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Vlasta Malkova · Igor Pospelov (Eds.)

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Optimization and Applications

13th International Conference, OPTIMA 2022
Petrovac, Montenegro, September 26–30, 2022
Revised Selected Papers



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Preface

This volume contains the second part of the refereed proceedings of the XIII International Conference on Optimization and Applications (OPTIMA 2022)¹.

Organized annually since 2009, the conference has attracted a significant number of researchers, academics, and specialists in many fields of optimization, operations research, optimal control, game theory, and their numerous applications in practical problems of data analysis and software development.

The broad scope of OPTIMA has made it an event where researchers involved in different domains of optimization theory and numerical methods, investigating continuous and discrete extremal problems, designing heuristics and algorithms with theoretical bounds, developing optimization software, and applying optimization techniques to highly relevant practical problems can meet together and discuss their approaches and results. We strongly believe that this facilitates collaboration between researchers working in optimization theory, methods, and applications, and those employing them to resolve valuable practical problems.

The conference was held during September 26–30, 2022, in Petrovac, Montenegro, in the picturesque Budvianian riviera on the azure Adriatic coast. For those who were not able to come to Montenegro this year, an online session was organized. The main organizers of the conference were the Montenegrin Academy of Sciences and Arts, Montenegro, the Dorodnicyn Computing Centre, FRC CSC RAS, Russia, and the University of Évora, Portugal. This year, the key topics of OPTIMA were grouped into seven tracks:

- (i) Mathematical programming
- (ii) Global optimization
- (iii) Discrete and combinatorial optimization
- (iv) Optimal control
- (v) Optimization and data analysis
- (vi) Game theory and mathematical economics
- (vii) Applications

The Program Committee (PC) and invited reviewers included more than one hundred well-known experts in continuous and discrete optimization, optimal control and game theory, data analysis, mathematical economy, and related areas from leading institutions of 25 countries: Argentina, Australia, Austria, Belgium, China, Finland, France, Germany, Greece, India, Israel, Italy, Lithuania, Kazakhstan, Mexico, Montenegro, the Netherlands, Poland, Portugal, Russia, Serbia, Sweden, Taiwan, the UK, and the USA. This year we received 70 submissions, mostly from Russia but also from Azerbaijan, Kazakhstan, Latvia, Montenegro, Poland, Portugal, and the USA. Each submission was reviewed in a single blind manner by at least three PC members or invited

¹ <http://agora.guru.ru/display.php?conf=OPTIMA-2022>.

reviewers, experts in their fields, to supply detailed and helpful comments. Out of 43 qualified submissions, the Program Committee decided to accept 17 papers to the first volume of the proceedings for publication in LNCS volume 13781. Thus the acceptance rate for the volume was about 40%.

In addition, after a short presentation of the candidate submissions, discussion at the conference, and subsequent revision, the Program Committee proposed 13 out of the remaining 26 papers to be included in this, second, volume of proceedings.

The conference featured two invited lecturers, plus several plenary and keynote talks. The invited lectures were as follows:

- Panos M. Pardalos, University of Florida, USA, “Computational Approaches for Solving Systems of Nonlinear Equations”
- Alexey Tret’yakov, Siedlce University of Natural Sciences and Humanities, Poland, “Degenerate Equality Constrained Optimization Problems and P-Regularity Theory”

We would like to thank all the authors for submitting their papers and the members of the PC for their efforts in providing exhaustive reviews. We would also like to express special gratitude to all the invited lecturers and plenary speakers.

October 2022

Nicholas Olenev
Yuri Evtushenko
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Invited Talks

Computational Approaches for Solving Systems of Nonlinear Equations

Panos M. Pardalos

University of Florida, USA

<http://www.ise.ufl.edu/pardalos/>, <https://nnov.hse.ru/en/latna/>

Abstract. Finding one or more solutions to a system of nonlinear equations (SNE) is a computationally hard problem with many applications in sciences and engineering. First, we will briefly discuss classical approaches for addressing (SNE). Then, we will discuss the various ways that a SNE can be transformed into an optimization problem, and we will introduce techniques that can be utilized to search for solutions to the global optimization problem that arises when the most common reformulation is performed. In addition, we will present computational results using different heuristics.

Degenerate Equality Constrained Optimization Problems and P-Regularity Theory

Alexey Tret'yakov

Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland
https://www.researchgate.net/profile/Alexey_Tretyakov

Abstract. We consider necessary optimality conditions for optimization problems with equality constraints given in the operator form as $F(x) = 0$, where F is an operator between Banach spaces. The paper addresses the case when the Lagrange multiplier λ_0 associated with the objective function might be equal to zero.

If the equality constraints are not regular at some point x^* in the sense that the Fréchet derivative of F at x^* is not onto, then the point $z^* = (x^*, \lambda_0^*, \lambda^*)$ is a degenerate solution of the classical Lagrange system of optimality conditions $\mathcal{L}(x, \lambda_0, \lambda) = 0$, where x^* is a solution of the optimization problem and (λ_0^*, λ^*) is a corresponding generalized Lagrange multiplier. We derive new conditions that guarantee that z^* is a locally unique solution of the Lagrange system. We also introduce a modified Lagrange system and prove that z^* is its regular locally unique solution.

The modified Lagrange system introduced in the paper can be used as a basis for constructing numerical methods for solving degenerate optimization problems. Our results are based on the construction of p -regularity and are illustrated by examples.

This is joint work with Yuri Evtushenko, Olga Brezhneva, and Vlasta Malkova

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