optimization problems of the form $\min_{x\in\{-1,1\}^n} f(Ax-b)$ with possibly nonsmooth loss f. Following the lifted rank-one semidefinite programming (SDP) approach \cite{qian2023matrix}, we develop a majorization-minimization algorithm by using the difference-of-convexity (DC) reformuation for the rank-one constraint and the Moreau envelop for the nonsmooth loss. We provide global complexity guarantees for the proposed Difference of Convex Relaxation Algorithm (DCRA) and show that it produces an approximately feasible binary solution with an explicit bound on the optimality gap. Numerical experiments on synthetic and real

datasets confirm that our method achieves superior accuracy and scalability compared with existing approaches.
Keywords: Binary orthogonal optimization problems; global exact penalty; relaxation methods; semantic hashing

6: Title: An Inexact ADMM for Nonconvex and Nonsmooth Optimization Problems

All Authors' Names and Affiliations: Jianchao Bai, Miao Zhang, Hongchao Zhang
Presenter's Name: Jianchao Bai

Abstract: In this talk, an Inexact Alternating Direction Method of Multiplies (I-ADMM) with an expansion linesearch step will be presented for solving a family of separable minimization problems subject to linear constraints, where the objective function is the sum of a smooth but possibly nonconvex function and a possibly nonsmooth nonconvex function. A unified proximal gradient method with momentum acceleration is also proposed for solving the smooth but possibly nonconvex subproblem. Numerical experiments on testing nonconvex quadratic programming problems and sparse optimization problems show that the proposed I-ADMM performs faster than some state-of-the-art algorithms in the literature.
Keywords: Nonconvex optimization, inexact ADMM, proximal gradient method, convergence

7: Title: Normalized tensor train decomposition: Riemannian geometry and applications

All Authors' Names and Affiliations:
1) Renfeng Peng, Academy of Mathematics and Systems Sciences, Chinese Academy of Sciences;
2) Chengkai Zhu, Thrust of Artificial Intelligence, Information Hub, The Hong Kong University of Science and Technology (Guangzhou);
3) Bin Gao, Academy of Mathematics and Systems Sciences, Chinese Academy of Sciences;
4) Xin Wang, Thrust of Artificial Intelligence, Information Hub, The Hong Kong University of Science and Technology (Guangzhou);
5) Ya-xiang Yuan, Academy of Mathematics and Systems Sciences, Chinese Academy

of Sciences

Presenter's Name: Renfeng Peng

Abstract: Tensors with unit Frobenius norm are fundamental objects in many fields, including scientific computing and quantum physics, which are able to represent normalized eigenvectors and pure quantum states. While the tensor train decomposition provides a powerful low-rank format for tackling high-dimensional problems, it does not intrinsically enforce the unit-norm constraint. To address this, we introduce the normalized tensor train (NTT) decomposition, which aims to approximate a tensor by unit-norm tensors in tensor train format. The low-rank structure of NTT decomposition not only saves storage and computational cost but also preserves the underlying unit-norm structure. We prove that the set of fixed-rank NTT tensors forms a smooth manifold, and the corresponding Riemannian geometry is derived, paving the way for geometric methods. We propose NTT-based methods for low-rank tensor recovery, high-dimensional eigenvalue problem, estimation of stabilizer rank, and calculation of the minimum output R\\'enyi 2-entropy of quantum channels. Numerical experiments demonstrate the superior efficiency and scalability of the proposed NTT-based methods.

Keywords: Tensor decomposition; tensor train; eigenvalue problem; quantum information theory; matrix product states

8: Title: Dynamic Methods for Solving Optimization Models with Absolute Value Operators

All Authors' Names and Affiliations:

1) Tiange Ma, Liaoning Technical University;

2) Cairong Chen,Fujian Normal University;

3) Deren Han, Beihang University.

Presenter's Name: Dongmei Yu

Abstract: A predefined-time robust gradient neural network (PRGNN) for solving absolute value equations is investigated. PRGNN achieves predefined-time convergence and exhibits complete resilience against bounded vanishing or bounded non-vanishing noise. Compared with several existing continuous-time models, PRGNN can achieve better noise-tolerance performance under large constant noise. Numerical

simulations demonstrate our claims.

Keywords: Absolute value equations; Predefined-time convergence; Gradient neural network; Robustness

9: Title: Optimization of Beamspace Blind Signal Separation Method

All Authors' Names and Affiliations:

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Presenter's Name: Cedric Yiu

Abstract: For speech extraction, multi-sensors are often deployed in order to pick up and enhance multi-source speech signals. This is the typical cocktail party problem. In general, there are two popular techniques, namely blind signal separation (BSS) and beamforming. BSS exploits the statistical properties of the signals while beamforming capitalizes on spatial information. One possible method, which combines the strength of both techniques, to carry out BSS under a pre-designed beamspace. However, in a dynamic environment, a fixed beamspace is not practical and more dynamic approach is required. Here, we discuss different optimization formulations and propose an optimization method which optimizes on both beamforming and BSS techniques. We demonstrate the performance of the method via several examples.

Keywords: Signal processing; beamforming; blind signal separation (BSS)

10: Title: Optimal Microphone Subset Selection for Beamforming

All Authors' Names and Affiliations:

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3) Zhibao Li, School of Mathematics and Statistics, Central South University, Changsha, Hunan 410083, PR China.

Presenter's Name: Yuhan Zhang

Abstract: Microphone arrays are widely utilized in speech-related applications, where selecting an optimal subset of microphones is crucial for minimizing computational burden without degrading beamformer performance. This subset selection is inherently a challenging combinatorial problem, conventionally addressed by greedy-based heuristics that cannot guarantee optimality. In this paper, we propose a novel exact formulation for microphone subset selection. By rigorously reformulating the combinatorial conditions into continuous algebraic constraints, we transform the problem into a novel mixed-integer linear programming (MILP) model. The optimal subset is derived from a multi-objective optimization problem that maximizes beamforming performance while minimizing the number of selected microphones. A branch-and-bound algorithm is employed to find the global optimum. Numerical experiments demonstrate that our proposed MILP approach achieves competitive beamforming performance compared to greedy and genetic algorithms (GA), while strictly minimizing the active microphone count, making it highly effective for hardware-constrained applications.

Keywords: Microphone selection; Beamformer design; Mixed integer linear programming; Branch-and-bound

11: Title: Accelerated proximal gradient algorithms for nonsmooth multiobjective optimization

All Authors' Names and Affiliations: Chengzhi Huang, sichuan university;

Presenter's Name: Chengzhi Huang

Abstract: Many practical problems can be modeled as nonsmooth multiobjective optimization problems; however, subgradient methods suffer from slow convergence and the lack of explicit convergence rate guarantees. To address these issues, this paper proposes two improved algorithms. First, based on a backtracking strategy, we develop a backtracking accelerated proximal gradient method, which achieves a convergence rate of $O(1/k^2)$ under relatively mild assumptions. By further incorporating smoothing techniques, the method is extended to the nonsmooth setting, attaining a convergence rate of $O(\backslash ln\ k\ /\ k)$, and outperforming classical subgradient methods in both iteration complexity and computational time. Second, to avoid the additional overhead introduced by backtracking, we propose an adaptive accelerated proximal gradient method by modifying the inertial term, under the assumption that an upper

bound on the initial estimate of the Lipschitz constant of the gradient is available. Combining this approach with smoothing techniques extends it to the nonsmooth case. The resulting method enjoys the same convergence rate as the aforementioned algorithm while requiring less computational time. Finally, we analyze the influence of the inertial parameter on convergence behavior, providing theoretical guidance for subsequent algorithm design.

Keywords: Nonsmooth multiobjective optimization; accelerated proximal gradient method; backtracking; adative updating scheme;

12: Title: New Algorithms via Multiobjective Damped Inertial Gradient-like Systems with Asymptotic Vanishing Normalized Gradient

Presenter's Name: Yingdong Yin

Abstract: For unconstrained convex smooth multiobjective optimization, we propose a novel gradient-like flow that incorporates the asymptotic vanishing normalized gradient. In the scalar case, this flow reduces to a first-order method with strong empirical performance, as introduced by Wang et al. [SIAM J. Sci. Comput., 2021].} We prove the existence of a trajectory solution and, using Lyapunov analysis, establish convergence rates of $O(1/t^2)$ *and* $O(\ln^2 t/t^2)$ under two distinct parameter choices. Under certain assumptions, we further show that the trajectory converges to a weakly Pareto optimal solution. By discretizing the flow, we derive a new multiobjective accelerated gradient method that achieves a convergence rate of $O(\ln^2 k/k^2)$. Numerical experiments demonstrate that both our continuous flow and discrete algorithm lead to faster convergence on most problems.

Keywords: Multiobjective optimization; Inertial Gradient-like system; Accelerated gradient method; Direction correction; Lyapunov analysis

13: Title: The control parametrization technique for numerically solving fractal-fractional optimal control problems involving Caputo–Fabrizio derivatives

All Authors' Names and Affiliations:

1) Chongyang Liu, Shandong Technology and Business University,

2) Xiaopeng Yi, Sunway University,

3) Zhaohua Gong, Curtin University,

4) Meijia Han, Shandong Technology and Business University

Presenter's Name: Chongyang Liu

Abstract: Fractal–fractional derivatives open new opportunities for modelling complex processes. In this talk, we develop a novel numerical computation approach for solving optimal control problems with Caputo–Fabrizio derivatives. Firstly, we propose a general class of fractal–fractional optimal control problems with Caputo–Fabrizio derivatives and subject to state constraints of equality and inequality. Then, by using control parametrization technique, the fractal–fractional optimal control problem is approximated by a series of finite-dimensional optimization problems. Furthermore, the gradients of the cost and constraint functions in regard to decision variables are derived, which can be obtained by solving auxiliary fractal–fractional systems. A 3rd-order numerical scheme is also presented to solve the involved fractal–fractional systems. On the basis of this result, we develop a gradient-based optimization algorithm to solve the resulting optimization problem. Finally, numerical examples are provided to demonstrate the applicability and effectiveness of the developed algorithm.

Keywords: Fractal-fractional optimal control, Caputo-Fabrizio derivative, Numerical scheme, Numerical optimization

14: Title: Robust Completion for Rank-1 Tensors with Noises

Presenter's Name: Jinling Zhou

Abstract: This talk studies the rank-1 tensor completion problem for cubic tensors when there are noises for observed tensor entries. First, we propose a robust biquadratic optimization model for obtaining rank-1 completing tensors. When the observed tensor is sufficiently close to be rank-1, we show that this biquadratic optimization produces an accurate rank-1 tensor completion. Second, we give an efficient convex relaxation for solving the biquadratic optimization. When the optimizer matrix is separable, we show how to get optimizers for the biquadratic optimization and how to compute the rank-1 completing tensor. When that matrix is not separable, we apply its spectral decomposition to obtain an approximate rank-1 completing tensor. The software SDPNAL+ is applied to solve the resulting large size semidefinite programs.

Keywords: Tensor, rank-1 completion, biquadratic optimization, convex relaxation

15: Title: Optimal quality supervision control model based on Internet plus agricultural product quality traceability system

All Authors' Names and Affiliations:

1) Ying Zhang, Zhejiang Normal University;

2) Yingtao Xu, Zhejiang Normal University;

3) Jinlin Xu, China Telecom Corporation Limited Jinhua Branch

Presenter's Name: Ying Zhang

Abstract: Quality traceability is a guarantee to reduce agricultural product safety risks, since it allows problems to be traced to all stages of production and distribution. Most of the research in this field is about system design or qualitative nature. This paper focuses on the quantitative approach to broaden the scope of current study. By supposing the enforcement of quality supervision as control variables, and taking selling price and sales volume as states variables, this paper presents a optimal quality supervision control (OQSC) model in the form of a discrete-time optimal control problem. The aim is to optimize an overall profit. Based on the gradient formulae for the cost and canonical constraint functions, the optimal control problem can be solved by any existing constraint optimization technique. A case study arising from Suichang's agricultural product traceability system reveals a better solution of effective optimal quality supervision.

Keywords: Discrete-time optimal control; quality traceability; gradient formulae; case study

16: Title: Riemannian Bilevel Optimization with Gradient Aggregation

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3) Shihui Ying, School of Mechanics and Engineering Science, Shanghai University, Shanghai, China;

4) Tieyong Zeng, Department of Mathematics, The Chinese University of Hong Kong,

Hong Kong, China
Presenter's Name: Zhuo Chen

Abstract: Bilevel optimization (BLO) provides a powerful framework for hierarchical decision-making and is widely used in machine learning tasks like hyperparameter optimization and meta-learning. Traditional BLO methods mainly operate in Euclidean spaces, yet many real-world problems have structural constraints. We propose a novel Riemannian bilevel optimization (RBLO) algorithm incorporating a bilevel descent aggregation (BDA) scheme to coordinate updates at both levels efficiently. Our approach abstracts constraints as manifold structures and reformulates the constrained BLO into an unconstrained RBLO problem. To overcome convergence limitations of existing methods, we leverage smooth manifold mappings and offer convergence guarantees under geodesic convexity and Lipschitz smoothness assumptions. Finally, we demonstrate our method on multi-view hypergraph spectral clustering with the 3sources dataset, showing superior performance compared to Euclidean and manifold-based baselines.

Keywords: Riemannian Optimization; Bilevel Optimization; Gradient Aggregation; Convergence Analysis; Hypergraph Spectral Clustering;

17: Title: Multi-Objective Online Convex Optimization from Metric Theory to Discrete Representations

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Presenter's Name: Jieyuan Guo

Abstract: Multi-Objective Online Convex Optimization (MO-OCO) has garnered significant attention for its ability to simultaneously address conflicting objectives and dynamic environmental changes in streaming data-driven decision-making scenarios. However, existing studies remain limited in two key aspects: on one hand, the geometric implications and theoretical properties of the metrics employed require further refinement; on the other hand, the continuous Pareto front generates an infinite number of potential solutions during the online process, imposing substantial computational and cognitive burdens on practical decision-making. To address these challenges, in this talk, we first proposes a multi-objective regret metric based on ε-nondominance, providing a novel perspective for evaluating the convergence performance of online decision sequences for MO-OCO problems. Theoretical analysis demonstrates that this metric is a natural extension of the regret concept in traditional single-objective online convex optimization. Furthermore, to address the practical demand for finite yet high-quality solution sets in decision-making, this paper proposes a Online Discrete Representation (ODR) algorithm. Theoretical proofs first demonstrate that each online decision sequence generated by the ODR algorithm achieves sublinear multi-objective regret. On this basis, this paper analyzes the uniformity of distribution and coverage accuracy of the entire discrete representation solution set in the objective space, revealing the intrinsic connection between the convergence of individual sequences and the representativeness of the overall solution set. Finally, this paper applies the proposed multi-objective regret and the ODR algorithm to several classic convex machine learning tasks. Experimental results demonstrate that compared to existing baseline methods, the ODR algorithm achieves a more uniformly distributed and broader non-dominated solution set while maintaining the fastest convergence rate. In summary, this paper not only theoretically unifies the measurement criteria for single-objective and multi-objective regret but also proposes the ODR algorithm for multi-objective decision-making in online settings, which simultaneously guarantees convergence and representativeness.

Keywords: multi-objective online convex optimization; Pareto front; ε-nondominance; discrete representation; convergence analysis

18: Title: High-order finite-difference methods for hyperbolic nonconservative systems of partial differential equations

Presenter's Name: Baifen Ren

Abstract: This work aims to extend the well-known high-order WENO finite-difference methods for systems of conservation laws to nonconservative hyperbolic systems. The main difficulty of these systems both from the theoretical and the numerical points of view comes from the fact that the definition of weak solution is not unique: according to the theory developed by Dal Maso, LeFloch, and Murat in 1995, it depends on the choice of a family of paths. A new strategy is introduced here that allows non-conservative products to be written as the derivative of a generalized flux function that is defined locally on the basis of the selected family of paths. WENO reconstructions are then applied to this generalized flux. Moreover, if a Roe linearization is available, the generalized lux function can be evaluated through matrix-vector operations instead of path-integrals. Two different known techniques are used to extend the methods to problems with source terms and the well-balanced properties of the resulting schemes are studied. These numerical schemes are applied to a coupled Burgers' system and to the two-layer shallow water equations in one- and two-dimensions to obtain high-order methods that preserve water-at-rest steady states.

Keywords: WENO finite difference scheme, High order accuracy, Well-balanced scheme, Nonconservative equations, Path-conservative method

19: Title: Riemannian Inexact Hybrid Stochastic Proximal Gradient Method for Low Rank and Group Sparse Stochastic Tensor Optimization

All Authors' Names and Affiliations:

1) Xiongwei Guo, School of Mathematics and Statistics, Beijing Jiaotong University;

2) Ziyan Luo, School of Mathematics and Statistics, Beijing Jiaotong University

Presenter's Name: Xiongwei Guo

Abstract: Motivated by the wide applications of random tensor data in statistical analysis and machine learning, we study a class of stochastic composite optimization

problems over multiple Stiefel manifolds, where the objective function comprises group sparse regularizers and a smooth function. By leveraging Tucker decomposition for low-rank representation, the model effectively captures latent structures and reduces high dimensionality. Group sparse regularizers further compress the representation and enable automatic feature selection. To address the challenge posed by the stochastic nature of the problem, we introduce a hybrid stochastic estimator based on vector transport to approximate the Riemannian gradient of the smooth term, effectively balancing variance and bias by combining a variance-reduced estimator with an unbiased one. Building upon this estimator, we then develop a Riemannian Inexact Hybrid Stochastic Proximal Gradient (R-IHSPG) method that simultaneously handles Stiefel manifold constraints and group sparse regularizers. Our algorithm can be viewed as a generalization of the Manifold Proximal Gradient (ManPG) method and other stochastic manifold methods. While most related works rely on a fixed step-size, our method admits adaptive step-size selection by leveraging the properties of the hybrid stochastic gradient estimator. Moreover, it achieves the best-known oracle complexity for finding a stochastic ε-stationary point, even when subproblems are solved inexactly under a prescribed error criterion. Considering that the biased term may dominate the unbiased one, we propose a restart variant of R-IHSPG by adding an outer loop that triggers a restart after a predetermined number of iterations. At each restart, the algorithm clears its historical gradient information, allowing it to begin the new phase with an unbiased gradient estimate. Theoretically, the variant also achieves the same oracle complexity as R-IHSPG. Numerical experiments on several examples are conducted to demonstrate the effectiveness of our proposed methods compared to existing ones.
Keywords: Tensor optimization; Riemannian optimization; Stochastic optimization algorithm; Hybrid stochastic estimator

20: Title: A control parameterization method for solving combined fractional optimal parameter selection and optimal control problems

Presenter's Name: Xiaopeng Yi

Abstract: In this paper, we consider a class of combined fractional optimal parameter selection and optimal control problems involving nonlinear fractional systems with Caputo fractional derivatives and subject to canonical equality and inequality constraints. We first approximate this problem by a set of finite-dimensional optimization problems using the control parameterization method, where both the heights of parameterized controls and system parameters are taken as decision variables. We then show that the gradients of the cost and constraint functions with respect to the decision variables can be expressed as the solutions of a series of auxiliary fractional systems, which can be solved together with the original fractional system forward in time, simultaneously. Furthermore, we present a third-order numerical scheme for solving both the original and auxiliary fractional systems. On this basis, a gradient-based optimization algorithm is developed to solve the resulting optimization problems. Finally, we demonstrate the effectiveness and applicability of the developed algorithm through two non-trivial examples.

Keywords: Fractional parameter selection; Fractional optimal control; Control parameterization; Numerical scheme; Numerical optimization

21: Title: Fractional Optimal Control in Cancer Chemotherapy

Presenter's Name: Meijia Han

Abstract: In this paper, considering the memory effect and non-local characteristic in biological systems, we propose a nonlinear fractional system with free terminal time to describe the tumor dynamics in cancer chemotherapy process. Based on this, we present a fractional optimal control problem subject to safety threshold constraints on cell counts, where the cost function aims to minimize the tumor cell population and the drug usage in an average sense. Then, we apply time-scaling transformation and constraint transcription to convert the problem into a sequence of optimal control problems with fixed terminal time and canonical constraints. Furthermore, an optimization algorithm, which combines a discretization scheme and gradients of the cost and canonical constraint functions, is developed to solve the resulting problems. Finally, numerical

results show that the proposed algorithm is highly effective.

Keywords: Fractional optimal control; free terminal time; time-scaling transformation; numerical optimization; cancer chemotherapy.

22: Title: A multi-strategy improved Kepler optimization algorithm for feature selection

All Authors' Names and Affiliations:

1) Dongmei Yu, College of Science, Liaoning Technical University;

2) Qihang Guo, College of Science, Liaoning Technical University

Presenter's Name: Qihang Guo

Abstract: Kepler Optimization Algorithm (KOA) is a metaheuristic inspired by the laws of planetary motion. Although KOA has demonstrated superior performance in several benchmark test sets, it still faces challenges such as susceptibility to local optima and imbalances between exploration and exploitation. To address these issues, we developed an improved version of the algorithm, named the Improved Kepler Optimization Algorithm (IKOA), designed for both global optimization and feature selection problems (FS). IKOA incorporates three key enhancements: Adaptive Sine-Cosine Heliocentric Motion (AHM), Extreme-guided Exponential Exploration (EGEE), and Elite Opposition-based Levy Flight (EOLF). The effectiveness of IKOA was validated using the CEC2022 benchmark function. Additionally, IKOA was applied to ten real-world datasets from the UCI repository. The numerical results demonstrate that IKOA outperforms other methods in the field of feature selection (FS). Overall, this study confirms that IKOA exhibits exceptional robustness, practicality, and effectiveness in feature vector reduction.

Keywords: Kepler optimization algorithm; Adaptive sine-cosine heliocentric motion; Extreme-guided exponential exploration; Elite opposition-based levy flight; Feature selection

23: Title: Linearly constrained convex optimization via inertial systems with Hessian driven damping

Presenter's Name: Chuanlong Xu 许传龙

Abstract: In this paper, for the convex minimization problem with linear equality constraints, we construct a second-order saddle-point constrained inertial dynamical system that incorporates viscous damping and Hessian geometric damping, and rigorously prove the equivalence between the proposed system and the constrained system with only primal variables. On this basis, we establish a complete theoretical framework for the existence and uniqueness of the global classical solution, dissipativity and asymptotic feasibility of the system. We also prove the strong convergence of the solution, and characterize the necessary and sufficient condition for the limit point to be the global optimal solution as well as the design criterion for initial values. The refined convergence rate analysis demonstrates that when the time-varying damping coefficient $\alpha \geq 3$, the system can achieve Nesterov-type accelerated convergence with an $o(1/t^2)$ rate, and an exponential convergence rate can be obtained for quadratic objective functions. Finally, via variable substitution, we construct a Hessian-free first-order equivalent system, design a low-complexity explicit numerical discretization scheme, and verify the stability and computational advantages of the proposed algorithm. The system proposed in this paper combines the anti-oscillation advantage of classical Hessian-driven systems with the acceleration property of time-varying damping, thus providing a new algorithmic framework for linearly constrained convex optimization problems.

Keywords: Hessian driven damping; Second order ordinary equation; Convex optimization; Linearly constrained

24: Title: Multiple objective approach for tensor complementarity problem with GUS-property

Presenter's Name: Chengdan Wang

Abstract: This paper explores a novel optimization-based approach for addressing tensor complementarity problems that possess the global uniqueness and solvability property. We establish a theoretical equivalence between obtaining the unique solution of such a tensor complementarity problem and identifying a Pareto-efficient (or zero-efficient) point of an associated multiple objective optimization problem. We reformulate the original tensor complementarity problem as a vector-valued optimization problem with multiple conflicting objectives. A smoothing-based gradient descent scheme is then proposed to solve the reformulated problem, and we rigorously prove its global convergence undermild assumptions on the smoothing parameter and tensor structure. We conduct comprehensive numerical experiments — including benchmark tensor complementarity problem instances and applications to Nash equilibrium computation in structured non-cooperative games—demonstrating both efficiency and reliability.

Keywords: Tensor complementarity problem; Multiple objective programming; Smoothing gradient method

25: Title: Existence and Uniqueness of Solutions to Advanced-Coupled Riccati Equations Arising in Stochastic LQ Control with Input Delay

All Authors' Names and Affiliations:

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2) Chenhe Zhang, School of Science, Dalian Jiaotong University;

3) Lei Wang, School of Mathematical Sciences, Dalian University of Technology.

Presenter's Name: Yan Wang

Abstract: We investigate the finite-horizon stochastic LQ control problem with input delay. By applying the maximum principle, we derive an explicit optimal delayed control law, characterized by a system of advanced-coupled Riccati equations and an ordinary differential equation. Sufficient conditions are established to guarantee the existence and uniqueness of solutions to this coupled system, providing a complete theoretical framework for the optimal control design.

Keywords: stochastic LQ control; input delay; advanced-coupled Riccati equations

26: Title: Smoothing trust region filter method with dynamic threshold for solving a kind of tensor absolute value equations

All Authors' Names and Affiliations: Zhao Huiyin, Chenyuanyuan, Xu Cheng

Presenter's Name: Shouqiang Du 杜守强

Abstract: In recent years, tensor absolute value equations (TAVE) have gained increasing attention in scientific calculation and engineering. This paper investigates a kind of tensor absolute value equations with positive solution and studies the solution method. Combined filter technique, we propose a new smoothing trust region filter method with dynamic threshold. Under general conditions, global convergence of our method is demonstrated. Numerical experiments show that the method has faster convergence in solving the TAVE than the smoothing trust region method. The experimental results also validate the effectiveness of our method.

Keywords: Tensor absolute value equations; Trust region method; Filter

27: Title: Testing positive definiteness of multivariate forms by tensor eigenvalue complementarity problem

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3) Haoning Yang, School of Mathematics and Statistics, Qingdao University;

4) Yunxiao Zhang, School of Mathematics and Statistics, Qingdao University;

Presenter's Name: Mengna Zhang

Abstract: Testing the positive definiteness of multivariate forms plays an important role in the stability study of nonlinear autonomous systems in automatic control. Directly determining the positive definiteness of multivariate forms is relatively complex. By combining the structural characteristics of multivariate forms and positive definite tensors, this paper transforms the problem into determining the positive definiteness of tensors. In particular, for multivariate forms associated with Z-tensors, we examine equivalent conditions for the positive definiteness of Z-tensors and test their positive definiteness via the tensor eigenvalue complementarity problem(TEiCP).

We reformulate TEiCP as an unconstrained optimization problem of a smooth function, and apply the Dai-Yuan conjugate gradient method to solve this problem. Relevant numerical example is also provided to verify the feasibility and effectiveness of the proposed method.
Keywords: Multivariate forms; Positive definiteness; Tensor eigenvalue complementarity problem; Conjugate gradient method.

28: Title: A New Neural Network for Interval-Valued Optimization Problems

All Authors' Names and Affiliations:

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2) Shouqiang Du, School of Mathematics and Statistics, Qingdao University;

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4) Mengna Zhang, School of Mathematics and Statistics, Qingdao University

Presenter's Name: Haoning Yang

Abstract: The interval-valued optimization problems are a type of optimization problem with a broad application prospect, but currently research on interval-valued optimization problems with nonlinear constraints are relatively limited. We transform a kind of interval-valued optimization problems into the constrained nonlinear optimization problems. Combined with a projection neural network with the trust-region method which is the best performing continuous time and discrete-time neural dynamics optimization model in terms of solution quality and time efficiency, we seek interval-valued optimization problem based on this model. We demonstrate the global convergence of this method and superlinear convergence rate. Relevant numerical results are also given to show the efficiency of the proposed method.

Keywords: Interval-Valued Optimization; Projection Neural Network; Trust-Region Method

29: Title: A polynomial path-following smoothing Newton method for symmetric cone programming

Presenter's Name: Ruijin Zhang

Abstract: This paper proposes a polynomial path-following smoothing Newton method (PFSNM) for symmetric cone programming (SCP), derived from a reduced smoothing barrier augmented Lagrangian (SBAL) function. The method applies a smoothing Newton scheme to the Karush--Kuhn--Tucker (KKT) system of the SCP within a path-following framework. We show that the smooth KKT system coincides with the first-order optimality condition of a minimax problem whose objective is the reduced SBAL function. Theoretically, this characterization enables an analysis within the framework of self-concordant convex-concave theory, yielding a worst-case iteration complexity of $\mathcal{O}(\sqrt{\nu}\ln(1/\varepsilon))$, which matches the best-known bounds for short-step interior-point methods. Computationally, the reduced SBAL formulation yields linear systems with an explicit Schur complement structure, thereby substantially reducing the computational cost of system formation and solution. Numerical experiments on standard conic benchmarks demonstrate competitive efficiency and robust performance compared with some widely used interior-point solvers.

Keywords: Symmetric cone; Smoothing Newton method; Polynomial complexity

30: Title: Near-Optimal Algorithms for Convex Simple Bilevel Optimization under Weak Assumptions

All Authors' Names and Affiliations:

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2) Xu Shi, School of Data Science, Fudan University;

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4) Jiulin Wang, School of Mathematical Sciences, Nankai University

Presenter's Name: Jiulin Wang

Abstract: We consider the simple bilevel optimization (SBO) problem, which minimizes a composite convex function over the optimal solution set of another composite convex minimization problem. We first show that this bilevel problem is equivalent to finding the left-most root of a nonlinear equation. Based on this and a novel dual approach for solving the subproblem in each iteration, we efficiently obtain

an (ϵ, ϵ)-optimal solution through the bisection and Newton methods. The proposed methods achieve near-optimal operation complexity of $\tilde{O}(\sqrt{1/\epsilon})$ under mild assumptions, aligning with the lower complexity bounds of the first-order methods in SBO with both level objectives being smooth convex and unconstrained composite convex optimization when ignoring logarithmic terms.

Keywords: Simple bilevel optimization; Bisection method; Near-optimal complexity

31: Title: Optimization for Grassmann dictionary learning with Stiefel representatives

All Authors' Names and Affiliations:

1) Xiaojing Zhu, Shanghai University of Electric Power;

2) Liuxu Du, Shanghai University of Electric Power

Presenter's Name: Xiaojing Zhu

Abstract: This presentation focuses on a new Grassmann dictionary learning model, which represents the Grassmann manifold as a quotient space of the Stiefel manifold and involves a logarithm-based nonlinear least-squares objective function. The proposed algorithm for solving this model follows an alternating minimization framework, which consists of sparse coding and dictionary update. The main difficulty lies in dictionary update, formulated as a Grassmann manifold optimization problem. Specifically, the challenge arises from gradient computation, involving the differential of the Riemannian logarithm. We derive formulas for computing the differential of the logarithm and its adjoint operator by utilizing a recently proposed Grassmann logarithm procedure and the derivative formulas of SVD. Based on this, we develop a Riemannian gradient method for solving the dictionary update subproblem. Furthermore, Riemannian Gauss-Newton and preconditioned gradient methods are discussed as well. Under some reasonable assumptions, we establish the global convergence of the proposed algorithm by leveraging the Riemannian Kurdyka-Lojasiewicz property. Image classification experiments on real-world datasets demonstrate that our dictionary learning approach achieves remarkably high efficiency while maintaining satisfactory accuracy.

Keywords: Dictionary learning; Grassmann manifold; Riemannian optimization; Riemannian logarithm; Image classification

32: Title: Cross-platform mission planning for UAVs under carrier delivery mode

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1) Junhong Jin, Dalian University of Technology;

2) Xin Li, Dalian University of Technology;

3) Xinwei Wang, Dalian University of Technology;

4) Lei Wang, Dalian University of Technology

Presenter's Name: Xin Li

Abstract: As battlefield scale enlarges, cross-platform collaborative combat provides an appealing paradigm for modern warfare. Complicated constraints and vast solution space pose great challenge for reasonable and efficient mission planning, where path planning and target assignment are tightly coupled. In this paper, we focus on UAV mission planning under carrier delivery mode (e.g., by aircraft carrier, ground vehicle, or transport aircraft) and design a three-layer hierarchical solution framework. In the first layer, we simultaneously determine delivery points and target set division by clustering. To address the safety concerns of radar risk and UAV endurance, an improved density peak clustering algorithm is developed by constraint fusion. In the second layer, mission planning within each cluster is viewed as a cooperative multiple-task assignment problem. A hybrid heuristic algorithm that integrates a voting-based heuristic solution generation strategy (VHSG) and a stochastic variable neighborhood search (SVNS), called VHSG-SVNS, is proposed for rapid solution. Based on the results of the first two layers, the third layer transforms carrier path planning into a multiple-vehicle routing problem with time window. The cost between any two nodes is calculated by the A∗ algorithm, and the genetic algorithm is then implemented to determine the global route. Finally, a practical mission scenario containing 200 targets is used to validate the effectiveness of the designed framework, where three layers cooperate well with each other to generate satisfactory combat scheduling. Comparisons are made in each layer to highlight optimum-seeking capability and

efficiency of the proposed algorithms. Works done in this paper provide a simple but efficient solution framework for cross-platform cooperative mission planning problems, and can be potentially extended to other applications such as post-disaster search and rescue, forest surveillance and firefighting, logistics pick and delivery, etc.

Keywords: Cross-platform mission planning; UAV; Carrier delivery mode; Clustering algorithm; Heuristic optimization algorithm

33: Title: Polyhedral results for two classes of submodular sets with GUB constraints

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2) Keyan Li, School of Mathematics and Statistics, Beijing Institute of Technology;

3)Wei-Kun Chen, School of Mathematics and Statistics, Beijing Institute of Technology;

4) Yu-Hong Dai, School of Mathematical Sciences, University of Chinese Academy of Sciences

Presenter's Name: Weikun Chen

Abstract: In this talk, we investigate the polyhedral structure of two submodular sets with generalized upper bound (GUB) constraints, which arise as important substructures in various real-world applications. We derive a class of strong valid inequalities for the two sets using sequential lifting techniques. The proposed lifted inequalities are facet-defining for the convex hulls of two sets and are stronger than the well-known extended polymatroid inequalities (EPIs). We provide a more compact characterization of these inequalities and show that each of them can be computed in linear time. Moreover, the proposed lifted inequalities, together with bound and GUB constraints, can completely characterize the convex hulls of the two sets, and can be separated using a combinatorial polynomial-time algorithm. Finally, computational results on probabilistic covering location and multiple probabilistic knapsack problems demonstrate the superiority of the proposed lifted inequalities over the EPIs within a branch-and-cut framework.

Keywords: Submodular set, GUB constraints, Sequential lifting, Polyhedral approach,

Branch-and-cut

34: Title: A Proximal Gradient Algorithm for High Dimensional Sparse Quantile Regression with Lp Regularization

All Authors' Names and Affiliations: Lintong Liu, Guoqiang Wang

Presenter's Name: Lintong Liu

Abstract: High-dimensional sparse quantile regression plays an important role in variable selection, robust estimation, and the analysis of heavy-tailed data. However, existing penalized quantile regression methods typically rely on convex regularization, and such regularization often introduces substantial shrinkage bias, whereas non-convex penalties alleviate this bias at the expense of increased computational complexity. To address these issues, we propose a high-dimensional sparse quantile regression framework that integrates a Huber-type approximation with Lp regularization for $0 < p < 1$. First, we approximate the quantile loss function with the Huber loss function to produce a differentiable objective function, thereby mitigating shrinkage bias while preserving robustness and computational efficiency. Second, we develop a proximal gradient algorithm adapted for the proposed model to solve the optimization problem. In particular, for L1/2 regularization, we derive an explicit thresholding operator that enables closed-form parameter updates. Third, extensive numerical experiments demonstrate that the proposed method achieves more accurate parameter estimation and improved variable selection performance compared with existing approaches. Finally, we apply the proposed method to real high-dimensional datasets and further confirm its practical effectiveness.

Keywords: Quantile regression; Lp regularization; Proximal gradient algorithm; Non-convex optimization

35: Title: Smoothing Binary Optimization: A Primal-Dual Perspective

All Authors' Names and Affiliations:

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City University of Hong Kong, Hong Kong SAR, China
Presenter's Name: Akang Wang

Abstract: Binary optimization is a powerful tool for modeling combinatorial problems, yet scalable and theoretically sound solution methods remain elusive. Conventional solvers often rely on heuristic strategies with weak guarantees or struggle with large-scale instances. In this work, we introduce a novel primal-dual framework that reformulates unconstrained binary optimization as a continuous minimax problem, satisfying a strong max-min property. This reformulation effectively smooths the discrete problem, enabling the application of efficient gradient-based methods. We propose a simultaneous gradient descent-ascent algorithm that is highly parallelizable on GPUs and provably converges to a binary solution in sublinear time. Extensive experiments on large-scale problems--including Max-Cut, MaxSAT, and Maximum Independent Set with up to 50,000 variables--demonstrate that our method identifies high-quality solutions within seconds, significantly outperforming state-of-the-art alternatives.

Keywords: Binary optimization, combinatorial optimization, primal-dual, minimax optimization, gradient descent-ascent

36: Title: Separable Eligible Regularized Mean-Variance Portfolio Selection: A Smoothing Active Set Approach

All Author' Names and Affiliations: Shuxuan Hao, Qian Li, Guoqiang Wang, Shanghai University of Engineering Science
Presenter's Name: Shuxuan Hao

Abstract: Robust portfolio construction in the presence of estimation error and model uncertainty remains a central challenge in modern mean-variance (MV) analysis. Classical MV portfolios are notoriously sensitive to noisy estimates of expected returns and covariances, and often yield unstable results, highly concentrated allocations with poor out-of-sample performance. To address these issues, we introduce a separable eligible mixed regularization term and embed it into the MV framework, leading to a separable eligible mean--variance (SEMV) portfolio selection model. The parameters $p\in[0,1]$, $\alpha\in[0,p]$ allow the model to approximate the l_0-norm and to unify a range of convex and nonconvex penalties. This design simultaneously promotes sparse portfolios, aligns sparsity with investability constraints, and enhances risk diversification. The resulting optimization problem is linearly constrained, nonsmooth, and nonconvex. We therefore use a smoothing active set method that constructs smooth approximations of the non-Lipschitz components and combines them with an active-set strategy tailored to simplex-type constraints. We establish that any accumulation point of the generated sequence is a limiting stationary point and provide sufficient conditions for strict local optimality of SEMV solutions. Empirical studies based on real market data demonstrate that SEMV delivers sparser, better-diversified portfolios and improves out-of-sample risk-return performance, after transaction costs, compared with several benchmark MV-type models.

Keywords: Separable eligible regularization, Sparsity portfolio optimization, Constrained nonconvex optimization, Local minimization

37: Title: Hybrid second-order gradient histogram based global low-rank sparse regression for robust face recognition

All Authors' Names and Affiliations:

1) Hongxia Li, Shanghai University of Engineering Science;

2) Ying Ji, Sunway University;

3) Yongxin Dong, East China University of Political Science and Law;

4) Yuehua Feng, Shanghai University of Engineering Science

Presenter's Name: Hongxia Li

Abstract: Low-rank sparse regression models have been widely adopted in face recognition due to their robustness against occlusion and illumination variations. However, existing methods often suffer from insufficient feature representation and limited modeling of structured corruption across samples. To address these issues,this paper proposes a Hybrid second-order gradient Histogram based Global Low-Rank Sparse Regression (H2H-GLRSR) model. First, we propose the Histogram of Oriented Hessian (HOH) to capture second-order geometric characteristics such as curvature and ridge patterns. By fusing HOH and first-order gradient histograms, we construct a unified local descriptor, termed the Hybrid second-order gradient Histogram (H2H), which enhances structural discriminability under challenging conditions. Subsequently, the H2H features are incorporated into an extended version of the Sparse Regularized Nuclear Norm based Matrix Regression (SR_NMR) model, where a global low-rank constraint is imposed on the residual matrix to exploit cross-sample correlations in structured noise. The resulting H2H-GLRSR model achieves superior discrimination and robustness. Experimental results on benchmark datasets demonstrate that the proposed method significantly outperforms state-of-the-art regression-based classifiers in both recognition accuracy and computational efficiency.

Keywords: Hybrid second-order gradient histograms, Nuclear norm, Global low-rank constraint, Sparse regression

38: Title: A Class of Improved Randomized Gauss-Seidel Methods Based on the Leverage Scores for the Parameters Estimation of TAR Model

All Authors' Names and Affiliations: Zhang-Yang Xu, Ju-Li Zhang, Shanghai University of Engineering Science

Presenter's Name: Zhangyang Xu

Abstract: In this work, inspired by the weighted leverage scores sketching (WLS) method, an aggregation leverage scores sketching (ALS) method is proposed for matrix compression. Subsequently, the ALS method is combined with the randomized Gauss-Seidel (RGS) method to perform parameters estimation for the TAR model. The detailed convergence analysis is given. Furthermore, we develop a leverage randomized block Gauss-Seidel (LRBGS) method, by incorporating block leverage scores and a relaxation parameter into the randomized block Gauss-Seidel (RBGS) method, and the corresponding convergence analysis is also given. Finally, the ALS method is also

employed to integrate with the LRBGS method, thus obtaining an aggregation leverage randomized block Gauss-Seidel (A-LRBGS) method for parameters estimation of the TAR model. Numerical experiments indicate that the ALS-RGS method and the A-LRBGS method exhibit efficiency in both parameters estimation and prediction for the TAR model.
Keywords: Randomized Gauss-Seidel method, Convergence analyses, Leverage scores, Parameters estimation, Tensor auto-regression model

39: Title: The multi-objective portfolio model for oil and gas exploration drilling projects selection and its operator-enhanced non-dominated sorting genetic algorithm based solution

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1) Chao Min, Southwest Petroleum University;

2) Junyi Cui, Southwest Petroleum University;

3) Stanislaw Migorski, Jagiellonian University;

4) Yonglan Xie, Southwest Petroleum University;

5) Qingxia Zhang, Southwest Petroleum University;

6) Jun Peng, Southwest Petroleum University.

Presenter's Name: Junyi Cui

Abstract: Drilling investment is a critical component of oil and gas exploration planning. Conventional drilling deployment relies heavily on fragmented expert assessments of geological and economic factors, resulting in limited capability for information integration. Motivated by portfolio theory as a parsimonious yet effective framework for asset allocation, we develop a multi-objective mean-variance portfolio model that explicitly accounts for uncertainty in geological parameters to enable an effective risk–return trade-off and optimal selection. First, probabilistic distributions of key geological parameters are constructed for the candidate exploration projects using expert-elicited priors. Second, drilling project screening is formulated as a portfolio selection problem, and an optimization model is established to characterize the return and risk of shortterm plans under multiple constraints. Third, we propose an operator-enhanced non-dominated sorting genetic algorithm tailored to the model. Specifically, (i) a directional crossover operator is designed to embed improving directions in objective space-derived from dominance and objective differences-into recombination, and (ii) a structure-aware mutation operator is designed to prioritize high-utility bit flips via probabilistic sampling with feasibility repair, thus improving the search ability for superior Pareto solutions. Finally, the proposed framework is validated using the 2023 exploration drilling deployment as a case study. The results indicate that the proposed method provides a reusable solution for drilling portfolio optimization in oil and gas exploration.

Keywords: Multiple objective programming; Optimal drilling; Portfolio; Meta-Heuristic; Non-dominated sorting genetic algorithm

40: Title: Federated Multi-View Clustering via Sparse Orthogonal Nonnegative Matrix Factorization

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Presenter's Name: Yanjiao Zhu

Abstract: Federated multi-view clustering aims to learn a consensus representation from distributed multi-view data without sharing raw samples. Nonnegative matrix factorization provides an effective modeling framework, but existing approaches severely limited by two drawbacks. First, improper handling of orthogonality constraints may lead to suboptimal subspaces. Second, the clients are required to share their data representations at each iteration of model training, leading to heavy communication overhead. To address these issues, we propose a sparse and

orthogonality nonnegative matrix factorization model for federated multi-view clustering. Local orthogonal bases reduce redundancy within each view and enhance subspace stability, while structure spare of the shared representation enables feature selection and significantly reduces communication cost. The resulting problem is a multi-block nonconvex and nonsmooth optimization task with coupled local and global variables. We develop a proximal alternating minimization, and establish theoretical guarantees the sequence convergence to stationary points. Experiments on benchmark datasets demonstrate superior clustering performance, reduced communication cost, and stable convergence compared with existing federated multi-view methods.
Keywords: Federated Learning, Nonnegative Matrix Factorization, Sparse Representation, Orthogonal Constraint, Multi-View Clustering.

41: Title: Column Generation for Bayesian Network Structure Learning via Difference-of-Submodular Optimization

All Authors' Names and Affiliations:

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2) Rui Chen, School of Data Science, The Chinese University of Hong Kong, Shenzhen.

Presenter's Name: Yiran Yang

Abstract: We study the Bayesian Network Structure Learning (BNSL) problem via a column generation framework built on difference-of-submodular (DS) optimization. We adopt a score-based integer programming formulation, which seeks a maximum-scoring directed acyclic graph but suffers from an exponential number of variables and constraints. Column generation addresses this by generating variables on demand, yet the resulting pricing subproblem becomes the main computational bottleneck. For a general class of ℓ_0-penalized likelihood scores, we show how the pricing problem can be reformulated as a DS optimization problem and how the Difference of Convex Algorithm (DCA) can be applied as an inexact method to efficiently solve this pricing problem. This yields higher-quality solutions on continuous Gaussian data than state-of-the-art score-based approaches. Building on the same DS formulation, we are further

developing an exact pricing method, which is crucial for integrating column generation with branch-and-price to obtain exact BNSL solutions.
Keywords: Bayesian Network Structure Learning; Integer Programming; Column Generation; Difference-of-Submodular Optimization.

42: Title: Fast Presolving Framework For Sparsity Constrained Convex Quadratic Programming: Screening-Based Cut Generation and Selection

All Authors' Names and Affiliations:

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2) Guanyi Wang, Department of Industrial Systems Engineering and Management, National University of Singapore

Presenter's Name: Guanyi Wang

Abstract: Screening is widely utilized for Mixed-Integer Programming (MIP) presolving. It aims to certify a priori whether one or multiple specific binary variables can be fixed to optimal values based on solutions from convex relaxations. This paper studies the challenge of solving Sparsity-constrained (strongly) Convex Quadratic Programming (SCQP) and proposes the Screening-based Cut Presolving Framework (SCPF). SCPF contains two parts: a Screening-based Cut Generation (SCG) rule and a Screening-based Cut Selection (SCS) method. We show that the SCG provides superior screening ability compared to existing screening methods, and achieves a finer balance between screening effectiveness and computational overhead. We then provide theoretical guarantees for the SCS method to ensure the selection of generated cuts with high screening ability. Extensive numerical experiments validate the theoretical findings and demonstrate that the proposed framework significantly outperforms state-of-the-art screening methods. Notably, our SCPF achieves a 1.7X to 3.0X acceleration in total running time, especially in challenging phases, across high-dimensional synthetic datasets, complex real-world instances, and simulation libraries from sparse identification of nonlinear dynamics.

Keywords: Screening; Cutting plane; Presolving; Mixed-integer nonlinear

programming; Sparsity

43: Title: Debiasing Conditional Stochastic Optimization

All Authors' Names and Affiliations:

1) Lie He, Shanghai University of Finance and Economics;

2) Shiva Kasiviswanathan, Amazon

Presenter's Name: Lie He

Abstract: Conditional Stochastic Optimization (CSO) is a powerful framework for addressing complex problems in meta learning, reinforcement learning, causal inference, etc. However, a fundamental challenge persists: the nested structure of the CSO objective results in biased sample-averaged gradients, leading to prohibitively high sample complexity for convergence. In this talk, we introduce a general stochastic extrapolation technique designed to mitigate this systematic bias. By combining a k-th order extrapolation with variance reduction, we achieve sample near-optimal sample complexity for nonconvex smooth objectives as k increases. We conclude by demonstrating how this debiasing framework serves as a versatile tool for broader stochastic optimization challenges.

Keywords: Conditional Stochastic Optimization; Bias Correction; Stochastic Optimization