

Friday, 8:30 - 9:00

■ **FA-01**

Friday, 8:30 - 9:00 - Auditorium 1C

Opening

Stream: Plenaries
Invited session

Friday, 9:00 - 10:00

■ **FB-01**

Friday, 9:00 - 10:00 - Auditorium 1C

Marc Teboulle

Stream: Plenaries
Invited session

Chair: *Giancarlo Bigi*
Chair: *Sonia Cafieri*

1 - Algorithms for Structured Nonconvex Optimization

Marc Teboulle

In recent years, nonconvex optimization models have attracted a revived interest among scientists working in various disparate modern applications such as signal and image processing, and in machine learning. Indeed, in such applications, the models are often genuinely nonconvex and nonsmooth, yet they are very hard to solve. This talk will review some recent developments on the design and analysis of simple algorithms for some important classes of nonconvex problems, highlighting the pillars of the convergence theory, and the exploitation of the problem's structure and data information.

Friday, 10:25 - 11:40

■ FC-02

Friday, 10:25 - 11:40 - Room 1.1

MINO 1 - Polynomial Optimization with binary variables

Stream: Mixed-integer nonlinear optimization

Invited session

Chair: *Luca Mencarelli*

1 - Quadraticization in the optimization of polynomials with binary variables

Sourour Elloumi, Yves Crama, Amélie Lambert, Elisabeth Rodriguez-Heck

We consider quadraticization-based solution approaches for the optimization of polynomials of 0-1 variables. The quadraticization step aims at rewriting a degree three or more pseudoboollean function into an equivalent quadratic optimization problem with binary variables. The solution step handles the obtained equivalent problem. We provide a unified presentation of quadraticizations from the literature and review several methods that can be applied in the solution step. We discuss the impact of the quadraticization on the efficiency of the solution step and illustrate with some computational results.

2 - Improved linear and SDP-based quadratic convex reformulations

Mathieu Verchère, Sourour Elloumi

In this talk, we focus on linear reformulations and quadratic convex reformulations for a polynomial optimization problem in binary variables. We review two linear reformulation methods, focused on maximizing the LP bound and minimizing the number of additional variables, respectively. We address some recent improvements and show that this work on linear reformulations can also enhance the performance of SDP-based quadratic convex reformulations. We present experimental results to show the practical impact of these improvements.

3 - Outer Approximation Algorithms for Binary Nonlinear Optimization Programming

Luca Mencarelli

In this talk, we consider Binary Nonlinear Optimization Problems (BNPs), i.e., optimization problems with binary variables and nonlinear objective and constraints. We consider a simple, but computationally promising convexification technique for this kind of problems and we propose multiple and single tree tailored Outer Approximation algorithms. Finally, we present computational experiments for polynomial unconstrained and constrained instances.

■ FC-03

Friday, 10:25 - 11:40 - Room 1.2

CGT 1 - Intertwining optimization, variational problems and games I

Stream: Mathematical programming and computational game theory

Invited session

Chair: *Monica Milasi*

1 - Robustness via generalized Nash games and saddlepoints

Giancarlo Bigi

Robust counterparts of optimization problems can be formulated by exploiting infinitely many constraints and semi-infinite programs can be turned into Generalized Nash games with a peculiar structure. Pairing it with a penalization scheme for GNEPs leads to a class of methods that are based on saddlepoint problems. Any algorithm for these latter problems provides the basic iterations for the penalty scheme. A projected subgradient method for nonsmooth optimization and a subgradient method for saddlepoints are adapted to our framework and the convergence of the resulting algorithms is shown.

2 - Multiple private goods to finance a public good

Marta Faias

We extend the seminal model by Bergstrom, Blume and Varian (1986) on the private provision of public goods to contributions given by multiple private commodities. Taking into account the value of the aggregate bundle to finance the public good, we present a notion of equilibrium, show its existence, and provide a strategic market game approach. We define a sequence of non-cooperative games whose equilibria converge to an equilibrium for the economy. Finally, we analyze the effects that redistributions of endowments have on the equilibrium outcome.

3 - Variational methods to study energy market equilibrium problems

Domenico Scoppelliti, Monica Milasi

This talk focuses on the study of electricity market models, which evolve in T+1 stages, so that, at each stage, a continuum state of nature is possible. Each agent maximizes her utility under a budget constraint set that depends on the equilibrium price system; in turn, such a price system is determined by suitable market-clearing conditions. To capture the evolutionary aspects of the problem in response to an increasing level of information, an opportune filtered probability space is introduced and all is studied through suitable multistage stochastic quasi-variational inequality problems.

■ FC-04

Friday, 10:25 - 11:40 - Room 1.14

CO 1 - Duality, optimality conditions, and regularization in Conic Optimization

Stream: Conic optimization

Invited session

Chair: *Tatiana Tchemisova*

1 - Strong duality for standard convex programs

Qinghong Zhang, Ken Kortanek, Guolin Yu

A primal optimization problem and its dual are in strong duality if either one has a finite optimal value, then the other one is consistent and has the same value, and the dual problem is attained. We study the strong duality for a convex optimization problem using the bifunction, image space analysis, and polynomial ring approaches. Specifically, we reproduce strong duality results developed in 1970s via the bifunction approach. We use image space analysis and polynomial ring approaches to formulate new strong duals for the primal problem. Finally, we give an example to illustrate our duals.

2 - Strong dual formulations for linear copositive optimization

Tatiana Tchemisova, Olga Kostyukova

In convex and conic optimization, optimality conditions and duality are usually formulated under certain regularity conditions, constraint qualifications that ensure the fulfilment of the Karush-Kuhn-Tucker-type optimality conditions and the strong duality property, consisting in the fact that the optimal values of the primal problem and the corresponding dual Lagrange are equal and the dual problem reaches its maximum. We present new dual formulations for linear copositive problem, compare their properties and show that the obtained pairs of dual problems satisfy strong duality relations.

■ FC-05

Friday, 10:25 - 11:40 - Room 1.15

COVA 1 - Continuous optimization and variational analysis I

Stream: Continuous optimization and variational analysis

Invited session

Chair: *Juan Matías Sepulcre*

1 - Relaxed Lagrangian duality in convex infinite optimization

Miguel Goberna

We associate with each convex optimization problem P , posed on some locally convex space, and a given non-empty family H of finite subsets of its index set, a suitable Lagrangian-Haar dual problem. We present results on the equivalence of P to some subproblem obtained by replacing its whole index set by some element of H , zero duality theorems, strong and reverse strong theorems, and optimality conditions for this new type of duality.

2 - Characterizations of the set of strong Slater points of a linear semi-infinite system

Margarita Rodríguez Álvarez, José Vicente-Pérez

In this work, we study the set of strong Slater points, whose non-emptiness guarantees the fulfillment of the strong Slater condition. Given a linear inequality system, we establish some basic properties of the set of strong Slater points. Then, we derive dual characterizations for this set in terms of the data of the system, following similar characterizations provided also for the set of Slater points and the solution set of the given system, which are based on the polarity operators for evenly convex and closed convex sets.

3 - Duality between cost functions and multi-output production mappings.

Abelardo Jordán, Juan Enrique Martínez-Legaz

In a microeconomic context of n inputs and m outputs, we present the production correspondence that maps every input vector into the set of output vectors, whose values are normal sets. From this, the cost function is derived and their properties are established. As a fundamental result, a duality scheme is formulated that involves the quasi-concave production correspondences and the cost functions, mainly by reconstructing the production correspondence from the cost function, generalizing results from single-product approach. Additionally, results about radiantness are obtained.

■ FC-06

Friday, 10:25 - 11:40 - Room 1.16

VIU 1 - Some aspects of vector optimization

Stream: Variational inequalities and optimization under uncertainty

Invited session

Chair: *Christian Günther*

1 - Active Network and Price of Anarchy in Multi-Commodity Routing Games with Variable Demands

Valerio Dose

We consider equilibria in nonatomic routing games as functions of the traffic demand in a multi-commodity network. We then study the Price of Anarchy not only as a function of every possible vector of demands across all the commodities, but also as a function of a single real parameter where the vector of demands is given by a fixed demand function of the parameter. We prove several results concerning analogies with the single-commodity setting, and the behavior of the Price of Anarchy around points where it is not differentiable. We consider both affine and more general cost functions.

2 - Explaining Trade-offs in Interactive Multiobjective Optimization

Bekir Afsar, Kaisa Miettinen

Interactive methods support decision makers (DMs) in finding the most preferred solution based on preferences provided iteratively by the DM. However, existing methods do not explain how preferences are linked to generated solutions and why they are shown to the DM. The DM should be aware of these to be confident in one's decisions. We are inspired by LIME, a well-known machine learning explainer, and use KKT multipliers to explain local trade-offs among conflicting objectives without increasing computational load. We argue that explainability has vast potential in multiobjective optimization.

3 - A Penalty Strategy Embedded in the Tchebycheff Scalarization Method for Multi-objective Optimization Problems

Ana Maria A.C. Rocha, M. Fernanda P. Costa, Edite M.G.P. Fernandes

A multi-objective optimization method based on the weighted Tchebycheff scalarization function has been used to provide reasonable solutions to a polymer screw extruder optimal design, in a way that good trade-offs between conflicting objectives are identified. In this work, a penalty term is embedded in the Tchebycheff scalarization method aiming to guide the solutions towards the Pareto front. The goal of the penalty parameter is to balance convergence and diversity. The results show that the solutions obtained by the penalty-based algorithm cover reasonably well the Pareto front.

■ FC-07

Friday, 10:25 - 11:40 - Room 1.17

OHI 1 - Optimization on health informatics I

Stream: Optimization on health informatics

Invited session

Chair: *Pilar M. Ortigosa*

1 - A new hybrid optimization algorithm to combine physical and biological criteria to compute IMRT planning

Juan José Moreno Riado, Savíns Puertas Martín, Juana Lopez Redondo, Leocadio G. Casado, Pilar M. Ortigosa, Ester M Garzon

Intensity Modulated Radiotherapy (IMRT) is an effective cancer treatment to kill tumorous cells by radiation while preserving surrounding healthy organs. Medical prescriptions must consider biological and physical criteria. Models based on the Equivalent Uniform Dose (EUD) biological criteria provide RT plans with excellent PTV coverage. However, achieving physical constraints requires additional EUD parameter tuning (EUD-PT). We propose a hybrid optimization scheme for an automatic EUD-PT, allowing a flexible combination of physical criteria and personalized prescriptions with the EUD model.

2 - A practical study of black-box and surrogate optimizers for tuning spiking neural models of striatum plasticity

N.c. Cruz, A. González-Redondo, Juana Lopez Redondo, E.m. Ortigosa, J.a. Garrido, Pilar M. Ortigosa

A realistic model of the striatum learns to select actions by trial and error. However, model tuning is challenging due to the expert knowledge required and the computational cost of assessing configurations (e.g., more than 60 minutes per run). In this work, we try to replace the tedious and potentially biased expert-based tuning with different optimizers that need few function evaluations. The options are the SurrogateOpt solver of Matlab and the RBFOpt library, both based on radial basis function approximation, and DIRECT-GL, an enhanced version of the widespread black-box method DIRECT.

3 - On the use of teaching-learning based optimization to train neural networks

Marcos Lupion Lorente, Nicolás Calvo Cruz, Ben Paechter, Pilar M. Ortigosa

Backpropagation (BP) is the most used technique to train neural networks. However, it can converge to local optima due to its mathematical conception. Meta-heuristic optimizers overcome this issue and achieve good results for small networks. This work uses and extends TLBO, one of such methods, to train a great network (LeNet-CNN). It is modified to start from a hybrid population combining pure random solutions and partially trained ones with BP. TLBO has also been updated to use BP to improve part of the population during the search, which results in a memetic optimization approach.

Friday, 11:45 - 13:00

■ FD-02

Friday, 11:45 - 13:00 - Room 1.1

MINO 2 - Mixed-integer nonlinear programming applications

Stream: Mixed-integer nonlinear optimization

Invited session

Chair: *Jan Rolfes*

1 - A Gauss-Newton-based Decomposition Algorithm for Nonlinear Mixed-Integer Optimal Control Problems

Clemens Zeile

For the fast approximate solution of Mixed-Integer Non-Linear Programs (MINLPs) arising in the context of Mixed-Integer Optimal Control Problems a decomposition algorithm exists that solves a sequence of three comparatively less hard subproblems to determine an approximate MINLP solution. In this work, we propose a problem formulation for the second algorithm stage that is a convex approximation of the original MINLP and relies on the Gauss-Newton approximation. We analyze the algorithm in terms of approximation properties and present a numerical case study of a renewable energy system.

2 - Simultaneous Design and Optimization of Complex Processes Constrained by Partial Differential Equations using Mixed Integer Formulations

Hasan Sildir, Emrullah Erturk, Sahin Sarrafi

Optimization problems constrained by partial differential equations (PDEs) are challenging but delivers significant impact in many engineering fields. A mixed-integer formulation is proposed for the simultaneous calculation of topology and process related continuous variables, unlike sequential design studies. The binary variables in the formulation limit some variables through linking constraints, forming the topology. The problem formulation is flexible and promising since it is flexible to further simplifications and reformulations in the large-scale implementations at various disciplines.

3 - Distributionally robust optimization with envelope and moment information

Jan Rolfes

Driven by an application from chromatography, we model an optimization problem with linear objective subject to robust constraints that depend on an uncertain particle size distribution (psd). Without further knowledge about this psd the problem would be too conservative. Thus, we combine a generalized form of the classical moment constraints by Shapiro with confidence set constraints on the psd. The latter are informed by an envelope around the psd. Thereby, we decrease the conservatism in our model and optimize the fractionation process together with our colleagues in process engineering.

■ FD-03

Friday, 11:45 - 13:00 - Room 1.2

CGT 2 - Intertwining optimization, variational problems and games-II

Stream: Mathematical programming and computational game theory

Invited session

Chair: *Lorenzo Lampariello*

1 - Quasi-variational problems with non-self map on Banach spaces: existence and application

Monica Milasi, Domenico Scopelliti

We study the generalized quasi-variational inequality problems with a non-self constraint map. We consider the concept of the projected solution and we prove the existence in real Banach spaces. Following the stochastic variational approach introduced by Rockafellar and Wets, we introduce the concept of the projected solution in the stochastic setting, and we prove the existence of such a solution. We apply these theoretical results in studying an electricity market with renewable power sources.

2 - Distributed methods for monotone inclusions

Yura Malitsky

In this talk, I would like to present some new methods for solving monotone inclusions with S_n operators. A notable interest is that they do not belong to the standard product space reformulation of existing algorithms. We will consider different methods, depending on the operators assumptions. These methods are distributed by design and can also be used for asynchronous computation. The talk is based on joint works with Matthew Tam, Francisco J. Aragón-Artacho, and David Torregrosa-Belén.

3 - Addressing Nested Variational Inequalities

Lorenzo Lampariello

We consider nested variational inequalities consisting in a (upper-level) variational inequality whose feasible region is given by the solution set of another (lower-level) variational inequality. To treat these problems numerically, we rely on the renowned Tikhonov paradigm using either averaging or prox-like techniques: convergence and complexity results are obtained under rather weak assumptions.

■ FD-04

Friday, 11:45 - 13:00 - Room 1.14

CO 2- Convex and nonconvex Optimization and applications

Stream: Conic optimization

Invited session

Chair: *Tatiana Tchemisova*

1 - Approximate solutions of convex semi-infinite optimization problems in finitely many iterations

Miltiadis Poursandis, Jochen Schmid

We develop two adaptive discretization algorithms for convex semi-infinite optimization, which terminate after finitely many iterations at approximate solutions of arbitrary precision. They terminate at a feasible point of the considered optimization problem. Compared to existing finitely feasible algorithms for general SIPs, our algorithms work with considerably smaller discretizations and all occurring finite optimization must be solved only approximately. We apply our algorithms to solve various shape-constrained regression problems in engineering processes. See: arxiv.org/abs/2105.08417.

2 - To the Solution of Constrained Experimental Design Problems - Extending an Adaptive Discretization Approach

Philipp Seufert, Jan Schwientek, Tobias Seidel, Michael Bortz, Karl-Heinz Küfer

While the literature on optimal experimental design (OED) is primarily concerned with unconstrained problems, it is also of interest to restrict individual experiments, certain design quantities, or even the entire experimental plan. For the numerical solution of such constrained infinite-dimensional nonlinear OED problems, we propose an adaptive discretization scheme w.r.t. the Lagrangian. We adapt constraint qualifications from nonlinear programming and prove convergence of the algorithm to a global optimal design. Finally, we apply the method in the context of multi-criteria OED.

■ FD-06

Friday, 11:45 - 13:00 - Room 1.16

VIU 2 - Vector optimization with uncertainties

Stream: Variational inequalities and optimization under uncertainty

Invited session

Chair: *Akhtar Khan*

1 - Computing robust efficient solutions of discrete vector optimization problems with uncertainties

Christian Günther, Nicolae Popovici, Elisabeth Anna Sophia Köbis

Different concepts of optimality are currently known in vector optimization with uncertainties (set optimization), and various types of binary relations (e.g., l-type and u-type preorder relations) can be used in order to define them. The principal aim of this talk is to present numerical procedures for computing robust efficient solutions of discrete vector optimization problems with uncertainties. These procedures are mainly based on certain set-valued counterparts of some methods originally conceived for vector optimization problems without uncertainties.

2 - Optimality conditions in optimization under uncertainty

Christiane Tammer

Most optimization problems involve uncertain data due to measurement errors, unknown future developments and modeling approximations. Stochastic optimization assumes that the uncertain parameter is probabilistic. An other approach is called robust optimization which expects the uncertain parameter to belong to a set that is known prior. In this talk, we consider scalar optimization problems under uncertainty with infinite scenario sets. We apply methods from vector optimization, set optimization and scalarization techniques to derive necessary optimality conditions.

3 - Set-valued vector optimizations in ordered Fell topological hyperspaces of partially ordered topological vector spaces

Jinlu Li

In this paper, we study the following two subjects: the continuity (topological order-embedding properties) of the canonical mappings from the partially ordered topological space X to the two ordered Fell topological hyperspaces $C(X)$; and the application of the continuity of the mappings to prove (a) the existence of solutions of some (closed) set-valued vector optimization problems and the properties of the solutions and (b) the solvability of some (closed) set-valued vector variational inequalities.

■ FD-07

Friday, 11:45 - 13:00 - Room 1.17

OHI 2 - Optimization on health informatics II

Stream: Optimization on health informatics

Invited session

Chair: *Juana Lopez Redondo*

1 - Drugs discovery by shape similarity using Deep Learning

Luis F. Romero, Luis Felipe Romero Caparrós, Juana Lopez Redondo, Pilar M. Ortigosa

Searching for one or several molecules in a database using its shape has great interest from a biochemical point of view, but requires a huge computational effort due to the complexity of the algorithms and the sizes of the databases in the pharmaceutical industry. This work uses Deep Learning by training neural networks with hundreds of images of each molecule, rendered by projections (using GPUs) on planes whose normals are equally distributed in the 3D space (using Fibonacci spirals). The obtained results, both in accuracy and time, exceed expectations, opening a hopeful path of research.

2 - Machine Learning for the prediction of retinopathy onset

Giulia Di Teodoro, Laura Palagi, Marianna Maranghi

Type-2 diabetes is associated with microvascular complications such as retinopathy. We aim to define a predictive ML model for the onset of the pathology. The database is the unique Italian Diabetes Association collection of over 20 years. The huge dataset is extremely unbalanced: 81,867 non-retinopathic and 8,280 retinopathic patients. We first obtain a baseline predictive model applying traditional ML classification models. We propose to develop weighted ensemble models, capable of leveraging the performance of the single models to improve KPIs and to include summary features of patients.

3 - Optimization method for maximizing the similarity in flexible molecules

Savíns Puertas Martín, Juana Lopez Redondo, Valerie J. Gillet, Horacio Pérez-Sánchez, Pilar M. Ortigosa

Virtual Screening (VS) aims to reduce the time and budget required in drug discovery. Although they have several rotatable bonds, the most current VS methods assume the ligands to be rigid. Therefore, it is compulsory to consider flexibility during the screening process to achieve good predictions. In this work, we have extended the functionality of OptiPharm, a recent piece of software, by considering the flexibility of the molecules. Additionally, the new version presents new strengths regarding its previous version and can provide valuable results based on different descriptors.

Friday, 14:30 - 16:10

■ FE-02

Friday, 14:30 - 16:10 - Room 1.1

MO 1 - Continuous multiobjective optimization

Stream: Multiobjective optimization

Invited session

Chair: *Birgit Rudloff*

1 - Treating nonsmooth regularization problems via multiobjective optimization

Bennet Gebken, Katharina Bieker, Sebastian Peitz

In many applications, optimization problems arise in which a smooth, scalar objective function is regularized with a weighted (nonsmooth) regularization term. Examples are image denoising, sparse regression and machine learning. In the context of multiobjective optimization, these problems are weighted sum scalarizations of the MOP that minimizes the smooth function and the regularization term simultaneously. In this talk, we will show how this connection enables us to analyze the structure of the solution of the regularization problem and construct path-following methods for its computation.

2 - A multiobjective model predictive control algorithm

Lisa Krügel, Gabriele Eichfelder, Lars Grüne, Jonas Schiebl

Model predictive control (MPC) is a control method in which an optimal control problem is solved in each iteration. In MCP it is a natural idea that we do not consider only one, but multiple objectives. This leads to the formulation of a multiobjective optimal control problem. In this talk, we introduce a multiobjective MPC scheme which yields system theoretic properties and, due to the optimization-based nature of the method, averaged and non-averaged performance results for all objective functions. Application examples and numerical simulations will illustrate our findings.

3 - A Quasi-Newton Approach for Large Scale Multi-Objective Optimization

Pierluigi Mansueto, Matteo Lapucci

We propose a Limited Memory Quasi-Newton method for large scale unconstrained multi-objective optimization. The algorithm approximates the combinations of the objective functions Hessians through positive definite matrices, whose formula is similar to the one of the L-BFGS method for scalar optimization. By means of a Wolfe line search, our method is well defined even for non-convex optimization problems. We compare the performance of the proposed algorithm with other state-of-the-art Newton and Quasi-Newton approaches, showing its effectiveness and strengths with respect to the competitors.

4 - Multivariate Dynamic Programming

Birgit Rudloff, Zachary Feinstein, Gabriela Kovacova

Dynamic multivariate problems are often time-inconsistent. Examples include the bi-objective mean-risk problem, or Nash equilibria in a dynamic game. Observing that one can formulate these problems with a set-valued value function, we extend the Bellman's principle to such value functions. It is shown that the problems above do satisfy this Bellman's principle and are thus actually time-consistent in a set-valued sense. Practical implications and interpretations are discussed. Numerical examples are given which lead to a sequence of vector optimization problems solved backwards in time.

■ FE-03

Friday, 14:30 - 16:10 - Room 1.2

CGT 3 - Mixed integer games

Stream: Mathematical programming and computational game theory

Invited session

Chair: *Tobias Harks*

1 - Submodular maximization of concave utility functions composed with a set-union operator

Fabio Furini, Stefano Coniglio, Ivana Ljubic

We study a discrete optimization problem asking for the maximization (in expectation over a discrete set of scenarios) of a concave, strictly increasing, and differentiable function (whose coefficients are scenario-dependent) composed with a set-union operator. In the work, we propose a double-hypograph decomposition which allows for projecting out the variables associated with the items by separately exploiting the structural properties of the utility function and the set-union operator.

2 - Pure Nash Equilibria in Resource Graph Games

Jannik Matuschke, Tobias Harks, Max Klimm

We study the existence of pure Nash equilibria in resource graph games, a general class of strategic games succinctly representing the players' private costs. These games are defined relative to a finite set of resources and the strategy set of each player corresponds to a set of subsets of resources. The cost of a resource is an arbitrary function of the load vector of a certain subset of resources. As our main result, we give complete characterizations of the cost functions guaranteeing the existence of pure Nash equilibria for weighted and unweighted players, respectively.

3 - Algorithmic Solutions for Almost Core Allocations

Marc Uetz

For cooperative games with empty core, several core relaxations are known, each relaxing the core minimally to make it non-empty. We consider the linear optimization problem to maximize the total amount that can be distributed over the individual players so that no proper subset of players would prefer to deviate. This can be studied also for problems with non-empty core. We discuss some complexity theoretic results for this problem, and give a 2-approximation algorithm for minimum spanning tree games. Several open questions remain. (Joint work with Rong Zou, Boyue Lin, and Matthias Walter.)

4 - Generalized Nash Equilibrium Problems with Mixed-Integer Variables

Tobias Harks

I will talk about generalized Nash equilibrium problems (GNEPs) with non-convex strategy spaces and non-convex cost functions. This general class of games includes the important case of games with mixed-integer variables for which only a few results are known in the literature. I present new approaches to characterize equilibria and show that some of them lead to direct approaches for computing them. This is joint work with Julian Schwarz.

■ FE-04

Friday, 14:30 - 16:10 - Room 1.14

DFO 1 - New algorithmic approaches in derivative-free optimization

Stream: Derivative-free optimization

Invited session

Chair: *Francesco Rinaldi*

1 - Quadratic Regularization Methods based on Finite-Difference Gradient Approximations

Geovani Grapiglia

In this talk, derivative-free quadratic regularization methods based on finite-difference gradient approximations are presented. In these methods, the accuracy of the gradient approximations and the regularization parameter in the quadratic models are jointly adjusted using a non-monotone acceptance condition for the trial points. Deterministic worst-case complexity bounds with linear dependence on the problem dimension are obtained for the generation of approximate stationary points. Preliminary numerical results illustrate the relative efficiency of the proposed methods.

2 - A derivative-free method for convex constrained minimization

Evelin Heringer Manoel Krulikowski, Ana Luisa Custodio, Marcos Raydan

We present a new DFO approach for solving convex constrained minimization problems, assuming that the feasible set is the intersection of a finite collection of convex sets. The method is based on a combination of Directional Direct Search and Spectral Projected Gradient approaches, with Dykstra's alternating algorithm used for projection, and simplex gradients replacing the true gradient. We will present the algorithmic framework, associated convergence results, and numerical experiments that state the quality of the proposed framework.

3 - An interior point method for nonlinear constrained derivative-free optimization

Andrea Brilli, Giampaolo Liuzzi, Stefano Lucidi

We consider constrained optimization problems where both the objective and constraint functions are of the black-box type. We assume that the nonlinear inequality constraints are non-relaxable, i.e. their values and that of the objective function cannot be computed outside of the feasible region. We propose a new derivative-free optimization method which is based on the use of a merit function that handles inequality constraints by means of a log-barrier approach and equality constraints by means of a quadratic penalty approach.

■ FE-05

Friday, 14:30 - 16:10 - Room 1.15

MINO 3 - Mixed-integer nonlinear optimization

Stream: Mixed-integer nonlinear optimization

Invited session

Chair: *Jan Kronqvist*

1 - Combining discrete and continuous information for multi-criteria optimization problems

Katrin Teichert, Tobias Seidel

For an MCO problem with a continuous underlying structure, the utility function may sometimes still be discrete in nature. A process model may have continuously dependent product yield and quality, but delivery batch size and quality categorization dictate a discrete utility function. In such a case, a Pareto front approximation that tries to represent the space of conceivable utility functions of the DM lends itself to a discrete approach, while derivative information from the continuous structure can be used to obtain better bounds. In our talk, we discuss appropriate solution strategies.

2 - Sequential penalty methods for mixed integer programs

Marianna De Santis

We present a branch-and-bound method for mixed binary programs based on adding penalty terms to the objective function along the nodes. The resulting scheme addresses a sequence of continuous problems that share the same feasible set, while the objective function slightly changes so that the penalization of the integrality constraint violation is progressively increased. In the context of mixed integer linear complementarity problems, enhancements of the method are explored and a numerical comparison with two benchmark approaches from the literature is shown.

3 - Semidefinite Programming Approach to Security Constrained Optimal Power Flow with FACTS Devices

Bartosz Filipecki

Producing accurate and secure solutions to the Optimal Power Flow problem becomes increasingly important due to rising demand and share of renewable energy sources. We consider an Optimal Power Flow model with additional decision variables associated with line switching and FACTS devices, such as phase-shifting transformers and thyristor-controlled series capacitors. We show how a Lasserre hierarchy can be applied to this model to obtain a semidefinite programming relaxation. Finally, we provide results of numerical experiments on this relaxation.

4 - On the use of regularization, trust regions, and Hessian information in outer-approximation for convex MINLP

Jan Kronqvist, David Bernal, Zedong Peng Peng, Ignacio Grossmann

Kronqvist et al. (2020) showed that by integrating ideas from level bundle methods in outer approximation (OA) it is possible to use regularization/trust-regions in the subproblems of finding new integer assignments. The same framework also enabled Hessian information to be utilized for selecting new integer assignment. Here we discuss the framework and extensions to general regularization functions. We show that finite convergence is independent of the choice of regularization function, and we present numerical results comparing different regularization functions.

■ FE-06

Friday, 14:30 - 16:10 - Room 1.16

VIU 3 - Uncertainty quantification in inverse problems

Stream: Variational inequalities and optimization under uncertainty

Invited session

Chair: *Jinlu Li*

1 - Modelling uncertainty in thermal models for residential buildings

Miguel Sama, Jorge Arias, Akhtar Khan

A new model for thermal behaviour of a single residential building which contains a single control element given by a smart thermostat is introduced. This model depends on four parameters of interest related with the insulation, heat capacity, heater power and solar energy contribution. To deal with the natural uncertainty, the mathematical model corresponds with a random differential equation where the parameters, and hence the temperature, are itself random variables. Numerical results show that enough data can compensate the lack of physical knowledge.

2 - Inferring the basal sliding coefficient for the Stokes ice sheet model under rheological uncertainty

Olalekan Babaniyi

We consider an inverse problem for the basal sliding coefficient in a nonlinear Stokes ice sheet model from noisy surface velocity measurements. This model has other rheological parameters that are unknown and uncertain but are not of interest. We use the Bayesian approximation error (BAE) approach to avoid joint inference for the Basal sliding coefficient and the rheological parameters. We show numerical examples that demonstrate the performance of the method on an ice sheet flow model problem.

3 - Inverse variational approach for a random time-dependent economic equilibrium problem

Annamaria Barbagallo

The talk deals with the random time-dependent oligopolistic market equilibrium model. In particular the policymaker's point of view of the model is studied. The random time-dependent optimal control equilibrium conditions are expressed by means of an inverse stochastic time-dependent variational inequality which is proved to be equivalent to a stochastic time-dependent variational inequality. Some existence and well-posedness results for optimal regulatory taxes are obtained. Moreover a numerical scheme to compute solutions to stochastic time-dependent variational inequalities is presented.

4 - Stochastic Approximation Approach for the Elastography Inverse Problem

Baasansuren Jadamba

We consider an inverse problem of identifying a stiffness parameter in a stochastic linear elasticity system that models displacements in human tissues under prescribed forces. An optimization approach for the problem is discussed and we present results obtained by using a projected-gradient type approximation method for the problem.

Friday, 16:15 - 17:30

■ FF-02

Friday, 16:15 - 17:30 - Room 1.1

MO 2 - Convex multiobjective optimization

Stream: Multiobjective optimization

Invited session

Chair: Firdevs Ulus

1 - A Benson algorithm for unbounded convex vector optimization problems

Gabriela Kovacova, Andrea Wagner, Firdevs Ulus, Birgit Rudloff, Niklas Hey

Benson's idea of approximating efficient values in the objective space has been adapted to solving bounded convex vector optimization problems in Löhne, Rudloff and Ulus (2014). In this work, we relax the assumption of boundedness. We generalize the solution concept to be applicable for both bounded and unbounded problems and derive an algorithm capable of handling both types of problems. Our algorithm initiates with a phase that simultaneously finds recession directions as well as an initial outer approximation. We illustrate the algorithm with examples.

2 - Convergence rate of Sandwiching methods for convex multi-objective optimization

Ina Lammell, Karl-Heinz Küfer

The Sandwiching method creates an inner and outer approximation of a convex Pareto front. While the algorithm has been thoroughly studied in the 2d case, no rigorous proof of the convergence rate in higher dimensions has been presented, yet. We adapt a proof of George Kamenev for a similar method for approximating convex sets to our algorithm and obtain a proof of the convergence rate for any number of objectives. We demonstrate that the smoothness conditions that yield an optimal convergence rate are fulfilled for some applications in radiotherapy planning and chemical process engineering.

3 - Direction-free primal and dual approximation algorithms for convex vector optimization problems

Firdevs Ulus, Cagin Ararat, Simay Tekgül

Various algorithms for solving convex vector optimization problems work by fixing a direction parameter. A direction-free primal algorithm has been proposed recently. We propose a direction-free geometric dual algorithm which gives finite- and finite weak*-solutions to the dual and primal problems, respectively. ϵ is determined by δ and the structure of the ordering cone. We also modify the primal algorithm such that it gives a finite (weak*)-solution to both problems. We test the performance of the algorithms for randomly generated problem instances.

■ FF-03

Friday, 16:15 - 17:30 - Room 1.2

CCO 1 - Complexity of convex optimization

Stream: Complexity of convex optimization

Invited session

Chair: Geovani Grapiglia

1 - Stochastic minibatch subgradient projection methods for composite optimization with functional constraints

Ion Necoara

We consider optimization problems with stochastic composite objective function subject to constraints given as level sets of convex but not necessarily differentiable functions. We derive a stochastic subgradient method with random feasibility updates, taking a stochastic proximal subgradient step aimed at minimizing the objective and then a subsequent subgradient step minimizing the feasibility violation of the observed random constraints. We analyse the convergence behavior of the algorithm when the objective function is convex or has a quadratic growth, unifying nonsmooth and smooth cases.

2 - Affine-invariant contracting-point methods for Convex Optimization

Nikita Doikov, Yuri Nesterov

In this work, we present new affine-invariant algorithms for solving convex minimization problems with bounded domain. We introduce a general framework of Contracting-Point methods, which solve at each iteration an auxiliary subproblem restricting the objective onto contraction of the domain. We show that using an appropriate affine-invariant smoothness condition, it is possible to implement iteration by one step of the Taylor approximation. For the methods of order one, it recovers Frank-Wolfe algorithm. For order two, it gives new Contracting Newton method with global complexity guarantees.

3 - Asynchronous SGD Beats Minibatch SGD Under Arbitrary Delays

Konstantin Mishchenko

The existing theory predicts that Asynchronous SGD becomes arbitrarily slower than Minibatch SGD when at least one worker experiences long delays. In this work, we show that it is not true and that regardless of the worst delay, Asynchronous SGD has rates at least matching those of Minibatch SGD. We prove this for nonconvex and convex problems, which can also be either smooth or nonsmooth. In all cases, we show that the performance of Asynchronous SGD scales with the number of workers rather than the largest delay.

■ FF-04

Friday, 16:15 - 17:30 - Room 1.14

IO 1 - Interval optimization

Stream: Interval optimization

Invited session

Chair: *Miroslav Rada*

1 - Maximization of sample variance over interval data is easy on average

Miroslav Rada, Michal Cerny, Ondřej Sokol

We deal with the following NP-hard problem motivated by robust statistics: given real intervals (each of them represents an imprecise data point), maximize the sample variance over these intervals. This amounts to maximization of rank-1 convex quadratic form over a hypercube. Despite the NP-hardness, we show that when the intervals come from a fairly general probabilistic setup, the problem is solvable in almost linear time using algorithm of Ferson et al., utilizing the rank-deficiency of the underlying quadratic form. Furthermore, we show how the result could be generalized to higher ranks.

2 - gH-differentiability for Interval-valued functions: an application to fuzzy environment

Beatriz Hernández-Jiménez, Rafaela Osuna-Gómez, Tiago M. da Costa, Yurilev Chalco-Cano

A gH-differentiability notion for interval-valued functions of several real variables is presented. It overcomes some drawbacks of the gH-differentiability definition in previous literature, getting a gH-differential that is a quasilinear interval-valued function. We prove that the gH-differentiability concept given by Markov (1979), Stefanini and Bede (2009) and Stefanini and Arana-Jiménez (2019) (extensions of Gâteaux differentiability) and the new definition are equivalents. As an application, we present the extension of the new differentiability concept to the fuzzy environment.

3 - On the Properties of Interval Transportation Problems

Elif Garajová, Miroslav Rada

Interval programming provides a mathematical model for handling interval-valued uncertainty in various optimization problems. Here, we assume that only lower and upper bounds on the data are known and the values can be independently perturbed within these bounds. In this talk, we adopt the approach to model transportation problems with interval costs, supply and demand. We investigate the main properties (such as the worst optimal value or the optimal solution set) and study the computational complexity of the connected decision problems for different forms of interval transportation problems.

■ FF-05

Friday, 16:15 - 17:30 - Room 1.15

COVA 3 - Continuous optimization and variational analysis III

Stream: Continuous optimization and variational analysis

Invited session

Chair: *Abderrahim Hantoute*

1 - A variational inequality approach to Network Games

Fabio Raciti

The aim of Network Games is to model the social and economic interactions among individuals with the help of graph theoretical concepts. After the foundational paper by Ballester et al., many scholars devoted many papers to this topic, mainly using methodologies from Game Theory and focusing on the case where the solution is interior to the constraint set. In this talk we show how the variational inequality approach can be effectively used to generalize some classic results, and provide efficient computational algorithms.

2 - Properties of the level sets of functions whose critical sets and Hess(+) complements are bounded

Cornel Pintea

We investigate the connectedness and the convexity of the level sets of the real valued functions, of two and three variables, with bounded critical sets and bounded Hess(+) complements. Recall that the Hess(+) region of the real valued function f is the set of all points in the domain of f such that the Hessian matrix of f is positive definite and its critical set of the is the vanishing set of its gradient. The technical details are based on the extreme points of the curvature function associated to f and they are pointed out by using the Lagrange multipliers technique.

3 - Tour on robust stability, duality and optimal conditions

Abderrahim Hantoute

In this talk we discuss some new optimality conditions for robust convex optimization on locally convex spaces. Our conditions make use of continuity and uniform continuity type criteria. These results are then applied to introduce new robust dual problems and provide operative conditions that ensure zero-duality gaps, stable duality and strong duality. Our approach make use of subdifferential calculus of integral functions, series functions, and infinite/robust sums of convex functions.

■ FF-06

Friday, 16:15 - 17:30 - Room 1.16

VIU 4 - Robust optimization

Stream: Variational inequalities and optimization under uncertainty

Invited session

Chair: *Annamaria Barbagallo*

1 - On proper minimality in robust vector optimization: a set optimization approach*Elena Molho, Lidia Huerga, Enrico Miglierina, Vicente Novo*

We extend some notions of proper minimality to set optimization. We focus our attention on the concepts of Henig proper minimality, where stability with respect to perturbations of the ordering cone is considered, and Geoffrion proper minimality, where the boundedness of trade off-ratios between conflicting objectives is required. We compare the two classes of notions in a finite dimensional space ordered by a special class of polyhedral cones. Both sufficient and necessary optimality conditions for proper minimality are proved by using linear and nonlinear scalarizations.

2 - Scalarization and robustness in uncertain vector optimization problems*Elisa Caprari, Lorenzo Cerboni Baiardi, Elena Molho*

The robust optimization approach can be used to tackle uncertain vector problems by considering worst case scenarios. In this context, notions of robust efficient solutions which are coherent with a set-valued minimization process have been introduced and we address the question whether scalarization and robustification can be commuted in a non componentwise framework.

3 - Scalarization and robustness in games with uncertain vector payoffs*Lorenzo Cerboni Baiardi, Elena Molho, Elisa Caprari*

In games with vector payoffs, players evaluate their outcomes characterized by conflicting objectives. When payoffs are affected by uncertain parameters, the robust optimization approach à la Ben Tal and Nemirowsky can be used to tackle such indeterminacy. Robust Nash equilibria extend the classical notion of equilibria in this context. We consider an axiomatic approach to scalarization that allows us to identify (pure and mixed) Nash equilibria in non cooperative games with vector payoffs. In this light, we discuss different approaches to scalarization that have been proposed in literature.

■ FF-07*Friday, 16:15 - 17:30 - Room 1.17***OC 1 - Optimal control and optimization in finance, commodity trade, insurance and pension fund systems I**

Stream: Optimal control and optimization in economics and social sciences

*Invited session*Chair: *Nuno Azevedo***1 - Bilevel interior point differential dynamic programming***Andrei Pavlov, Jia-Jie Zhu*

We present a novel interior-point differential dynamic programming algorithm for solving bilevel optimization problems that arise in optimal control of nonlinear discrete-time dynamics with general inequality constraints. Our primary motivation is to solve optimal control problems in the presence of external disturbances or adversaries. We demonstrate how exploiting the structure of the optimization problem given by the Markovian property, Bellman optimality principle, and interior point method leads to a computationally efficient numerical algorithm for the bilevel optimal control problem.

2 - A Dynamic Programming Approach for a Nonzero Sum Stochastic Differential Game Problem*Gerhard-Wilhelm Weber, Emel Savku*

We apply dynamic programming principle to discuss an optimal investment problem by using nonzero-sum stochastic game approach in a continuous-time Markov regime-switching environment within the frame work of behavioral finance. We represent different states of an economy and, consequently, investors' floating levels of psychological reactions by a D-state Markov chain. We derive regime-switching Hamilton-Jacobi-Bellman-Isaacs equations and obtain explicit optimal portfolio strategies with Feynman-Kac representations of value functions.

3 - Two-player zero-sum stochastic differential games with Markov-switching jump-diffusion dynamics and a random horizon*Nuno Azevedo, Miguel Ferreira, Diogo Pinheiro, Susana Pinheiro*

We consider a two-player zero-sum stochastic differential game with a random horizon whose state variable dynamics are given by a Markov-switching jump-diffusion. We study this game using a combination of dynamic programming and viscosity solution techniques. Under some mild assumptions, the value of the game exists and is the unique viscosity solution of a certain nonlinear partial integro-differential equation of Hamilton-Jacobi-Bellman-Isaacs type. Time allowing, we will discuss applications to Finance and Insurance.

Friday, 18:00 - 19:00

■ FG-01

Friday, 18:00 - 19:00 - Auditorium 1C

Alper Yildirim

Stream: Plenaries

Invited session

Chair: *Paula Amaral*

1 - Convex Relaxations of Nonconvex Quadratic Programs: A New Perspective via Convex Underestimators

E. Alper Yildirim

Quadratic programming is concerned with minimizing a (nonconvex) quadratic function over a polyhedron. In addition to numerous applications, quadratic programs arise as subproblems in many algorithms for general nonlinear optimization problems. It is therefore a fundamental NP-hard problem in optimization.

Saturday, 8:30 - 10:10

■ SA-02

Saturday, 8:30 - 10:10 - Room 1.1

MO 3 - Mixed-integer multiobjective optimization

Stream: Multiobjective optimization

Invited session

Chair: *Gabriele Eichfelder*

1 - Solving multi-objective mixed-integer convex optimization problems by hybrid patch decomposition

Leo Warnow, Gabriele Eichfelder

In this talk, we present a new approach to compute an enclosure of the nondominated set of multi-objective mixed-integer convex optimization problems. More precisely, we decompose the overall problem into several multi-objective continuous convex optimization problems, which we refer to as patches. We then dynamically compute and improve coverages of the nondominated sets of those patches to finally combine them to obtain an enclosure of the nondominated set of the original problem. Further, we introduce a mechanism to reduce the number of patches that need to be considered in total.

2 - Multiobjective Optimization of Decentralized Energy Supply Networks

Moritz Link, Stefan Volkwein

In view of the climate change, energy supply network planning can no longer focus only on the economic objective, but also on other criteria such as minimizing the carbon emissions. This leads to multiobjective optimization problems for decentralized energy supply networks. Moreover, taking into account static energy flow equations together with modeling practical decisions in the network yields a mixed-integer nonlinear structure of the resulting problems. In this talk, we present first results towards tackling real-world network instances.

3 - Adaptive patch approximation algorithm for bicriteria mixed-integer problems

Erik Diessel

We present an algorithm for bicriteria mixed-integer problems with convex constraints based on creating patches consisting of solutions with shared assignments for the discrete variables. By solving single-criteria MIPs, iteratively patches are computed that provide the largest possible improvement on the approximation quality. We show that the algorithm requires a number of iterations that is of the same order as the minimal number of patches necessary to achieve the given approximation quality. This is illustrated by bicriteria optimization of supply chains regarding costs and risks.

4 - Using Dual Bounds for Multiobjective Mixed Integer Quadratic Programming

Daniele Patria, Marianna De Santis, Gabriele Eichfelder, Leo Warnow

We present an algorithmic framework for solving Multi-Objective Mixed Integer Convex Quadratic Programs. The framework is based on two phases: a branch-and-bound method is applied to detect promising integer fixings, that are needed to initialize the second phase, where the Pareto front is detected using the solver HyPaD. The branch-and-bound works by fixing subsets of variables to integer values. Lower bounds are computed by addressing properly defined dual problems. A smart preprocessing allows to enumerate nodes in the branch-and-bound tree very quickly. Numerical experiments are shown.

■ SA-03

Saturday, 8:30 - 10:10 - Room 1.2

CGT 4 - Advances in conic optimization

Stream: Mathematical programming and computational game theory

Invited session

Chair: *Alice Calamita*

1 - A Sparse Interior Point Method for Linear Programs arising in Optimal Transport

Filippo Zanetti, Jacek Gondzio

Discrete Optimal Transport (OT) problems give rise to very large linear programs with a particular structure of the constraint matrix. In this talk we present an Interior Point Method (IPM) specialized for OT. Its main features are: we force all intermediate iterates to be as sparse as possible; we employ a matrix-free technique to avoid forming the huge matrices involved; we solve the Newton system mixing direct and iterative solvers. We compare our method with state-of-the-art network solvers and show that the IPM can compete with them in terms of computational time and memory usage.

2 - Computational comparison of various formulations of MIQP problems

Alice Calamita, Pasquale Avella, Laura Palagi

We discuss different formulations that can be used to address a family of quadratic mixed-integer optimization problems with logically constrained decision variables. In particular, we consider problems that exhibit logical relationships between continuous and discrete variables and present quadratic convex objectives. The formulations are compared from a computational point of view on problems arising in network applications. Differences in terms of size, computing times, and other optimization performance are highlighted.

■ SA-04

Saturday, 8:30 - 10:10 - Room 1.14

DFO 2 - Derivative-free optimization for challenging problems

Stream: Derivative-free optimization

Invited session

Chair: *Ana Luisa Custodio*

1 - A derivative-free method for stochastic structured optimization problems

Andrea Cristofari, Francesco Rinaldi

In this talk, we propose a derivative-free method to minimize the expected value of a function over the convex hull of a finite number of atoms. The proposed algorithm uses random estimates of the objective function and tries to solve, at each iteration, a reduced problem obtained by considering only a subset of atoms. Under standard assumptions on the accuracy and the variance of the random estimates, global convergence to stationary points is established. Finally, we provide some numerical results.

2 - Comparison of Randomized Direct-Search Approaches: Application to Beam Angle Optimization in Intensity-Modulated Proton Therapy

Humberto Rocha, Joana Matos Dias

Direct-search approaches have been used to successfully address challenging real-world optimization problems. Randomization of poll directions is one of the strategies for computational time efficiency. Opportunistic polling on a positive spanning set is an effective deterministic strategy to reduce the number of function evaluations. Recently, probabilistic strategies reported excellent numerical results by testing a reduced number of random poll directions at each iteration. In this study we compare different randomized direct-search approaches applied to beam angle optimization in IMPT.

3 - Effective matrix adaptation strategy for noisy derivative-free optimization

Morteza Kimiaei, Arnold Neumaier

In this paper, we construct and implement two effective versions of the matrix adaptation evolution strategy (MAES) for noisy derivative-free optimization problems. The main ingredients of our method are a new stochastic non-monotone line search condition and a new subspace technique. A comparison with state-of-the-art solvers show that our method is highly competitive in the presence of strong noise, having the lowest relative cost of function evaluations and the highest number of solved problems.

4 - Universal adversarial perturbation via generalised matrix norms

Dayana Savostianova, Francesco Tudisco

In recent years DNNs became wide-spread in computer vision problems. Although quite effective for those tasks they are vulnerable to adversarial attacks. In this talk, we examine a simple and yet effective approach based on a nonlinear extension of the classical matrix power method for creating Universal Adversarial perturbations. In particular we discuss possible extensions of this method that incorporate the knowledge of intrinsic and structural non-homogeneity of the real data resulting in less perceptible noise.

■ SA-05

Saturday, 8:30 - 10:10 - Room 1.15

COVA 5 - Continuous optimization and variational analysis V

Stream: Continuous optimization and variational analysis

Invited session

Chair: *Francisco Javier Aragón Artacho*

1 - Exponential polynomials via convex hulls

Juan Matías Sepulcre

In this talk we present an overview on the global distribution of the zeros of exponential polynomials with complex coefficients and frequencies, in which the convex hulls of the complex conjugates of the frequencies play a key role. As a continuation of these investigations, we analyze the density properties of the projections of the zeros of certain classes of exponential sums, and other related functions such as almost periodic functions, which is a topic with applications in many fields. Also, we present a thorough extension of Bohr's equivalence theorem for these classes of functions.

2 - On farthest Bregman Voronoi cells

Juan Enrique Martínez-Legaz, Maryam Tamadoni Jahromi, Eskandar Naraghirad

Let g be a strictly convex function on an evenly convex set X with nonempty interior. Assuming that g is differentiable on the interior of X , we consider the Bregman distance associated with g . Given a set T , whose elements are called sites, and a particular site s , the farthest g -Bregman Voronoi cell of s consists of all points that are farther from s than from any other site, with respect to the Bregman distance associated with g . We study farthest g -Bregman Voronoi cells; in particular, we characterize those sets that can be written as the farthest g -Bregman Voronoi cell of s for some T .

3 - Set-valued evenly convex functions: characterizations and c-conjugacy

María Dolores Fajardo

We deal with set-valued functions with values in the power set of a separated locally convex space where a nontrivial pointed convex cone induces a partial order relation. A set-valued function is evenly convex if its epigraph is an evenly convex set, i.e., it is the intersection of an arbitrary family of open half-spaces. We characterize evenly convex set-valued functions as the pointwise supremum of its set-valued e -affine minorants. Moreover, a suitable conjugation pattern will be developed for these functions, as well as the counterpart of the biconjugation Fenchel-Moreau theorem.

4 - Duality assertions in vector optimization w.r.t. relatively solid convex cones in real linear spaces

Bahareh Khazayel, Christian Günther, Christiane Tammer

We derive duality assertions for vector optimization problems in real linear spaces based on a scalarization using the concept of relative solidness for convex cones. We focus on an abstract vector optimization problem with generalized inequality constraints and investigate Lagrangian type duality assertions for (weak, proper) minimality notions. Our interest is neither to impose a pointedness assumption nor a solidness assumption for the convex cones involved in the solution concept of the vector problem. We are able to extend the well-known Lagrangian vector duality approach by Jahn (1983).

■ SA-07

Saturday, 8:30 - 10:10 - Room 1.17

OC 2 - Optimal control and optimization in finance, commodity trade, insurance and pension fund systems II

Stream: Optimal control and optimization in economics and social sciences

Invited session

Chair: *Emel Savku*

Chair: *Miguel F. Anjos*

1 - An Inexpensive Machine Learning Approach for Robust Forecasting, or How To Fix the Forecasting Models that the Pandemic Broke

Miguel F. Anjos

Reliable forecasts are a crucial business need. The Covid-19 pandemic's effect on consumer behaviour caused many predictive models to completely fail. We present a machine learning method developed with ExPretio Technologies to tackle this problem for rail passenger demand forecasting. The key insight is that existing models can be reused as inputs for machine learning to reassess their predictions in the context of new data. This method not only fixed the models broken by the pandemic but also gives an improved performance compared to previously used individual models on pre-pandemic data.

2 - Market Integration of Behind-the-meter Residential Energy Storage

Bárbara Rodrigues, Miguel F. Anjos, Valérie Provost

This work proposes an innovative business model to harness the potential of aggregating behind-the-meter residential storage in which the aggregator compensates prosumers for using their energy storage system. A bilevel model is developed to evaluate the potential of this business model and determine the optimal compensation scheme for the participants. A realistic Texas case study confirms the year-round profitability of the model, and that the main driver for a successful implementation is a suitable setting of the compensation paid to participants for using their energy storage system.

3 - Vehicle Routing Heuristics based on Reinforcement Learning

Corrado Coppola, Laura Palagi, Simone Foà, Giorgio Grani

We address one of the hardest routing problem, the VRP, from an optimal control perspective. We cast the problem into a Markov Decision Process environment, and we integrate the system dynamic with standard improving heuristics. We use Reinforcement Learning algorithms, in particular Proximal Policy Gradient, to train a neural architecture which approximates the stochastic optimal policy. The tests we are carrying out are showing early promising results with respect to state-of-the-art solvers.

4 - Adjoint state method for the trajectory optimization of a reentry vehicle

Francesco Marchetti, Edmondo Minisci

The presented work investigates the use of the adjoint state method for the trajectory optimization of a reentry vehicle. The trajectory is optimized using a direct optimal control method with single shooting transcription, where the gradients are evaluated using the adjoint method. This approach leads to a faster optimization process with results comparable to those obtained using the finite differences. The comparison between the adjoint method and the use of the finite differences will be detailed, both in terms of gradient computations and optimisation efficiency.

Saturday, 10:40 - 11:55

■ SB-02

Saturday, 10:40 - 11:55 - Room 1.1

MO 4 - Global multiobjective optimization

Stream: Multiobjective optimization

Invited session

Chair: *Gabriele Eichfelder*

1 - Conditions for the existence of weakly efficient solutions to vector optimization problems

César Gutiérrez, Ruben Lopez

The talk addresses the existence of weakly efficient solutions in vector optimization. By connecting the notion of colevel of a vector mapping with a formulation of the so-called Gerstewitz scalarization, new existence results are obtained in different settings. In particular, the noncoercive and nonconvex case is dealt with by considering a suitable regularization of the nominal problem.

2 - Numerical certification of Pareto optimality for biobjective nonlinear problems

Frédéric Messine, Charles Audet, Jordan Ninin

The solution to a biobjective optimization problem is composed of a collection of trade-off solution called the Pareto set. Based on a computer assisted proof methodology, the present work studies the question of certifying numerically that a conjectured set is close to the Pareto set. Two situations are considered. First, we analyze the case where the conjectured set is directly provided: one objective is explicitly given as a function of the other. Second, we analyze the situation where the conjectured set is parameterized: both objectives are explicitly given as functions of a parameter.

3 - Conic reformulations for quadratic multiobjective optimization

Gabriele Eichfelder, Patrick Groetzner

In a single-objective setting, nonconvex quadratic problems can equivalently be reformulated as convex problems over the cone of completely positive matrices. Considering multiobjective non-convex quadratic problems, naturally the question arises whether the advantage of convex reformulations extends to the multicriteria framework. Within this talk we show that this approach is no longer useful for two or more objective functions. The reason it that it only allows to find the supported nondominated points, which can, however, already be found by using a weighted sum scalarization.

■ SB-03

Saturday, 10:40 - 11:55 - Room 1.2

CO 3- Advances in copositive and quadratic optimization

Stream: Conic optimization

Invited session

Chair: *Markus Gabl*

1 - Scalable copositive methods for two-stage-stochastic StQPs

Immanuel Bomze, Markus Gabl, Francesca Maggioni, Georg Pflug

We study two-stage stochastic optimization of (nonconvex) Standard Quadratic Optimization Problems (StQPs) and treat it by discretization, leading to nonconvex quadratic problems over polytopes. By a Pairwise Frank-Wolfe method, we generate high-quality feasible solutions quickly (and more generally, guaranteed in finite time). Rigorous scalable lower bounds are obtained by refined copositivity techniques.

2 - Conic formulation of QPCCs applied to truly sparse QPs

Bo Peng, Immanuel Bomze

We study (nonconvex) quadratic optimization problems with complementarity constraints, showing an exact completely positive reformulation of it under mild conditions involving only the constraints. Moreover, we also give the conditions for strong conic duality between the obtained completely positive problem and its dual. An application on pursuing interpretable sparse solutions of quadratic optimization problems is shown to satisfy our settings, and therefore we link quadratic problems with an exact sparsity term to copositive optimization.

3 - Sparse Conic Reformulation of Structured QCQPs based on Copositive Optimization

Markus Gabl

Motivated by recent developments in search of more practical conic reformulations of QCQPs, we investigate sparse conic reformulations of QCQPs with arrowhead sparsity patterns. We present a new type of convex reformulation of QCQPs that lifts the variables into a comparatively lower dimensional space. It rests on a generalization of the set-completely positive matrix cone, that can be approximated via inner and outer approximations in order to obtain bounds, which potentially close the optimality gap.

■ SB-04

Saturday, 10:40 - 11:55 - Room 1.14

PPA 1 - Splitting and regularization

Stream: Proximal point algorithm and related numerical methods

Invited session

Chair: *Stefano Cipolla*

1 - Convergence of Douglas-Rachford splitting for nonmonotone inclusions*Brecht Evens, Pieter Pas, Puya Latafat, Panagiotis Patrinos*

We study the classical Douglas-Rachford splitting (DRS) method in the absence of the monotonicity assumption. Introducing the concept of (σ, ρ) -semimonotonicity, we investigate DRS for the sum of two general semimonotone operators and show convergence of DRS with appropriately chosen parameters, even when the sum of the two operators (or of their inverses) is nonmonotone. Our analysis relies on establishing a connection with the proximal point algorithm, allowing us to show global convergence of DRS under an oblique weak Minty condition on the underlying primal-dual operator.

2 - Iterative regularization for low complexity regularizers*Silvia Villa, Mathurin Massias, Cesare Molinari, Lorenzo Rosasco*

Iterative regularization exploits the implicit bias of an optimization algorithm to regularize ill-posed problems. Constructing algorithms with such built-in regularization mechanisms is a classic challenge in inverse problems but also in modern machine learning, where it provides both a new perspective on algorithms analysis, and significant speed-ups compared to explicit regularization. In this talk, I will discuss an iterative regularization procedure able to handle biases described by non smooth and non strongly convex functionals, prominent in low-complexity regularization.

3 - Relaxed Peaceman-Rachford splitting method to find the zero of the sum of two maximal strongly monotone operators: Convergence and its rate*Chee Khian Sim*

We consider the problem to find zeros of the sum of two maximal monotone operators. Solving this problem has wide applicability, as the problem appears in many areas, such as in machine learning for example. The relaxed Peaceman-Rachford splitting method is one of the known methods to solve the problem. In this presentation, we give theoretical results on the convergence and the convergence rate of the method to find the zero of the sum of two maximal strongly monotone operators for different values of the relaxation parameter.

■ SB-05*Saturday, 10:40 - 11:55 - Room 1.15***COVA 4 - Continuous optimization and variational analysis IV**

Stream: Continuous optimization and variational analysis

*Invited session*Chair: *Miguel Goberna***1 - A primal-dual splitting algorithm for composite monotone inclusions with minimal lifting***Francisco Javier Aragón Artacho, Radu Ioan Bot, David Torregrosa-Belén*

We present a resolvent splitting algorithm for solving composite monotone inclusion problems, whose objective is finding a zero in the sum of maximally monotone operators composed with linear operators. Our main contribution is establishing the first primal-dual splitting algorithm for composite monotone inclusions with minimal lifting. Specifically, the proposed scheme reduces the dimension of the product space where the underlying fixed point operator is defined, in comparison to other algorithms, without requiring additional evaluations of the resolvent operators.

2 - Forward-Backward Methods with Reduced Dimensions*David Torregrosa-Belén, Francisco Javier Aragón Artacho, Yura Malitsky, Matthew Tam*

In this talk, we present two new forward-backward-type algorithms for finding a zero in the sum of finitely many monotone operators, which are not based on reduction to a two operator inclusion in the product space. These methods reduce the dimension of the fixed point operators, in comparison to other forward-backward schemes without requiring additional evaluations of the operators.

3 - Splitting and projection methods for control-constrained linear-quadratic optimal control problems*Bethany Caldwell, Regina Burachik, Yalçın Kaya*

We use projection-type algorithms to solve control-constrained linear-quadratic optimal control problems. Instead of the traditional approach of discretizing and solving the problem via large-scale numerical optimization techniques, we split the problem in two and use projection methods. Promising numerical results with this approach for a double integrator problem have earlier been obtained by Bauschke, Burachik and Kaya. Here we extend their work to more general linear-quadratic optimal control problems and provide numerical results and comparisons using four different algorithms.

■ SB-07*Saturday, 10:40 - 11:55 - Room 1.17***OC 3 - Optimal control and optimization in finance, commodity trade, insurance and pension fund systems III**

Stream: Optimal control and optimization in economics and social sciences

*Invited session*Chair: *Gerhard-Wilhelm Weber*

1 - Optimization of Trading Signals in Intraday Pairs Trading Strategy*Petra Tomanová, Vladimír Holý*

We present a stochastic spread approach to the intraday pairs trading strategy using ultra-high-frequency data. The spread process is modeled by the Ornstein-Uhlenbeck process with continuous time. To avoid bias in parameter estimation due to the microstructure noise of the ultra-high-frequency data, we propose three noise-robust estimators. For the optimal trading signals, we focus on the mean-variance optimization and determine the first-passage times of the process. We also address the geometric and optimization-theoretic viewpoint of the risk-bounded trading strategy.

2 - Facility Locations on a Network*Mindaugas Kepalas, Julius Žilinskas*

We consider the problem of locations on a network: we want to open K facilities, with the aim to place them in such a way that a certain criterion is minimal. Usually, the facilities may be located in a continuous space or in a discrete set of possible places. In our problem, we instead require that each facility must be located on an edge of a planar network. In addition, we add a constraint that facilities cannot be too close to each other: there is a certain given radius R , which must separate any two facilities. We present the results of our research in this presentation.

Saturday, 12:00 - 13:00**■ SC-01***Saturday, 12:00 - 13:00 - Auditorium 1C***Dolores Romero Morales**

Stream: Plenaries

*Invited session*Chair: *Sonia Cafieri*Chair: *Giancarlo Bigi***1 - Transparent Machine Learning Calls For More Optimization***Dolores Romero Morales*

While the complexity of data and models is continuously increasing, the use of machine learning in high-stakes decisions calls for more transparency and accountability. In this presentation we will navigate through some novel mathematical optimization models that embed explainability and fairness in the construction of Data Science models. This includes the ability to provide global, local and counterfactual explanations, as well as model cost- sensitivity and fairness requirements. We will show the versatility of our methodology when applied to more complex data types such as functional data.

Saturday, 14:30 - 16:10

■ SD-02

Saturday, 14:30 - 16:10 - Room 1.1

MO 5 - Multiobjective optimization and machine learning

Stream: Multiobjective optimization

Invited session

Chair: *Julia Niebling*

Chair: *Gabriele Eichfelder*

1 - A multiobjective view on creating counterfactual explanations for explaining uncertainty in machine learning

Julia Niebling

Counterfactual explanations are a popularly used technique in explainable and interpretable AI. For a given data sample and a trained machine learning model, they provide a new, slightly different data sample together with its new prediction. Recently, counterfactual explanations are also used to explain uncertainty. For that, an optimization problem has to be solved in order to minimize the uncertainty as well as the distance to the original data. This talk gives a multiobjective view on the described problem setting as this provides more insights to the data and its uncertainty.

2 - Deep Learning the Efficient Frontier of Convex Vector Optimization Problems

Zachary Feinstein, Birgit Rudloff

In this talk, we propose a neural network architecture to approximate the weakly efficient frontier of convex vector optimization problems satisfying Slater's condition. The proposed methodology provides both an inner and outer approximation of the weakly efficient frontier. The proposed machine learning methodology provides an upper bound to the error at each approximated efficient point. In numerical case studies we demonstrate that the proposed algorithm is effectively able to approximate the true weakly efficient frontier of convex vector optimization problems.

3 - Series of Hessian-Vector Products for Tractable Saddle-Free Newton Optimisation of Neural Networks

Ross Clarke, Elre Oldewage, Jose Miguel Hernandez Lobato

Saddle-Free Newton methods offer an appealingly intuitive strategy for second-order optimisation, but require direct modification of the eigenvalues of the Hessian (or an approximation thereof). We present a series-based approach to this eigenvalue transformation which avoids the need to eigendecompose the Hessian, and can be computed efficiently by Hessian-vector products alone. Our truncated series provides an interesting new method for tractable exploitation of the Hessians of large neural network models; in its untruncated form, it converges exactly to the inverted saddle-free Hessian.

4 - Training neural networks with l_1 regularization via multiobjective continuation

Katharina Bieker, Bennet Gebken, Sebastian Peitz

Regularization with an l_1 -norm term is common practice in many areas, e.g. in neural network training. There, the motivation is to ensure robustness against noisy data and to avoid overfitting. In order to gain a better understanding of the trade-off between accuracy and sparsity, we will not use the standard weighted-sum approach. Instead, we solve the corresponding multiobjective optimization problem. We present a continuation method which is specifically tailored to the l_1 -norm as a second objective and discuss the advantages but also challenges of our method in neural network training.

■ SD-03

Saturday, 14:30 - 16:10 - Room 1.2

CGT 5 - Advances in operator splitting

Stream: Mathematical programming and computational game theory

Invited session

Chair: *Pontus Giselsson*

1 - Double Splitting Preconditioner A New Class of Preconditioners

Maycon De Souza, Aurelio Oliveira

We propose a generalization of splitting preconditioner. We propose a double preconditioner for the augmented system, including three new parameters. In this way, it allowed us a greater range of possibilities for new preconditioners, which we named Double Splitting Preconditioner. Similar to the previous one, the double splitting preconditioner works very well close to a solution to the LP problem, a nice feature, since close to the solution the system tends to be extremely ill-conditioned. We perform some tests using the Matlab software, to verify the efficiency of the proposed method.

2 - Escaping limit cycles: Global convergence for constrained nonconvex-nonconcave minimax problems

Puya Latafat, Thomas Pethick, Panagiotis Patrinos, Olivier Fercoq, Volkan Cevher

It is well-known that finding a local solution for general minimax problems is computationally intractable. This observation has motivated the study of structures sufficient for convergence of first order methods when the so-called weak Minty variational inequality (MVI) holds. This problem class captures non-trivial structures as we demonstrate with examples, for which a large family of existing algorithms provably converge to limit cycles. Our results require a less restrictive parameter range in the weak MVI compared to what is previously known, thus capturing a larger class of problems.

3 - Inertial Algorithms in optimization, variational inequalities and fixed point problems*Juan Peypouquet*

We present an overview of the dynamical aspects of old and new first-order methods used in optimization and variational analysis, and how inertial features and relaxation can help improve their performance. Special attention will be paid to inertial and overrelaxed primal-dual methods, as an illustration.

4 - Necessary and sufficient conditions for existence of quadratic Lyapunov functions for first-order methods*Pontus Giselsson, Manu Upadhyaya, Sebastian Banert, Adrien Taylor*

We present a unifying framework for establishing linear convergence rates for first-order methods, based on quadratic Lyapunov functions. We provide necessary and sufficient conditions for verifying that a quadratic function is a Lyapunov function for the algorithm and problem class under consideration, thereby allowing to produce tight convergence certificates for the setting at hand (i.e., producing worst-case certificates and matching worst-case examples).

■ SD-04*Saturday, 14:30 - 16:10 - Room 1.14***DFO 3 - Global and multiobjective derivative-free optimization**

Stream: Derivative-free optimization

*Invited session*Chair: *Ana Luisa Custodio***1 - A Derivative-free Trust-region Approach for Computing Pareto Fronts in Multiobjective Optimization***Aboozar Mohammadi, Ana Luisa Custodio*

We propose an algorithm based on a trust-region approach for computing an approximation to the complete Pareto front of a given multiobjective optimization problem. The algorithm alternates between two main steps, the extreme point step, that moves towards extreme points of the Pareto front, and a scalarization step, that attempts to reduce the gaps on the Pareto front, by solving an adequate scalarization problem. In any of these two steps, interpolation models are built to replace the components of the objective function. Numerical experiments illustrate the good performance of the method.

2 - A DIRECT Exploratory-based Hyper-rectangle Evaluation for Bound Constrained Global Optimization Problems*M. Fernanda P. Costa, Ana Maria A.C. Rocha, Edite M.G.P. Fernandes*

A DIRECT-type algorithm based on a hyper-rectangle exploratory strategy to identify promising hyper-rectangle is presented. A set of exploratory points are generated on the hyper-rectangles and their average objective function values are used to select promising hyper-rectangles for further partitioned. Thus, the average fitness selection replaces the usual function value at the centre selection if the average fitness is better than that of the centre point. Computational experience on a set of well-known problems shows that the new algorithm is effective and robust.

3 - A Direct Multisearch Filter Method for Biobjective Optimization*Everton Silva, Ana Luisa Custodio*

In this work, we propose integrating a filter approach in DMS to address biobjective optimization problems with linear and nonlinear constraints. The violations of the nonlinear constraints are aggregated in a third function and are treated as an additional objective. The algorithm explicitly treats the linear constraints by adapting the positive generating sets considered at each iteration to the geometry of the nearby constraints. We will describe the proposed algorithm, provide results on the theoretical properties of the method, and report numerical experiments.

4 - Incorporating Radial Basis Functions in Global and Local Direct Search*Bruno Baptista, Ana Luisa Custodio, Carmo Bras*

GLODS is a global derivative-free optimization algorithm, relying on local directional direct search (DDS) and a clever multistart strategy. New initializations are generated by sampling techniques, not taking advantage of the information gathered by the algorithm in previous iterations. In this work, we propose to use radial basis functions, computed by reusing the function evaluations of DDS, as a strategy for new initializations. We will describe the algorithmic procedure and present numerical results that state the improvement in the performance of GLODS algorithm.

■ SD-05*Saturday, 14:30 - 16:10 - Room 1.15***GO 1 - Advanced techniques for global optimization**

Stream: Global optimization

*Invited session*Chair: *Sonia Cafieri***1 - Comparing Different Methods for the Configuration Space Search Problem***Claudia D'Ambrosio, Vanesa Guerrero, Gabriele Iommazzo, Renan Spencer Trindade*

In Iommazzo et al (2020), a method composed of two phases was proposed to optimally configure a given algorithm A. In the first phase, machine learning, such as support vector regression, was used to find an approximation of the performance function of A, based on historical data. In the second phase, mixed-integer non-linear programming was used to find the configuration of A that optimizes the approximated performance function. In this work, we focus on the second phase, where we solve the so-called Configuration Space Search Problem. We compare different optimization methods for solving it.

2 - Techniques for accelerating Branch-and-Bound algorithms dedicated to sparse optimization

Gwenaël Samain, Sebastien Bourguignon, Jordan Ninin

We propose two acceleration techniques for sparse optimization (the minimization of a cardinality-penalized least-squares function) with branch-and-bound algorithms. Convex duality is applied to the relaxation problems at each node of the search tree, allowing one to early prune suboptimal nodes thanks to the computation of valid dual bounds. Then, screening methods are implemented during each node evaluation, which reduce the problem size by fixing variables to their optimal value. Numerical experiments study the efficiency of such techniques as a function of the problem difficulty.

3 - On the convergence of controlled mini-batch gradient algorithms

Laura Palagi, Giampaolo Liuzzi, Ruggiero Seccia

We consider the wide-studied problem of minimizing a finite sum of functions. Incremental gradient methods have been deeply studied and usually require strong assumptions for proving convergence. We introduce minimal modifications to control the behaviour of minibatch gradient algorithms. We prove convergence toward stationary points under light and standard assumptions in unconstrained non-convex optimization. We show on a set of benchmark problems that the proposed control strategy does not deteriorate the computational performance in comparison with standard incremental gradient methods.

4 - Handling logical constraints by continuous optimization

Sonia Cafieri, Andrew Conn, Marcel Mongeau

We propose a continuous-optimization formulation of logical constraints. Based on the simple idea of guiding the search of a continuous-optimization method towards the parts of the domain where the logical constraint is satisfied, we introduce a smooth penalty-function formulation of logical constraints. The effectiveness of this formulation, that allows the direct use of state-of-the-art continuous optimization solvers, is demonstrated on a real-world application in air transportation.

■ SD-06

Saturday, 14:30 - 16:10 - Room 1.16

VIU 6 - Stochastic approximation

Stream: Variational inequalities and optimization under uncertainty

Invited session

Chair: *Christiane Tammer*

1 - A Variational Inequality Based Stochastic Approximation Approach for Stochastic Inverse Problems.

Akhtar Khan

This talk will focus on the nonlinear inverse problem of estimating stochastic parameters in partial differential equations and variational inequalities with random data. This talk is a joint work with Professor Jürgen Dippon, Joachim Gwinner, and Miguel Sama.

2 - Lp solutions of random differential equations using scales of Banach spaces

Hans-Jörg Starkloff

Extending the theory for scalar-valued differential equations to a corresponding theory for functions with values in Banach spaces some problems arise. For example, investigating Lp solutions of random differential equations often the condition of essential boundedness of a random coefficients is imposed. In the talk it will be illustrated, how such assumptions can be weakened considering equations not in a fixed Banach space but in an appropriate scale of Banach spaces instead. It is a joint work with Antje Mugler from BTU Cottbus.

3 - Randomized stochastic optimization with semi-martingales

Jürgen Dippon

We consider the problem of finding the minimum of a real-valued function whose values can be observed with some noise only. If we assume that these observations are accessible in a time-discrete or -continuous fashion, Kiefer-Wolfowitz-type recursions or Ito-type sde's are appropriate, respectively. These algorithms can be unified in a semi-martingale approach.

Since gradient estimates based on difference quotients may be expensive in high dimensional domains a general randomization scheme with only two observations per time step are introduced, which show optimal rate of convergence.

4 - A Stochastic Nash Equilibrium Problem for Medical Supply Competition

Georgia Fargetta, Laura Rosa Maria Scrimali

We focus on the competition of healthcare institutions for medical supplies described as a two-stage stochastic programming model that includes the unmet demand and the consequent penalty. Institutions simultaneously solve their own stochastic optimization problems and reach a stable state governed by the stochastic Nash equilibrium concept. The problem is formulated as a variational inequality, and both the discrete and the general probability distribution cases are discussed. Some numerical examples applying the progressive hedging method are presented.

■ SD-07

Saturday, 14:30 - 16:10 - Room 1.17

OC 4 - Optimal control and optimization in finance and insurance

Stream: Optimal control and optimization in economics and social sciences

Invited session

Chair: *Fernanda Cipriano*

1 - Mitigating the impact of negative occurrences in investment projects through insurance*Carlos Oliveira, Alexandra Moura*

We consider a company that intends to invest in a project, for which are two sources of uncertainty: the company's future revenue and the existence of unexpected adverse events that reduce it. To protect itself against such adverse events, the company can buy an insurance contract. The firm has to decide the moment to invest in the market and the insurance contract that it wants to buy. These decisions depend on the premium required and how the firm measures its risk. In this context, we study the optimal insurance contract, formulating the model as a control problem.

2 - Finite maturity caps and floors on continuous flows under the CEV process*José Carlos Dias, Joao Pedro Nunes, Fernando Silva*

This paper offers novel analytical solutions for evaluating perpetual caps and floors on continuous flows under the constant elasticity of variance (CEV) model. We demonstrate that the inclusion of a perpetual bubble value is required to avoid arbitrage opportunities in the case of the CEV process with upward-sloping volatility skews. We then extend the previous literature on caps and floors arrangements by providing new analytical formulae for valuing finite maturity caps and floors that are contingent on continuous flows.

3 - On randomized solutions for optimization problems*Manuel Guerra*

Randomized solutions have been introduced to optimization problems, mainly due to the fact that many nonlinear problems become convex when randomized solutions are considered. Many optimization problems in insurance and finance are not convexified by randomized solutions, but spaces of randomized solutions still have useful properties for the study of such problems. Further, randomized solutions can, in many cases, be provided with meaningful economic interpretations and can be used as a tool in model construction.

4 - Portfolio Problem with Consumption Under the α -Hypergeometric Stochastic Volatility Model*Paulo Rocha*

In this session, we will look at the dynamic programming method to solve a variant of the portfolio problem in which consumption is allowed. We assume that the agent makes his investment and consumption decisions based on a power utility function. Considering a simple portfolio, composed of a bond and a single stock on a market modeled by the α -Hypergeometric Stochastic volatility model, we will derive the correspondent Hamilton-Jacobi-Bellman equation and discuss the existence of a classical solution and the techniques used to find such a solution.

Saturday, 16:15 - 17:30

■ SE-02

Saturday, 16:15 - 17:30 - Room 1.1

MINO 4 - Decomposition and MINLP for machine learning

Stream: Mixed-integer nonlinear optimization

Invited session

Chair: *Laura Palagi*

1 - Maximum Margin Optimal Classification Trees

Marta Monaci, Laura Palagi, Giorgio Grani

Thanks to their interpretability, decision trees have been intensively studied for classification tasks, and, due to the remarkable advances in mixed-integer programming (MIP), various approaches have been proposed to formulate the Optimal Classification Tree (OCT) problem as a MIP model. We present a novel MIP formulation for the OCT problem, denoted as Maximum Margin Optimal Classification Tree (MARGOT), which exploits the generalization capabilities of support vector machines. In order to improve interpretability, we also develop an embedded feature selection version of our approach.

2 - On multivariate randomized classification trees

Andrea Manno, Edoardo Amaldi, Antonio Consolo

We investigate the nonlinear continuous formulation proposed in Blanquero et al. (EJOR, vol.284, 2020) for training sparse optimal randomized classification trees, where sparsity is induced by the l_1 and l_∞ norms. For such trees, we first consider alternative methods to induce sparsity based on concave approximations of the l_0 "norm", showing promising results. Then, we derive bounds on the VC dimension. Finally, we propose a simple decomposition training method suited to reduce training times on large-dimensional instances without compromising the accuracy.

3 - Randomized regression trees: a model variant and a decomposition training algorithm

Antonio Consolo, Edoardo Amaldi, Andrea Manno

We present a variant of multivariate randomized regression trees (MRRTs) proposed by Blanquero et al. (EJOR Vol. 299, 2022). The formulation is well-suited not only to decomposition but also to induce fairness measures. Our decomposition training algorithm includes a specific initialization strategy and a heuristic for the reassignment of the input vectors along the branching nodes of the tree. Under mild assumptions, we also establish asymptotic convergence guarantees. Computational results are reported and compared with those of the original version and of an alternative MILO method.

■ SE-03

Saturday, 16:15 - 17:30 - Room 1.2

CGT 6 - Recent advances in projection free methods

Stream: Mathematical programming and computational game theory

Invited session

Chair: *Francesco Rinaldi*

1 - Generalized Self-Concordant Analysis of Frank-Wolfe algorithms

Pavel Dvurechensky, Kamil Safin, Shimrit Shtern, Mathias Staudigl

We propose several variants of the Frank-Wolfe method for minimizing generalized self-concordant (GSC) functions over compact sets. Such problems are ill-conditioned and are motivated by machine learning applications such as inverse covariance estimation or distance-weighted discrimination problems in support vector machines. We obtain $O(1/k)$ convergence rate guarantees in the general situation and linear convergence under strong convexity and additional assumptions.

2 - Projection-free methods for structured problems

Francesco Rinaldi, Immanuel Bomze, Damiano Zeffiro

Recently, projection-free methods have gained popularity thanks to their ability to efficiently handle the structured constraints appearing in machine learning and data science applications. In this work, we focus on some Frank-Wolfe variants for specific classes of structured problems and analyze their theoretical and practical behaviour.

3 - Convergent Mixed-Integer Derivative-Free Optimization

Juan Jose Torres Figueroa, Giacomo Nannicini, Emiliano Traversi, Roberto Wolfler-Calvo

In this project we developed two trust-region algorithms for the optimization of black-box problems with mixed-integer variables. The first algorithm is based on the assumption of local mixed-integer quadratic structure of the objective function, while the second one exploits combinatorial properties in the objective function and works as a hybrid between the DCA and first-order continuous derivative-free methods. Both algorithms are proven to converge into several definitions of mixed-integer first-order stationary points, depending on the structure of the objective function.

■ SE-04

Saturday, 16:15 - 17:30 - Room 1.14

PPA 2 - Primal dual methods and related numerical issues

Stream: Proximal point algorithm and related numerical methods

Invited session

Chair: *Jacek Gondzio*

1 - Non-linear primal-dual descent for Optimal transport and barycenter problems

Antonin Chambolle, Juan Pablo Contreras

I will present a study in collaboration with J.P. Contreras (U. A. Ibanez, Santiago, Chile) where we revisit non-linear primal dual algorithms, and in particular extend an accelerated line-search based primal-dual method of Malitsky and Pock to the non-linear (ie based on a Bregman distance) context. This is done in order to efficiently solve, within some given error, assignment and optimal transport problems, which are large scale constrained linear problems, and leads to state-of-the art results in terms both of efficiency and quality.

2 - Primal-Dual Regularized Interior Point Methods (IPMs): a Proximal Point perspective

Stefano Cipolla, Jacek Gondzio

In this talk, we will show that it is possible to naturally frame the primal-dual regularized IPMs in the context of the Proximal Point Algorithm. Among the benefits of the proposed approach, we will show how convergence can be guaranteed without any supplementary assumptions and how the rate of convergence can be explicitly estimated in relation to regularization parameters. Moreover, we will show how regularization could be exploited in order to devise suitable preconditioners of the Newton system which are required to be re-computed only in a fraction of the total number of IPM

3 - Faster First-Order Primal-Dual Methods for Linear Programming using Restarts and Sharpness

Oliver Hinder

First-order primal-dual methods are often slow at finding high accuracy solutions, which creates a barrier to their use for linear programming (LP). Our work exploits the sharpness of primal-dual formulations of LP instances using restarts in a general setting that applies to ADMM (alternating direction method of multipliers), PDHG (primal-dual hybrid gradient method) and EGM (extragradient method). In particular, we show restarts improve the linear convergence rate of these methods in both theory and practice.

■ SE-05

Saturday, 16:15 - 17:30 - Room 1.15

GO 2 - Simplicial branch and bound

Stream: Global optimization

Invited session

Chair: *Frédéric Messine*

1 - The face graph in simplicial branch and bound

Eligius M.T. Hendrix, Boglárka G.-Tóth, Leocadio G. Casado, Frédéric Messine

Like in Interval Arithmetic, dimension of partition sets can be reduced when monotonicity is detected. One of the challenges is that only border facets are relevant for dimension reduction. With a box constrained feasible set, it is relatively easy to discover a facet is border. However, in a simplicial feasible set, the face graph helps us to identify border facets. We will illustrate this concept up to the extreme of the standard Quadratic Program. This contribution has been supported by The Spanish fund RTI2018-095993-B-I00 in part financed by the European Regional Development Fund (ERDF).

2 - Monotone directions by Linear Programming in simplicial B&B

Boglárka G.-Tóth, Eligius M.T. Hendrix, Leocadio G. Casado, Frédéric Messine

Using interval arithmetic based tests in simplicial branch and bound raise many questions. How to decide the function is monotone over a lower dimensional simplex? If it is monotone, which facets contain the possible minimum? In order to answer these questions with proofs, one can solve some linear programming problems, or a mixed integer programming problem. This does not necessarily pay off, but it is interesting to see how much the best monotone directions help. The research is supported by the Spanish fund RTI2018-095993-B-I00, in part financed by the European Regional Development Fund.

3 - Heuristic directional derivatives in simplicial branch and bound

Leocadio G. Casado, Boglárka G.-Tóth, Frédéric Messine, Eligius M.T. Hendrix

A monotonicity test is not as easy for a simplicial feasible set as for a box, as the orientation does not coincide with the coordinate axes. For a simplicial partition set at the boundary of the feasible region, a question is, which direction (directional derivative) to use in order to discard it? This can be answered by Linear Programming at increasing computational cost. We study applying heuristic direction vectors and their effectiveness. This contribution has been supported by the Spanish fund RTI2018-095993-B-I00 in part financed by the European Regional Development Fund (ERDF).

■ SE-06

Saturday, 16:15 - 17:30 - Room 1.16

COVA 6 - Continuous optimization and variational analysis VI

Stream: Continuous optimization and variational analysis

Invited session

Chair: *Cornel Pinte*

1 - A Single Leader Radner Equilibrium problem: industrial symbiosis in an Eco-Industrial Park

Rossana Riccardi, Elisabetta Allevi, Didier Aussel, Domenico Scopelliti

In this study, we propose a bilevel programming model for an industrial symbiosis network located in an Eco-Industrial Park (EIP). At the upper level, the leader is an authority in charge of the ecological concerns, while, at the lower level, a finite number of enterprises act as followers with economic objectives. Based on the EIP authority decisions, all enterprises compete with each other in a sequential parametric non-cooperative game with the strategies of the EIP authority as exogenous parameters, under uncertainty on resource fluxes and environmental conditions.

2 - Emission trading system and border carbon adjustment: a spatial equilibrium problem for the European pulp and paper industry

Giorgia Oggioni, Elisabetta Allevi, Adriana Gnudi, Igor Konnov, Rossana Riccardi

This paper proposes a spatial equilibrium problem for a pulp and paper supply chain in the context of circular economy. The developed supply chain model accounts for the forest deployment and the production of paper using both virgin pulp and recyclable paper waste, which is collected and re-used. The aim of the paper is to investigate the impacts of carbon emission regulations on the volume produced and exchanged in this supply chain and the related costs. The case study is focused on the European pulp and paper industry that is subject to the Emission Trading Scheme.

3 - Fan-hemicontinuity for the gradient of the norm in Banach space

Marcel Bogdan

Fan-hemicontinuity for the gradient of the norm defined on its scalarly-positive subdomain of a Hilbert space was recently proved. For a subdomain expressed as a particular countable intersection of half-planes the gradient of the norm is not Fan-hemicontinuous. The issue is whether or not the positive result on Fan-hemicontinuity can be extended to an arbitrary reflexive Banach space. In this matter it is natural to consider the duality map and its topological properties. Based on weak-weak* sequential continuity of it, the property above holds on l_p .

Saturday, 18:00 - 19:00

■ SF-01

Saturday, 18:00 - 19:00 - Auditorium 1C

EUROPT Fellowship Lecture - Oliver Stein

Stream: Plenaries

Invited session

Chair: *Gabriele Eichfelder*

Chair: *Giancarlo Bigi*

1 - Branch-and-bound for continuous and mixed-integer multiobjective optimization

Oliver Stein

The talk explains a recently developed general framework for branch-and-bound methods in multiobjective optimization. It may be applied to continuous and mixed-integer convex and nonconvex multiobjective problems. After providing summaries of main ideas in branch-and-bound and in multiobjective optimization, the talk focuses on natural generalizations of notions and techniques from the single objective to the multiobjective case, including a gap-based termination criterion. As a central tool we discuss convergent enclosures for the set of nondominated points and their limiting behaviour.

Saturday, 19:00 - 19:15

■ SG-01

Saturday, 19:00 - 19:15 - Auditorium 1C

Closing

Stream: Plenaries

Invited session

Complexity of convex optimization

Track(s): 3

Conic optimization

Track(s): 3 4

Continuous optimization and variational analysis

Track(s): 5 6

Derivative-free optimization

Track(s): 4

Global optimization

Track(s): 5

Interval optimization

Track(s): 4

Mathematical programming and computational game theory

Track(s): 3

Mixed-integer nonlinear optimization

Track(s): 2 5

Multiobjective optimization

Track(s): 2

Optimal control and optimization in economics and social sciences

Track(s): 7

Optimization on health informatics

Track(s): 7

Plenaries

Track(s): 1

Proximal point algorithm and related numerical methods

Track(s): 4

Variational inequalities and optimization under uncertainty

Track(s): 6

Session Chair Index

- Amaral, Paula** FG-01
paca@fct.unl.pt
 Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Caparica, Lisbon, Portugal
- Anjos, Miguel F.** SA-07
anjos@stanfordalumni.org
 School of Mathematics, University of Edinburgh, United Kingdom
- Aragón Artacho, Francisco Javier** SA-05
francisco.aragon@ua.es
 Mathematics, University of Alicante, Alicante, Spain
- Azevedo, Nuno** FF-07
ncazevedo@gmail.com
 Statistics Department, Banco de Portugal & EEG - Universidade do Minho, Porto, Portugal
- Barbagallo, Annamaria** FF-06
annamaria.barbagallo@unina.it
 Department of Mathematics and Applications "R. Cacciopoli", Università di Naples "Federico II", Napoli, Italy
- Bigi, Giancarlo** FB-01, SC-01, SF-01
giancarlo.biggi@unipi.it
 Dipartimento di Informatica, Università di Pisa, Pisa, Italy
- Cafieri, Sonia** FB-01, SC-01, SD-05
sonia.cafieri@enac.fr
 ENAC - Ecole Nationale d'Aviation Civile, Toulouse, France
- Calamita, Alice** SA-03
alice.calamita@uniroma1.it
 DIAG - Department of Computer, Control and Management Engineering, Sapienza University of Rome, Rome, Italy, Italy
- Cipolla, Stefano** SB-04
scipolla@ed.ac.uk
 School of Mathematics, The University of Edinburgh, United Kingdom
- Cipriano, Fernanda** SD-07
mfsm@fct.unl.pt
 Mathematics, Fct Nova, Caparica, Portugal
- Custodio, Ana Luisa** SA-04, SD-04
alcustodio@fct.unl.pt
 Dept. Mathematics, Universidade Nova de Lisboa, Caparica, Portugal
- Eichfelder, Gabriele** SF-01, SA-02, SB-02, SD-02
Gabriele.Eichfelder@tu-ilmenau.de
 Institute of Mathematics, Technische Universität Ilmenau, Ilmenau, Germany
- Gabl, Markus** SB-03
markus.gabl@kit.edu
 Karlsruhe Institute of Technology, Wien, Austria
- Giselsson, Pontus** SD-03
pontusg@control.lth.se
 Dept. of Automatic Control, Lund University, Sweden
- Goberna, Miguel** SB-05
mgoberna@ua.es
 Mathematics, Universidad de Alicante, San Vicente del Raspeig, Alicante, Spain
- Gondzio, Jacek** SE-04
j.gondzio@ed.ac.uk
 School of Mathematics, University of Edinburgh, Edinburgh, United Kingdom
- Grapiglia, Geovani** FF-03
geovani.grapiglia@uclouvain.be
 Applied Mathematics, Université catholique de Louvain, LOUVAIN-LA-NEUVE, Belgium
- Günther, Christian** FC-06
Christian.Guenther@mathematik.uni-halle.de
 Institute of Mathematics, Martin Luther University Halle-Wittenberg, Halle (Saale), Germany
- Hantoute, Abderrahim** FF-05
hantoute@ua.es
 Mathematics, Universidad de Alicante, Alicante, Spain, Spain
- Harks, Tobias** FE-03
tobias.harks@math.uni-augsburg.de
 Institut für Mathematik, Universität Augsburg, Augsburg, Germany
- Khan, Akhtar** FD-06
aaksma@rit.edu
 School of Mathematical Sciences, Rochester Institute of Technology, Rochester, New York, United States
- Kronqvist, Jan** FE-05
jankr@kth.se
 Mathematics, KTH Royal Institute of Technology, Sweden
- Lampariello, Lorenzo** FD-03
lampariello@dis.uniroma1.it
 Dipartimento di Informatica e Sistemistica Antonio Ruberti, University of Rome La Sapienza, Rome, Italy
- Li, Jinlu** FE-06
jli@shawnee.edu
 Shawnee State University, Portsmouth, United States
- Lopez Redondo, Juana** FD-07
jlredondo@ual.es
 Department of Informatics, University of Almeria, Almeria, Spain
- Mencarelli, Luca** FC-02
luca.mencarelli.university@gmail.com
 UMA, ENSTA Paris, Institut Polytechnique de Paris, France
- Messine, Frédéric** SE-05
Frederic.Messine@laplace.univ-tlse.fr
 LAPLACE-ENSEEIH-INTPT University of Toulouse, Toulouse, France
- Milasi, Monica** FC-03

- mmilasi@unime.it*
Università degli Studi di Messina, Messina, Italy
- Niebling, Julia** SD-02
Julia.Niebling@dlr.de
Institute of Data Science, Deutsches Zentrum für Luft- und Raumfahrt, Jena, Germany
- Ortigosa, Pilar M.** FC-07
ortigosa@ual.es
Departament of Informatics, University of Almería, Almería, Spain
- Palagi, Laura** SE-02
laura.palagi@uniroma1.it
Dipartimento di Ingegneria informatica automatica e gestionale, La Sapienza Università di Roma, Roma, Italy
- Pintea, Cornel** SE-06
cpintea@math.ubbcluj.ro
Babes Bolyai University, Romania
- Rada, Miroslav** FF-04
miroslav.rada@vse.cz
Department of Econometrics, Prague University of Economics and Business, Czech Republic
- Rinaldi, Francesco** SE-03, FE-04
rinaldi@math.unipd.it
Dipartimento di Matematica "Tullio Levi-Civita", Università di Padova, Italy
- Rolfes, Jan** FD-02
jrolfes@kth.se
Optimization and System Theory, Royal Institute of Technology (KTH) Stockholm, Stockholm, Sweden
- Rudloff, Birgit** FE-02
brudloff@wu.ac.at
Vienna University of Economics and Business, Wien, Austria
- Savku, Emel** SA-07
esavku@gmail.com
Department of Mathematics, University of Oslo, Oslo, – Select state–, Norway
- Sepulcre, Juan Matías** FC-05
JM.Sepulcre@ua.es
Department of Mathematics, University of Alicante, Spain
- Tammer, Christiane** SD-06
christiane.tammer@mathematik.uni-halle.de
Mathematics and Computer Science, Martin-Luther-University Halle-Wittenberg, Halle, Germany
- Tchemisova, Tatiana** FC-04, FD-04
tatiana@ua.pt
Mathematics Department, University of Aveiro, Aveiro, Portugal
- Ulus, Firdevs** FF-02
firdevs@bilkent.edu.tr
Industrial Engineering, Bilkent University, Ankara, Turkey
- Weber, Gerhard-Wilhelm** SB-07
gerhard-wilhelm.weber@put.poznan.pl
Faculty of Engineering Management, Poznan University of Technology, Poznan, Poland

Author Index

- A.C. Rocha, Ana Maria** SD-04, FC-06
arocha@dps.uminho.pt
 Algoritmi Research Centre, University of Minho, Braga, Portugal
- Afsar, Bekir** FC-06
bekir.b.afsar@jyu.fi
 University of Jyväskylä, Finland
- Allevi, Elisabetta** SE-06
elisabetta.allevi@unibs.it
 University of Brescia, Brescia, Italy
- Amaldi, Edoardo** SE-02
edoardo.amaldi@polimi.it
 DEIB, Politecnico di Milano, Milano, Italy
- Anjos, Miguel F.** SA-07
anhos@stanfordalumni.org
 School of Mathematics, University of Edinburgh, United Kingdom
- Aragón Artacho, Francisco Javier** SB-05
francisco.aragon@ua.es
 Mathematics, University of Alicante, Alicante, Spain
- Ararat, Cagin** FF-02
cararat@bilkent.edu.tr
 Industrial Engineering, Bilkent University, Ankara, Turkey
- Arias, Jorge** FE-06
jarias310@alumno.uned.es
 Matemática Aplicada I, Universidad Nacional de Educación a Distancia (UNED, Madrid, Madrid, Spain)
- Audet, Charles** SB-02
Charles.Audet@gerad.ca
 Polytechnique Montreal, Montreal, Qc, Canada
- Aussel, Didier** SE-06
aussel@univ-perp.fr
 Lab.PROMES UPR 8521, University of Perpignan, Perpignan, France
- Avella, Pasquale** SA-03
avella@unisannio.it
 DING, Università del Sannio, Benevento, Italy
- Azevedo, Nuno** FF-07
ncazevedo@gmail.com
 Statistics Department, Banco de Portugal & EEG - Universidade do Minho, Porto, Portugal
- Babaniyi, Olalekan** FE-06
obsma@rit.edu
 Rochester of Technology, Rochester, New York, United States
- Banert, Sebastian** SD-03
sebastian.banert@control.lth.se
 Department of Automatic Control, Lund University, Lund, Sweden
- Baptista, Bruno** SD-04
ba.baptista@campus.fct.unl.pt
 NOVA School of Science and Technology, Portugal
- Barbagallo, Annamaria** FE-06
annamaria.barbagallo@unina.it
 Department of Mathematics and Applications "R. Cacciopoli", Università di Naples "Federico II", Napoli, Italy
- Bernal, David** FE-05
bernalde@cmu.edu
 Chemical Engineering, Carnegie Mellon University, Pittsburgh, PA, United States
- Bieker, Katharina** FE-02, SD-02
bieker@math.upb.de
 Chair of Applied Mathematics, Paderborn University, Paderborn, Germany
- Bigi, Giancarlo** FC-03
giancarlo.biggi@unipi.it
 Dipartimento di Informatica, Università di Pisa, Pisa, Italy
- Bogdan, Marcel** SE-06
marcel.bogdan@umfst.ro
 Industrial Engineering and Management, George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures, Targu Mures, Romania
- Bomze, Immanuel** SB-03, SE-03
immanuel.bomze@univie.ac.at
 Dept. of Statistics and OR, University of Vienna, Vienna, Austria
- Bortz, Michael** FD-04
michael.bortz@itwm.fraunhofer.de
 Optimization, Fraunhofer ITWM, Kaiserslautern, Deutschland, Germany
- Bot, Radu Ioan** SB-05
radu.bot@univie.ac.at
 Faculty of Mathematics, University of Vienna, Vienna, Austria
- Bourguignon, Sebastien** SD-05
Sebastien.Bourguignon@ec-nantes.fr
 Ecole Centrale de Nantes, France
- Bras, Carmo** SD-04
mb@fct.unl.pt
 Mathematics, CMA/FCT-UNL, Caparica, Portugal
- Brilli, Andrea** FE-04
brilli@diag.uniroma1.it
 Department of Computer Control and Management Engineering "A. Ruberti", Sapienza University of Rome, Roma, RM, Italy
- Burachik, Regina** SB-05
regina.burachik@unisa.edu.au
 School of Mathematics and Statistics, University of South Australia, Adelaide, South Australia, Australia
- Cafieri, Sonia** SD-05

- sonia.cafieri@enac.fr*
ENAC - Ecole Nationale d' Aviation Civile, Toulouse, France
- Calamita, Alice** SA-03
alice.calamita@uniroma1.it
DIAG - Department of Computer, Control and Management Engineering, Sapienza University of Rome, Rome, Italy, Italy
- Caldwell, Bethany** SB-05
calbi001@mymail.unisa.edu.au
UniSA STEM, University of South Australia, Mawson Lakes, South Australia, Australia
- Calvo Cruz, Nicolás** FC-07
ncalvocruz@gmail.com
Departamento de Informática, Universidad de Almería, Almería, Andalucía, Spain
- Caprari, Elisa** FF-06
elisa.caprari@unipv.it
Dipartimento di Scienze Economiche e Aziendali, Università di Pavia, PAVIA, Italy
- Casado, Leocadio G.** SE-05, FC-07
leo@ual.es
Computer Science, Universidad de Almeria (ceiA3), Almeria, Spain
- Cerboni Baiardi, Lorenzo** FF-06
lorenzo.cerboni@unibo.it
Department of Mathematics, University of Bologna, Bologna, Bo, Italy
- Cerny, Michal** FF-04
cernym@vse.cz
Department of Econometrics, Prague University of Economics & Business, Prague, Czech Republic
- Cevher, Volkan** SD-03
volkan.cevher@epfl.ch
School of Engineering, EPFL, Lausanne, Switzerland
- Chalco-Cano, Yurilev** FF-04
ychalco@uta.cl
Universidad de Tarapaca, Arica, Chile
- Chambolle, Antonin** SE-04
antonin.chambolle@ceremade.dauphine.fr
CEREMADE, CNRS, Université Paris-Dauphine, PSL, Paris, France
- Cipolla, Stefano** SE-04
scipolla@ed.ac.uk
School of Mathematics, The University of Edinburgh, United Kingdom
- Clarke, Ross** SD-02
rnc78@cam.ac.uk
Department of Engineering, University of Cambridge, United Kingdom
- Coniglio, Stefano** FE-03
stefano.coniglio@gmail.com
Mathematical Sciences, University of Southampton, Southampton, United Kingdom
- Conn, Andrew** SD-05
arconn@us.ibm.com
IBM TJ Watson Research Center, New York, United States
- Consolo, Antonio** SE-02
antonio.consolo@polimi.it
Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Milano, Italy
- Contreras, Juan Pablo** SE-04
juan.contrerasff@gmail.com
Universidad Adolfo Ibañez, Chile
- Coppola, Corrado** SA-07
corrado.coppola@uniroma1.it
Department of Computer, Control and Management Engineering, Sapienza University of Rome, Rome, RM, Italy
- Costa, M. Fernanda P.** SD-04, FC-06
mfc@math.uminho.pt
Centre of Mathematics, University of Minho, Braga, Portugal
- Crama, Yves** FC-02
Yves.Crama@uliege.be
HEC - Management School, University of Liège, Liege, Belgium
- Cristofari, Andrea** SA-04
andrea.cristofari@uniroma2.it
Department of Civil Engineering and Computer Science Engineering, University of Rome "Tor Vergata", Rome, Italy
- Cruz, N.c.** FC-07
ncalvocruz@ual.es
Dpt. of Computer Architecture and Technology, University of Granada, Almeria, Andalucia, Spain
- Custodio, Ana Luisa** FE-04, SD-04
alcustodio@fct.unl.pt
Dept. Mathematics, Universidade Nova de Lisboa, Caparica, Portugal
- D'Ambrosio, Claudia** SD-05
dambrosio@lix.polytechnique.fr
LIX, CNRS - Ecole Polytechnique, Palaiseau, France
- da Costa, Tiago M.** FF-04
grafunjo@yahoo.com.br
Universidad de Tarapacá, Arica, Chile
- De Santis, Marianna** SA-02, FE-05
mdesantis@diag.uniroma1.it
DIAG, Sapienza, University of Rome, Roma, Italy
- De Souza, Maycon** SD-03
maycon_matematico@hotmail.com
Aplicated Math, Unicamp, Uruaçu, GO, Brazil
- Di Teodoro, Giulia** FD-07
giulia.diteodoro@uniroma1.it
Dipartimento di ingegneria informatica automatica e gestionale A. Ruberti, La Sapienza university of Rome, Martin-sicuro, Teramo, Italy

- Dias, José Carlos** SD-07
jose.carlos.dias@iscte.pt
 Finance, Instituto Universitário de Lisboa (Iscte), Lisbon, Portugal
- Diessel, Erik** SA-02
erik.diessel@itwm.fraunhofer.de
 Department of Optimization, Fraunhofer Institute for Industrial Mathematics ITWM, Kaiserslautern, Germany
- Dippon, Jürgen** SD-06
dippon@math.uni-stuttgart.de
 Mathematics, University Stuttgart, Stuttgart, Germany
- Doikov, Nikita** FF-03
nikitad101@gmail.com
 Université catholique de Louvain (UCL), Belgium
- Dose, Valerio** FC-06
valerio.dose@gmail.com
 Department of Computer, Control and Management Engineering, "Sapienza" Università di Roma, Italy
- Dvurechensky, Pavel** SE-03
pavel.dvurechensky@gmail.com
 Weierstrass Institute for Applied Analysis and Stochastics, Berlin, Germany
- Eichfelder, Gabriele** FE-02, SA-02, SB-02
Gabriele.Eichfelder@tu-ilmenau.de
 Institute of Mathematics, Technische Universität Ilmenau, Ilmenau, Germany
- Elloumi, Sourour** FC-02
sourour.elloumi@ensta-paris.fr
 Unité de Mathématiques Appliquées, ENSTA Paris, Palaiseau, France
- Erturk, Emrullah** FD-02
e.erturk@gtu.edu.tr
 Chemical Engineering, Gebze Technical University, Kocaeli, Turkey
- Evans, Brecht** SB-04
brecht.evans@kuleuven.be
 Department of Electrical Engineering ESAT-STADIUS, KU Leuven, Leuven, Vlaams-Brabant, Belgium
- Faias, Marta** FC-03
mcm@fct.unl.pt
 Universidade NOVA de Lisboa, Lisbon, Portugal
- Fajardo, Maria Dolores** SA-05
md.fajardo@ua.es
 Mathematics, University Of Alicante, Alicante, Spain
- Fargetta, Georgia** SD-06
georgia.fargetta@phd.unict.it
 Mathematics and Computer Science, University of Catania, Catania, Italy
- Feinstein, Zachary** FE-02, SD-02
zfeinste@stevens.edu
 School of Business, Stevens Institute of Technology, HOBOKEN, NJ, United States
- Fercoq, Olivier** SD-03
olivier.fercoq@telecom-paristech.fr
 Telecom Paristech University, Paris, France
- Fernandes, Edite M.G.P.** SD-04, FC-06
emgpf@dps.uminho.pt
 Algoritmi Research Centre, University of Minho, Braga, Portugal
- Ferreira, Miguel** FF-07
miguel.ferreira@isag.pt
 Cemapre and Isag, Portugal
- Filipecki, Bartosz** FE-05
bartosz.filipecki@gmail.com
 -, Germany
- Foà, Simone** SA-07
foa.1803733@studenti.uniroma1.it
 Sapienza, Rome, Italy
- Furini, Fabio** FE-03
fabio.furini@uniroma1.it
 DIAG, La Sapienza, Roma, Please Select, Italy
- G.-Tóth, Boglárka** SE-05
boglarka@inf.szte.hu
 Department of Computational Optimization, University of Szeged, Szeged, Hungary
- Gabl, Markus** SB-03
markus.gabl@kit.edu
 Karlsruhe Institute of Technology, Wien, Austria
- Garajová, Elif** FF-04
elif@kam.mff.cuni.cz
 Department of Applied Mathematics, Charles University, Faculty of Mathematics and Physics, Praha 1, Czech Republic
- Garrido, Ja.** FC-07
jesusgarrido@ugr.es
 Universidad de Granada, Granada, Spain
- Garzon, Ester M** FC-07
gmartin@ual.es
 Informatics, Almeria University, Almería, Spain
- Gebken, Bennet** FE-02, SD-02
bgebken@math.upb.de
 Department of Mathematics, Paderborn University, Germany
- Giselsson, Pontus** SD-03
pontusg@control.lth.se
 Dept. of Automatic Control, Lund University, Sweden
- Gnudi, Adriana** SE-06
adriana.gnudi@unibg.it
 Mathematics, Statistics, Computer science and Applications, University of Bergamo, Bergamo, Italy
- Goberna, Miguel** FC-05
mgoberna@ua.es
 Mathematics, Universidad de Alicante, San Vicente del

- Raspeig, Alicante, Spain
- Gondzio, Jacek** SA-03, SE-04
j.gondzio@ed.ac.uk
 School of Mathematics, University of Edinburgh, Edinburgh,
 United Kingdom
- González-Redondo, A.** FC-07
alvarogr@ugr.es
 Universidad de Granada, Granada, Spain
- Grani, Giorgio** SE-02, SA-07
g.grani@uniroma1.it
 Department of Statistical Sciences, Sapienza University of
 Rome, Rome, Lazio, Italy
- Grapiglia, Geovani** FE-04
geovani.grapiglia@uclouvain.be
 Applied Mathematics, Université catholique de Louvain,
 LOUVAIN-LA-NEUVE, Belgium
- Groetzner, Patrick** SB-02
patrick.groetzner@math.uni-augsburg.de
 Mathematics, University of Augsburg, Augsburg, Germany
- Grossmann, Ignacio** FE-05
grossmann@cmu.edu
 Chemical Engineering, Carnegie Mellon University, Pitts-
 burgh, PA, United States
- Grüne, Lars** FE-02
Lars.Gruene@uni-bayreuth.de
 Mathematics Department, University of Bayreuth, Mathe-
 matical Institute, Bayreuth, Germany
- Guerra, Manuel** SD-07
mguerra@iseg.ulisboa.pt
 ISEG, Lisboa, Portugal
- Guerrero, Vanesa** SD-05
vanesa.guerrero@uc3m.es
 Department of Statistics, Universidad Carlos III de Madrid,
 Getafe, Spain
- Günther, Christian** SA-05, FD-06
Christian.Guenther@mathematik.uni-halle.de
 Institute of Mathematics, Martin Luther University Halle-
 Wittenberg, Halle (Saale), Germany
- Gutiérrez, César** SB-02
cesargv@mat.uva.es
 Departamento de Matemática Aplicada, Universidad de Val-
 ladolid, Valladolid, Spain
- Hantoute, Abderrahim** FF-05
hantoute@ua.es
 Mathematics, Universidad de Alicante, Alicante, Spain,
 Spain
- Harks, Tobias** FE-03
tobias.harks@math.uni-augsburg.de
 Institut für Mathematik, Universität Augsburg, Augsburg,
 Germany
- Hendrix, Eligius M.T.** SE-05
eligius@uma.es
 Computer Architecture, Universidad de Málaga, Malaga,
 Spain
- Heringer Manoel Krulikowski, Evelin** FE-04
e.krulikowski@fct.unl.pt
 Cma Fct-nova, Portugal
- Hernandez Lobato, Jose Miguel** SD-02
jmh233@cam.ac.uk
 University of Cambridge, United Kingdom
- Hernández-Jiménez, Beatriz** FF-04
mbherjim@upo.es
 Economics, University Pablo de Olavide, SEVILLA, Spain
- Hey, Niklas** FF-02
nihey@wu.ac.at
 Institute For Statistics and Mathematics, Vienna University
 of Economics and Business, Vienna, Vienna, Austria
- Hinder, Oliver** SE-04
ohinder@pitt.edu
 Industrial Engineering, University of Pittsburgh, Pittsburgh,
 United States
- Holý, Vladimír** SB-07
vladimir.holy@vse.cz
 Department of Econometrics, Prague University of Eco-
 nomics and Business, Czech Republic
- Huerga, Lidia** FF-06
lhuerga@ind.uned.es
 Applied Mathematics, Universidad Nacional de Educación a
 Distancia, UNED, Madrid, Spain
- Iommazzo, Gabriele** SD-05
gab.iom89@gmail.com
 Zuse Institute Berlin, Berlin, Germany
- J. Gillet, Valerie** FD-07
v.gillet@sheffield.ac.uk
 Information School, University of Sheffield, Sheffield, United
 Kingdom
- Jadamba, Baasansuren** FE-06
bxjsma@rit.edu
 Rochester Institute of Technology, Rochester, New York,
 United States
- Jordán, Abelardo** FC-05
ajordan@pucc.edu.pe
 Sciences, Pontificia Universidad Católica del Perú, San
 Miguel, Lima, Peru
- Kaya, Yalçın** SB-05
yalcin.kaya@unisa.edu.au
 UniSA STEM, University of South Australia, Adelaide,
 South Australia, Australia
- Kepalas, Mindaugas** SB-07
mindaugas.kepalas@gmail.com
 Institute of Data Science and Digital Technologies, Vilnius
 University, Vilnius, Lithuania

- Khan, Akhtar** FE-06, SD-06
aaksma@rit.edu
 School of Mathematical Sciences, Rochester Institute of Technology, Rochester, New York, United States
- Khazayel, Bahareh** SA-05
Bahareh.Khazayel@mathematik.uni-halle.de
 Institute of Mathematics, Martin Luther University Halle-Wittenberg, Halle (Saale), Saxony-Anhalt, Germany
- Kimiaei, Morteza** SA-04
kimiaeim83@univie.ac.at
 Department of Mathematics, University of Vienna, Wien, Wien, Austria
- Klimm, Max** FE-03
klimm@math.tu-berlin.de
 Institut für Mathematik, Technische Universität Berlin, Berlin, Germany
- Köbis, Elisabeth Anna Sophia** FD-06
elisabeth.koebis@mathematik.uni-halle.de
 Martin-Luther-University Halle-Wittenberg, Germany
- Konnov, Igor** SE-06
konn-igor@ya.ru
 System Analysis & IT, Kazan University, Kazan, Russian Federation
- Kortanek, Ken** FC-04
ken-kortanek@uiowa.edu
 Department of Industrial Engineering, University of Pittsburgh, Pittsburgh, PA, United States
- Kostyukova, Olga** FC-04
kostyukova@im.bas-net.by
 Mathematical System Theory, Institute of Mathematics, National Academy of Sciences of Belarus, Minsk, Belarus
- Kovacova, Gabriela** FE-02, FF-02
gabriela.kovacova@wu.ac.at
 Department of Finance, Accounting and Statistics, Vienna University of Economics and Business, Wien, Austria, Austria
- Kronqvist, Jan** FE-05
jankr@kth.se
 Mathematics, KTH Royal Institute of Technology, Sweden
- Krügel, Lisa** FE-02
lisa.kruegel@uni-bayreuth.de
 Mathematical Institute, University of Bayreuth, Bayreuth, Germany
- Küfer, Karl-Heinz** FF-02, FD-04
kuefer@itwm.fhg.de
 Optimization, Fraunhofer ITWM, Kaiserslautern, Germany
- Lambert, Amélie** FC-02
amelie.lambert@cnam.fr
 CEDRIC, CNAM, paris, France
- Lammel, Ina** FF-02
ina.lammel@itwm.fraunhofer.de
 Optimization, Fraunhofer ITWM, Kaiserslautern, Germany
- Lampariello, Lorenzo** FD-03
lorenzo.lampariello@uniroma3.it
 Roma Tre University, Italy
- Lapucci, Matteo** FE-02
matteo.lapucci@unifi.it
 Department of Information Engineering, University of Florence, Firenze, Italy
- Latafat, Puya** SD-03, SB-04
puya.latafat@kuleuven.be
 Electrical Engineering (ESAT) STADIUS Center for Dynamical Systems, Signal Processing and Data Analytics, KU Leuven, Leuven, Belgium
- Li, Jinlu** FD-06
jli@shawnee.edu
 Shawnee State University, Portsmouth, United States
- Link, Moritz** SA-02
moritz.link@uni-konstanz.de
 Mathematics and Statistics, Universität Konstanz, Germany
- Liuzzi, Giampaolo** FE-04
giampaolo.liuzzi@diag.uniroma1.it
 DIAG - Sapienza University of Rome, Rome, Italy
- Liuzzi, Giampaolo** SD-05
giampaolo.liuzzi@uniroma1.it
 DIAG, Sapienza Univ. of Rome, Rome, RM, Italy
- Ljubic, Ivana** FE-03
ivana.ljubic@essec.edu
 IDS, ESSEC Business School of Paris, Cergy-Pontoise, France
- Lopez Redondo, Juana** FC-07, FD-07
jlredondo@ual.es
 Department of Informatics, University of Almeria, Almeria, Spain
- Lopez, Ruben** SB-02
rlopezm@academicos.uta.cl
 Departamento de Matematica, Universidad de Tarapaca, Arica, Region Arica y Parinacota, Chile
- Lucidi, Stefano** FE-04
lucidi@dis.uniroma1.it
 Department of Computer, Control, and Management Science, University of Rome "La Sapienza", Rome, Italy
- Lupion Lorente, Marcos** FC-07
marcoslupion@ual.es
 Computer Science, University of Almería, Albuñol, Andalucía, Spain
- Maggioni, Francesca** SB-03
francesca.maggioni@unibg.it
 Department of Management, Information and Production Engineering, University of Bergamo, Bergamo, Italy
- Malitsky, Yura** SB-05
y.malitsky@gmail.com
 Linköping University, Linköping, Sweden

- Malitsky, Yura** FD-03
y.malitsky@gmail.com
 MAI, Linköping University, Linköping, Sweden
- Manno, Andrea** SE-02
andrea.manno@univaq.it
 University of L'Aquila, Italy
- Mansueto, Pierluigi** FE-02
pierluigi.mansueto@unifi.it
 Department of Information Engineering, University of Florence, Florence, Italy
- Maranghi, Marianna** FD-07
marianna.maranghi@uniroma1.it
 Dipartimento di Medicina Traslazionale e di Precisione, "Sapienza", University of Rome, Rome, Italy
- Marchetti, Francesco** SA-07
francesco.marchetti@strath.ac.uk
 Mechanical and Aerospace Engineering, University of Strathclyde, Glasgow, Scotland, United Kingdom
- Martínez-Legaz, Juan Enrique** FC-05, SA-05
JuanEnrique.Martinez.Legaz@uab.cat
 Departament d'Economia, Universitat Autònoma de Barcelona, Bellaterra, Spain
- Massias, Mathurin** SB-04
mathurin.massias@gmail.com
 INRIA Lyon, Lyon, France
- Matos Dias, Joana** SA-04
joana@fe.uc.pt
 Univ Coimbra - FEUC, Inesc Coimbra, Coimbra, Portugal
- Matuschke, Jannik** FE-03
jannik.matuschke@kuleuven.be
 KU Leuven, Leuven, Belgium
- Mencarelli, Luca** FC-02
luca.mencarelli.university@gmail.com
 UMA, ENSTA Paris, Institut Polytechnique de Paris, France
- Messine, Frédéric** SB-02, SE-05
Frederic.Messine@laplace.univ-tlse.fr
 LAPLACE-ENSEEIH-ENST INPT University of Toulouse, Toulouse, France
- Miettinen, Kaisa** FC-06
kaisa.miettinen@jyu.fi
 Faculty of Information Technology, University of Jyväskylä, University of Jyväskylä, Finland
- Miglierina, Enrico** FF-06
enrico.miglierina@unicatt.it
 Dipartimento di Dipartimento di Matematica per le scienze economiche, finanziarie ed attuariali, Università Cattolica del Sacro Cuore, Milano, Italy
- Milasi, Monica** FC-03
mmilasi@unime.it
 Università degli Studi di Messina, Messina, Italy
- Milasi, Monica** FD-03
monica.milasi@gmail.com
 Economics, University of Messina, Messina, Italy, Italy
- Minisci, Edmondo** SA-07
edmondo.minisci@strath.ac.uk
 MEchanical and Aerospace Engineering, University of Strathclyde, Glasgow, United Kingdom
- Mishchenko, Konstantin** FF-03
konsta.mish@gmail.com
 Informatique, École Normale Supérieure, Paris, France
- Mohammadi, Aboozar** SD-04
a.mohammadi@campus.fct.unl.pt
 Mathematics, Faculdade de Ciências e Tecnologia, NOVA, Lisbon, Lisbon, Portugal
- Molho, Elena** FF-06
elena.molho@unipv.it
 Dipartimento di Scienze Economiche e Aziendali, Università di Pavia, Pavia, Italy
- Molinari, Cesare** SB-04
cesare.molinari@edu.unige.it
 Università di Genova, Genova, GE, Italy
- Monaci, Marta** SE-02
marta.monaci@uniroma1.it
 Department of Computer, Control and Management Engineering "Antonio Ruberti" (DIAG), Sapienza University of Rome, Rome, Lazio, Italy
- Mongeau, Marcel** SD-05
marcel.mongeau@enac.fr
 ENAC, Toulouse, France
- Moreno Riado, Juan José** FC-07
juanjomoreno@ual.es
 Universidad de Almería, Spain
- Moura, Alexandra** SD-07
amoura@iseg.ulisboa.pt
 CEMAPRE and ISEG - Lisbon School of Economics and Management, Lisbon, Portugal
- Nannicini, Giacomo** SE-03
nannicini@us.ibm.com
 IBM T.J. Watson Research Center, Yorktown Heights, New York, United States
- Naraghirad, Eskandar** SA-05
eskandarrad@gmail.com
 mathematics, Yasouj University, Yasouj, Boyerahmad, Iran, Islamic Republic of
- Necoara, Ion** FF-03
ion.necoara@upb.ro
 Automatic Control and Systems Engineering, University Politehnica Bucharest, Bucharest, Romania
- Nesterov, Yurii** FF-03
Yurii.Nesterov@uclouvain.be
 CORE, Université catholique de Louvain (UCL), Louvain-la-neuve, Belgium

- Neumaier, Arnold** SA-04
Arnold.Neumaier@univie.ac.at
 Fakultät fuer Mathematik, University of Vienna, Vienna, Austria
- Niebling, Julia** SD-02
Julia.Niebling@dlr.de
 Institute of Data Science, Deutsches Zentrum für Luft- und Raumfahrt, Jena, Germany
- Ninin, Jordan** SB-02, SD-05
jordan.ninin@ensta-bretagne.fr
 ENSTA-Bretagne, Brest, France
- Novo, Vicente** FF-06
vnovo@ind.uned.es
 Matematica Aplicada, Universidad Nacional de Educacion a Distancia, Madrid, Spain
- Nunes, Joao Pedro** SD-07
joao.nunes@iscte.pt
 ISCTE-IUL, Carcavelos, Carcavelos, Portugal
- Oggioni, Giorgia** SE-06
giorgia.oggioni@unibs.it
 Department of Economics and Management, University of Brescia, Italy, Brescia, Italy, Italy
- Oldewage, Elre** SD-02
etv21@cam.ac.uk
 Department of Engineering, University of Cambridge, United Kingdom
- Oliveira, Aurelio** SD-03
aurelio@ime.unicamp.br
 Computational & Applied Mathematics, University of Campinas, Campinas, SP, Brazil
- Oliveira, Carlos** SD-07
carlosoliveira@iseg.ulisboa.pt
 ISEG, Universidade de Lisboa, Lisboa, Lisboa, Portugal
- Ortigosa, E.m.** FC-07
ortigosa@ugr.es
 Universidad de Granada, Granada, Spain
- Ortigosa, Pilar M.** FC-07, FD-07
ortigosa@ual.es
 Department of Informatics, University of Almería, Almería, Spain
- Osuna-Gómez, Rafaela** FF-04
rafaela@us.es
 University of Seville, Sevilla, Spain
- Žilinskas, Julius** SB-07
julius.zilinskas@mif.vu.lt
 Institute of Data Science and Digital Technologies, Vilnius University, Vilnius, Lithuania
- Paechter, Ben** FC-07
b.paechter@napier.ac.uk
 School of Computing, Napier University, Edinburgh, United Kingdom
- Palagi, Laura** SE-02, SA-03, SD-05, FD-07, SA-07
laura.palagi@uniroma1.it
 Dipartimento di Ingegneria informatica automatica e gestionale, La Sapienza Università di Roma, Roma, Italy
- Pas, Pieter** SB-04
pieter.pas@kuleuven.be
 Department of Electrical Engineering ESAT-STADIUS, KU Leuven, Leuven, Belgium
- Patria, Daniele** SA-02
daniele.patria@uniroma1.it
 DIAG, Sapienza, University of Rome, Rome, RM, Italy
- Patrinos, Panagiotis** SD-03, SB-04
panos.patrinos@esat.kuleuven.be
 Electrical Engineering, KU Leuven, Leuven, Belgium
- Pavlov, Andrei** FF-07
xapavlov@gmail.com
 WIAS, Berlin, Germany
- Pérez-Sánchez, Horacio** FD-07
hperez@ucam.edu
 Universidad Católica de Murcia, Murcia, Murcia, Spain
- Peitz, Sebastian** FE-02, SD-02
sebastian.peitz@upb.de
 Department of Computer Science, University of Paderborn, Paderborn, Germany
- Peng, Bo** SB-03
bo.peng@univie.ac.at
 University of Vienna, Vienna, , Austria
- Peng, Zedong Peng** FE-05
peng_zedong@126.com
 College of Control Science and Engineering, Zhejiang University, Hangzhou,, Hangzhou, China
- Pethick, Thomas** SD-03
thomas.pethick@epfl.ch
 Laboratory for Information and Inference Systems, EPFL, Lausanne, Switzerland
- Peypouquet, Juan** SD-03
j.g.peypouquet@rug.nl
 Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence, University of Groningen, Groningen, Netherlands
- Pflug, Georg** SB-03
georg.pflug@univie.ac.at
 Department of Statistics and Decision Support Systems, University of Vienna, Vienna, Austria
- Pinheiro, Diogo** FF-07
dpinheiro@brooklyn.cuny.edu
 Department of Mathematics, Brooklyn College of the City University of New York, Brooklyn, NY, United States
- Pinheiro, Susana** FF-07
Spinheiro@qcc.cuny.edu
 Mathematics and Computer Science, Queensborough Com-

- munity College - CUNY, Bayside, NY, United States
- Pintea, Cornel** FF-05
cpintea@math.ubbcluj.ro
 Babes Bolyai University, Romania
- Popovici, Nicolae** FD-06
popovici@math.ubbcluj.ro
 Mathematics, Babes-Bolyai University of Cluj-Napoca, Cluj-Napoca, Romania
- Poursandis, Miltiadis** FD-04
miltiadis.poursanidis@itwm.fraunhofer.de
 Fraunhofer Institut ITWM, Germany
- Provost, Valérie** SA-07
provost.valerie@gmail.com
 Département de mathématiques et de génie industriel, Polytechnique Montréal, Québec, Canada
- Puertas Martín, Savíns** FC-07, FD-07
savinspm@ual.es
 University of Almería, Spain
- Raciti, Fabio** FF-05
fabio.raciti@unict.it
 University of Catania, Catania, Italy, Italy
- Rada, Miroslav** FF-04
miroslav.rada@vse.cz
 Department of Econometrics, Prague University of Economics and Business, Czech Republic
- Raydan, Marcos** FE-04
m.raydan@fct.unl.pt
 Cma Fct-nova, Caparica, None Selected, Portugal
- Riccardi, Rossana** SE-06
rossana.riccardi@unibs.it
 Economics and Management, University of Brescia, Brescia, Italy
- Rinaldi, Francesco** SE-03, SA-04
rinaldi@math.unipd.it
 Dipartimento di Matematica "Tullio Levi-Civita", Università di Padova, Italy
- Rocha, Humberto** SA-04
hrocha@fe.uc.pt
 CeBER, Faculty of Economics, University of Coimbra, Portugal
- Rocha, Paulo** SD-07
paulorochoa99@hotmail.com
 Faculdade de Ciências da Universidade de Lisboa, Portugal
- Rodríguez Álvarez, Margarita** FC-05
marga.rodriguez@ua.es
 Dpto. Matemáticas, Universidad de Alicante, San Vicente del Raspeig, Alicante, Spain
- Rodrigues, Bárbara** SA-07
B.C.Rodrigues@sms.ed.ac.uk
 School of Mathematics, University of Edinburgh, Edinburgh, United Kingdom
- Rodriguez-Heck, Elisabeth** FC-02
erodriguezheck@gmail.com
 Chair of Operations Research, RWTH Aachen University, Aachen, Germany
- Rolfes, Jan** FD-02
jrolfes@kth.se
 Optimization and System Theory, Royal Institute of Technology (KTH) Stockholm, Stockholm, Sweden
- Romero Caparrós, Luis Felipe** FD-07
fr@uma.es
 University of Malaga, Málaga, Málaga, Spain
- Romero Morales, Dolores** SC-01
drm.eco@cbs.dk
 Copenhagen Business School, Frederiksberg, Denmark
- Romero, Luis F.** FD-07
felipe@uma.es
 Computer Architecture, University of Malaga, Spain
- Rosasco, Lorenzo** SB-04
lrosasco@mit.edu
 MaLGA, DIBRIS, Università di Genova, Genova, Italy
- Rudloff, Birgit** FF-02, SD-02
birgit.rudloff@wu.ac.at
 Department of Finance, Accounting and Statistics, Vienna University of Economics and Business, Wien, Austria
- Rudloff, Birgit** FE-02
brudloff@wu.ac.at
 Vienna University of Economics and Business, Wien, Austria
- Safin, Kamil** SE-03
kamil.safin@phystech.edu
 Moscow Institute of Physics and Technology, Dolgoprudny, Russian Federation
- Sama, Miguel** FE-06
msama@ind.uned.es
 Matemática Aplicada, Universidad Nacional de Educación a Distancia, UNED, Madrid, Spain
- Samain, Gwenaël** SD-05
gwenael.samain@ls2n.fr
 LS2N, France
- Sarrafi, Sahin** FD-02
shahinsarrafi@gmail.com
 SOCAR Turkey R&D and Innovation Co., Izmir/Aliaga, Izmir, Turkey
- Savku, Emel** FF-07
esavku@gmail.com
 Department of Mathematics, University of Oslo, Oslo, – Select state–, Norway
- Savostianova, Dayana** SA-04
dayana.savostianova@gssi.it
 Mathematics, Gran Sasso Science Institute, L'Aquila, AQ, Italy

- Schießl, Jonas** FE-02
jonas.schiessl@uni-bayreuth.de
 Mathematical Institute, University of Bayreuth, Bayreuth, Germany
- Schmid, Jochen** FD-04
jochen.schmid@itwm.fraunhofer.de
 Fraunhofer Institut ITWM, Kaiserslautern, Germany
- Schwientek, Jan** FD-04
Jan.Schwientek@itwm.fraunhofer.de
 Optimization, Fraunhofer ITWM, Kaiserslautern, Rhineland-Palatinate, Germany
- Scopelliti, Domenico** FC-03, FD-03, SE-06
domenico.scopelliti@unibs.it
 University of Brescia, Italy
- Scrimali, Laura Rosa Maria** SD-06
scrimali@dmi.unict.it
 DMI, Università di Catania, Catania, Italy
- Seccia, Ruggiero** SD-05
ruggiero.seccia@ortec.com
 Ortec, Zoetermeer, Netherlands
- Seidel, Tobias** FD-04, FE-05
tobias.seidel@itwm.fhg.de
 Optimization, Fraunhofer Institute ITWM, Germany
- Sepulcre, Juan Matías** SA-05
JM.Sepulcre@ua.es
 Department of Mathematics, University of Alicante, Spain
- Seufert, Philipp** FD-04
philipp.seufert@itwm.fraunhofer.de
 Optimization, Fraunhofer ITWM, Kaiserslautern, Germany
- Shtern, Shimrit** SE-03
shimrits@technion.ac.il
 Industrial Engineering and Management, Technion-Israel Institute of Technology, Haifa, Israel
- Sildir, Hasan** FD-02
hasansildir@gtu.edu.tr
 Chemical Engineering, Gebze Technical University, Turkey
- Silva, Everton** SD-04
ejo.silva@campus.fct.unl.pt
 Mathematics, NOVA School of Science and Technology, Almada, Portugal
- Silva, Fernando** SD-07
fernando.c.dasilva@gmail.com
 Instituto Universitário de Lisboa (Iscte), Lisbon, Portugal
- Sim, Chee Khian** SB-04
chee-khian.sim@port.ac.uk
 Mathematics, University of Portsmouth, Portsmouth, United Kingdom
- Sokol, Ondřej** FF-04
ondrej.sokol@vse.cz
 Department of Econometrics, Prague University of Economics and Business, Prague, Prague, Czech Republic
- Spencer Trindade, Renan** SD-05
rst@lix.polytechnique.fr
 Lix, Cnrs, École Polytechnique, Palaiseau, Île-de-France, France
- Starkloff, Hans-Jörg** SD-06
Hans-Joerg.Starkloff@math.tu-freiberg.de
 Fakultät für Mathematik und Informatik, TU Bergakademie Freiberg, Freiberg, Germany
- Staudigl, Mathias** SE-03
mathias.staudigl@gmail.com
 Data Science and Knowledge Engineering, Maastricht University, Maastricht, Netherlands
- Stein, Oliver** SF-01
stein@kit.edu
 Institute of Operations Research, Karlsruhe Institute of Technology, Karlsruhe, Germany
- Tam, Matthew** SB-05
matthew.tam@unimelb.edu.au
 School of Mathematics and Statistics, University of Melbourne, Australia
- Tamadoni Jahromi, Maryam** SA-05
tamadoni_maryam@yahoo.com
 Yasouj University, Yasouj, Iran, Islamic Republic of
- Tammer, Christiane** SA-05, FD-06
christiane.tammer@mathematik.uni-halle.de
 Mathematics and Computer Science, Martin-Luther-University Halle-Wittenberg, Halle, Germany
- Taylor, Adrien** SD-03
adrien.taylor@inria.fr
 Inria/ENS, France
- Tchemisova, Tatiana** FC-04
tatiana@ua.pt
 Mathematics Department, University of Aveiro, Aveiro, Portugal
- Teboulle, Marc** FB-01
teboulle@math.tau.ac.il
 School of Mathematical Sciences, Tel Aviv University, Tel-Aviv, Israel
- Teichert, Katrin** FE-05
katrin.teichert@itwm.fraunhofer.de
 Optimization, Fraunhofer ITWM, Kaiserslautern, Germany
- Tekgül, Simay** FF-02
simaytekgul@gmail.com
 Bilkent University, Ankara, Turkey
- Tomanová, Petra** SB-07
petra.tomanova@vse.cz
 Department of Econometrics, Prague University of Economics and Business, Prague 3, Czech Republic
- Torregrosa-Belén, David** SB-05
 david.torregrosa@ua.es
 Mathematics, University of Alicante, Alicante, Alicante,

- Spain
- Torres Figueroa, Juan Jose** SE-03
torresfigueroa@lipn.univ-paris13.fr
 LIPN-Universite Sorbonne Paris Nord, France
- Traversi, Emiliano** SE-03
emiliano.traversi@lipn.univ-paris13.fr
 University of Paris XIII, Villetaneuse, France
- Tudisco, Francesco** SA-04
tudisco.francesco@gmail.com
 Gran Sasso Science Institute, Italy
- Uetz, Marc** FE-03
m.uetz@utwente.nl
 Applied Mathematics, University of Twente, Enschede, Netherlands
- Ulus, Firdevs** FF-02
firdevs@bilkent.edu.tr
 Industrial Engineering, Bilkent University, Ankara, Turkey
- Upadhyaya, Manu** SD-03
manu.upadhyaya.42@gmail.com
 Department of Automatic Control, Lund University, Lund, Skåne, Sweden
- Verchère, Mathieu** FC-02
mathieu.verchere@ensta-paris.fr
 UMA, ENSTA Paris, France
- Vicente-Pérez, José** FC-05
jose.vicente@ua.es
 University of Alicante, Alicante, Spain
- Villa, Silvia** SB-04
silvia.villa@unige.it
 Department of Mathematics, MaLGa, università di Genova, Genova, Italy
- Volkwein, Stefan** SA-02
stefan.volkwein@uni-konstanz.de
 Mathematics and Statistics, University of Konstanz, Konstanz, Baden-Wuerttemberg, Germany
- Wagner, Andrea** FF-02
andrea.wagner@wu.ac.at
 Vienna University of Economics and Business, Institute for Statistics and Mathematics, Vienna, Austria
- Warnow, Leo** SA-02
leo.warnow@tu-ilmenau.de
 Institute of Mathematics, Technische Universität Ilmenau, Ilmenau, Germany
- Weber, Gerhard-Wilhelm** FF-07
gerhard-wilhelm.weber@put.poznan.pl
 Faculty of Engineering Management, Poznan University of Technology, Poznan, Poland
- Wolfler-Calvo, Roberto** SE-03
roberto.wolfler@lipn.univ-paris13.fr
 LIPN, Université Paris Nord, Villetaneuse, France
- Yildirim, E. Alper** FG-01
eayildirim@gmail.com
 School of Mathematics, The University of Edinburgh, Edinburgh, United Kingdom
- Yu, Guolin** FC-04
guolin_yu@126.com
 Institute of Applied Mathematics, North Minzu University, Yinchuan, Ningxia, China
- Zanetti, Filippo** SA-03
f.zanetti@sms.ed.ac.uk
 School of Mathematics, University of Edinburgh, Edinburgh, United Kingdom
- Zeffiro, Damiano** SE-03
damiano.zeffiro@math.unipd.it
 University of Padua, Padua, Italy
- Zeile, Clemens** FD-02
clemens.zeile@ovgu.de
 Otto-von-Guericke-Universität Magdeburg, Germany
- Zhang, Qinghong** FC-04
qzhang@nmu.edu
 Mathematics and Computer Science, Northern Michigan University, Marquette, MI, United States
- Zhu, Jia-Jie** FF-07
zplusj@gmail.com
 Data-driven Optimization and Control Group, Weierstrass Institute for Applied Analysis and Stochastics, Berlin, Berlin Germany, BW, Germany

Friday, 8:30 - 9:00

FA-01: Opening (Auditorium 1C).....	1
-------------------------------------	---

Friday, 9:00 - 10:00

FB-01: Marc Teboulle (Auditorium 1C).....	1
---	---

Friday, 10:25 - 11:40

FC-02: MINO 1 - Polynomial Optimization with binary variables (Room 1.1).....	2
FC-03: CGT 1 - Intertwining optimization, variational problems and games I (Room 1.2).....	2
FC-04: CO 1 - Duality, optimality conditions, and regularization in Conic Optimization (Room 1.14).....	3
FC-05: COVA 1 - Continuous optimization and variational analysis I (Room 1.15).....	3
FC-06: VIU 1 - Some aspects of vector optimization (Room 1.16).....	3
FC-07: OHI 1 - Optimization on health informatics I (Room 1.17).....	4

Friday, 11:45 - 13:00

FD-02: MINO 2 - Mixed-integer nonlinear programming applications (Room 1.1).....	5
FD-03: CGT 2 - Intertwining optimization, variational problems and games-II (Room 1.2).....	5
FD-04: CO 2- Convex and nonconvex Optimization and applications (Room 1.14).....	6
FD-06: VIU 2 - Vector optimization with uncertainties (Room 1.16).....	6
FD-07: OHI 2 - Optimization on health informatics II (Room 1.17).....	6

Friday, 14:30 - 16:10

FE-02: MO 1 - Continuous multiobjective optimization (Room 1.1).....	8
FE-03: CGT 3 - Mixed integer games (Room 1.2).....	8
FE-04: DFO 1 - New algorithmic approaches in derivative-free optimization (Room 1.14).....	9
FE-05: MINO 3 - Mixed-integer nonlinear optimization (Room 1.15).....	9
FE-06: VIU 3 - Uncertainty quantification in inverse problems (Room 1.16).....	10

Friday, 16:15 - 17:30

FF-02: MO 2 - Convex multiobjective optimization (Room 1.1).....	11
FF-03: CCO 1 - Complexity of convex optimization (Room 1.2).....	11
FF-04: IO 1 - Interval optimization (Room 1.14).....	12
FF-05: COVA 3 - Continuous optimization and variational analysis III (Room 1.15).....	12
FF-06: VIU 4 - Robust optimization (Room 1.16).....	12
FF-07: OC 1 - Optimal control and optimization in finance, commodity trade, insurance and pension fund systems I (Room 1.17)	

Friday, 18:00 - 19:00

FG-01: Alper Yildirim (Auditorium 1C)	14
---	----

Saturday, 8:30 - 10:10

SA-02: MO 3 - Mixed-integer multiobjective optimization (Room 1.1)	15
SA-03: CGT 4 - Advances in conic optimization (Room 1.2)	15
SA-04: DFO 2 - Derivative-free optimization for challenging problems (Room 1.14)	16
SA-05: COVA 5 - Continuous optimization and variational analysis V (Room 1.15)	16
SA-07: OC 2 - Optimal control and optimization in finance, commodity trade, insurance and pension fund systems II (Room 1.17)	17

Saturday, 10:40 - 11:55

SB-02: MO 4 - Global multiobjective optimization (Room 1.1)	18
SB-03: CO 3- Advances in copositive and quadratic optimization (Room 1.2)	18
SB-04: PPA 1 - Splitting and regularization (Room 1.14)	18
SB-05: COVA 4 - Continuous optimization and variational analysis IV (Room 1.15)	19
SB-07: OC 3 - Optimal control and optimization in finance, commodity trade, insurance and pension fund systems III (Room 1.17)	19

Saturday, 12:00 - 13:00

SC-01: Dolores Romero Morales (Auditorium 1C)	20
---	----

Saturday, 14:30 - 16:10

SD-02: MO 5 - Multiobjective optimization and machine learning (Room 1.1)	21
SD-03: CGT 5 - Advances in operator splitting (Room 1.2)	21
SD-04: DFO 3 - Global and multiobjective derivative-free optimization (Room 1.14)	22
SD-05: GO 1 - Advanced techniques for global optimization (Room 1.15)	22
SD-06: VIU 6 - Stochastic approximation (Room 1.16)	23
SD-07: OC 4 - Optimal control and optimization in finance and insurance (Room 1.17)	23

Saturday, 16:15 - 17:30

SE-02: MINO 4 - Decomposition and MINLP for machine learning (Room 1.1)	25
SE-03: CGT 6 - Recent advances in projection free methods (Room 1.2)	25
SE-04: PPA 2 - Primal dual methods and related numerical issues (Room 1.14)	25
SE-05: GO 2 - Simplicial branch and bound (Room 1.15)	26
SE-06: COVA 6 - Continuous optimization and variational analysis VI (Room 1.16)	26

Saturday, 18:00 - 19:00

SF-01: EUROPT Fellowship Lecture - Oliver Stein (Auditorium 1C) 27

Saturday, 19:00 - 19:15

SG-01: Closing (Auditorium 1C) 27