WISDOM presents YoungWomen4OR in:

"Latest Advances in Mathematical Optimization"

Join us for a coffee and a chat!

What: EURO WISDOM Forum YoungWomen4OR Talks[1]

Where: Zoom – Register here to receive the Zoom link - The webinar will be recorded and made available on the EURO WISDOM YouTube channel.

When: Thursday November 14, 2024, 15:30 – 16:30 (Central European Time)

Webinar Format

- Introductions/Webinar etiquette – Prof Dolores Romero Morales - 5 mins
- Latest Advances in Mathematical Optimization – YoungWomen4OR Talks - each 10 mins:
  - *Benders decomposition algorithms for minimizing the spread of harmful contagions in networks* - Dr Kübra Tanınmış, Koç University, İstanbul, Turkey;
  - *A Machine Learning Approach to deal with Ambiguity in the Humanitarian Decision Making* - Dr Emilia Grass, Germany;
  - *A framework for computational efficiency and user interaction in multi-objective optimization* - Ms Mariana Mesquita da Cunha, Portugal;
- Meeting the challenges - Overview/Current Challenges, synergies with existing work
  - Prof Andrea Lodi - 15 minutes
- Moderated open discussion with Coffee and Networking – 10 minutes

[1] WISDOM is a forum to support, empower, and encourage the participation of all genders in Operational Research and Management Science. It is an initiative supported by EURO, the Association of European Operational Research Societies. Please visit: https://www.euro-online.org/web/pages/1654/wisdom

YoungWomen4OR Speakers

Dr Kübra Tanınmış, Koç University, İstanbul, Turkey

Title: Benders decomposition algorithms for minimizing the spread of harmful contagions in networks

Abstract: In this talk, I will present our work on developing an exact method for minimizing the spread of harmful contagions on networks. The COVID-19 pandemic has been a recent example for the spread of a harmful contagion in large populations. A harmful contagion is not only restricted to an infectious disease, but is also relevant to computer viruses and malware in computer networks. Furthermore, the spread of fake news and propaganda in online social networks is also of major concern. In this study, we introduce the measure-based spread minimization problem (MBSMP), which can help policy makers in minimizing the spread of harmful contagions in large networks. We develop exact solution methods based on the application of Benders decomposition method to two different mixed-integer programming formulations of the MBSMP: an arc-based formulation and a path-based formulation. We show that the Benders optimality cuts can be generated using a combinatorial procedure rather than solving the dual subproblems using linear programming. Additional improvements such as using scenario-dependent extended seed sets, initial cuts, and a starting heuristic are also incorporated into our branch-and-Benders-cut algorithms. We investigate the contribution of various components of the solution algorithms to the performance on the basis of computational results obtained on a set of instances derived from existing ones in the literature.

Dr Emilia Grass, Karlsruhe Institute of Technology, Institute of Operations Research, Operations of Critical Infrastructures, Germany

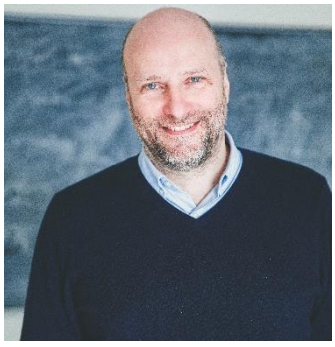
Title: A Machine Learning Approach to deal with Ambiguity in the Humanitarian Decision Making

Abstract: One of the major challenges for humanitarian organizations when planning relief efforts is dealing with the inherent ambiguity and uncertainty in disaster situations. The available information that comes from different sources in post-disaster settings may involve inconsistencies, which can severely hamper effective humanitarian decision making. In this talk, we present a new methodological framework based on graph clustering and stochastic optimization to support humanitarian decision makers in analyzing the implications of divergent estimates from multiple data sources on final decisions and efficiently integrating these estimates into decision making. We illustrate the proposed approach on a case study that focuses on locating shelters to serve internally displaced people in a conflict setting, specifically, the Syrian civil war. We use the needs assessment information published by different reliable sources to estimate the shelter needs in Idleb, Syria. The analysis of data has revealed a high degree of ambiguity due to inconsistent estimates. We apply the proposed methodology to integrate the ambiguous and divergent estimates into the decision making for determining shelter locations. The results highlight that our methodology leads to higher satisfaction of demand for shelters than other approaches. Moreover, we show that our solution integrates information coming from both sources more efficiently thereby hedging against the ambiguity more effectively.

Ms Mariana Mesquita da Cunha, Instituto Superior Técnico, Universidade de Lisboa, Portugal

Title: A framework for computational efficiency and user interaction in multi-objective optimization

Abstract: In real-world decision-making, many problems involve balancing multiple conflicting objectives. Multi-objective optimization provides a way to handle these challenges by identifying a set of optimal trade-off solutions known as the Pareto front (PF). However, two major challenges arise in practice: generating the full PF, especially for large-scale problems, is computationally expensive; and presenting too many solutions can make it difficult for decision-makers (DMs) to stay engaged. This work addresses these challenges by proposing a framework that combines three complementary strategies, each focused on improving the efficiency of generating solutions and the effectiveness of the process involving the DM. The first strategy tackles computational complexity by proposing methods to compute only a representative subset of the PF. This subset preserves key characteristics of the original front, is uniformly spaced, and has minimal cardinality. The second strategy includes the DM's preferences upfront, focusing the computational and analysis efforts on potentially more promising solutions. By ranking objectives in advance, we can reduce the feasible region to focus on solutions that align with the DM's priorities. The third strategy introduces an interactive approach where the DM's preferences are gradually incorporated during the optimization process using convex preference cones. This way, the solution space is iteratively refined. The proposed integrated framework offers an efficient and focused approach to solving multi-objective problems, balancing computational demands while simplifying decision-making for the DM.



Subject Matter Expert:

Andrea Lodi is an Andrew H. and Ann R. Tisch Professor at the Jacobs Technion-Cornell Institute at Cornell Tech and the Technion. He is a member of the Operations Research and Information Engineering field at Cornell University. Before joining Cornell, he was a Herman Goldstine Fellow at the IBM Mathematical Sciences Department, NY in 2005–2006, full professor of Operations Research at DEI, University of Bologna 2007-2015 and Canada Excellence Research Chair in "Data Science for Real-time Decision Making" at Polytechnique Montréal 2015-2022. His main research interests are in Mixed-Integer Linear and Nonlinear Programming and Data Science and his work has received several recognitions including the IBM and Google faculty awards. Andrea is the recipient of the INFORMS Optimization Society 2021 Farkas Prize and has been elected an INFORMS Fellow in 2023. Andrea has been the principal investigator of scientific projects (often involving industrial partners) for Italy, European Union, Canada and USA. In the period 2006-2021, he was a consultant of the IBM CPLEX research and development team, developing CPLEX, one of the leading software for Mixed-Integer Optimization.