

IFORS

International Federation of Operational Research Societies

NEWS

FROM THE PRESIDENT

Janny Leung < jannyleung@um.edu.mo >

I am honoured to have been elected the 23rd President of IFORS. Together with the other members of the Administrative Committee for this 2022-2024 term, I look forward to serving IFORS in support our member societies and the many initiatives to promote Operational Research around the world.

Like many of you, I discovered Operational Research in my undergraduate days. The models and methodologies of Operational Research include elegant mathematical theories, integrate knowledge from different disciplines, and are applied to decision-making in practice. Doing OR means working on problems that are intellectually stimulating and have practical impact – what's not to love about OR!



Operational Research was created out of necessity, where scientists of different disciplines – mathematics, physics, statistics, physiology --- were brought together to help develop solutions for the pressing problems arising in a war situation. Since then, the use of Operational Research have spread across almost all industries, in production, transportation, communications, services, finance, etc. Throughout OR's development, a firm theoretical underpinning for its methods and effective applicability in their implementation have always been intertwined.

In the past two years, Covid-19 has disrupted all our lives, causing havoc to our health care systems, supply chains and economies. As with the early days of OR, multi-disciplinary and multi-locational teams of OR scientists have responded to the challenge, developing models and methods for forecasting and tracing the spread of the epidemic, for vaccine allocation and distribution, etc. --- as part of the global effort to control the pandemic.

As Operational Researchers, I believe that we can play a critical role in developing solutions to the many complex global challenges that are facing the world today. As the global federation of OR societies, IFORS has the responsibility to promote the use of OR and the sharing of knowledge and best practices across the world. The Administrative Committee and I look forward to working with all of you in that effort.

May I wish you all the best for this the Year of the Tiger! 🌏



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FROM THE PAST PRESIDENT

Grazia Speranza <grazia.speranza@unibs.it>

When I started my adventure as IFORS President, I vaguely knew what IFORS is, which is what happens to most of us, I guess. To me IFORS essentially was an organization that gives the name to a series of triennial conferences that travel around the world more than any other series. After three years I can say that I now know what IFORS is. IFORS is the federation of all the national scientific societies of the world with a clear focus on operations research. IFORS is the organization that defines operations research as a discipline by rejecting or accepting national scientific societies as members. IFORS is the glue that keeps together all the communities that, spread over the planet, work in operations research, in theory and in practice. IFORS is operations research.

During these three years I had the honour and pleasure to share the experience with a group of amazing colleagues, the members of the IFORS Administrative Committee (AC): Mike Trick, the former President; David Chang Won Lee, the vice-President; Richard Hartl, the treasurer; Rosiane de Freitas, Sunity Shrestha Hada, Stefan Nickel and Karla Hoffman, representing the four regional groupings of IFORS member societies: ALIO, APORS, EURO, NORAM. I am proud to say that, together, we have achieved a number of results among which the most relevant are: the foundation of a new

IFORS journal on Sustainability Analytics and Modeling; the registration of IFORS as an international organization in Switzerland; the starting of a new award, the IFORS fellows; the series of the IFORS global webinars. I take this opportunity to express my deepest gratitude to the members of the AC, to the committee who nominated me as IFORS President, to Mary and Christy, to all the colleagues I worked with in these three years.



With the end of 2021 my term as IFORS President has expired. I will remain a member of the AC under the Presidency of Janny Leung. This is how IFORS guarantees continuity of action and transfer of experience. I wish to Janny and to the members of the new AC to enjoy the experience as much as I did. I am sure IFORS will grow stronger thanks to their passion and commitment and to the collaboration with our amazing international community. 🌐

EDITORIAL

Antonio Mauttone <mauttone@fing.edu.uy>

It is with great pleasure that I am beginning this new period as Editor-in-Chief of the IFORS Newsletter. First of all, I would like to thank Prof. Sunity Shrestha Hada, who as outgoing editor kindly provided to me guidance and knowledge transfer on the publication process of the newsletter. Also, I would like to thank the current IFORS Administrative Committee for its support, especially to the President, Prof. Janny Leung, and to the community of ALIO for giving me the opportunity of being part of this committee. Finally, I would like to thank the Section Editors of the newsletter for their warm welcome to the team.

Operations Research (OR) took my attention since my undergraduate studies in Computer Science, as an exciting combination of mathematical modeling, algorithmic development, and real applications. Even though OR is today a well-established discipline, there are still big challenges and opportunities for its application to a wide range of problems related to decision making. Each context (whereas organization, company, country, etc.) has its own specific problems, and therefore, poses the need for developing new methodologies or adapting new ones. In this regard, from IFORS and particularly from this newsletter, we hope to contribute to share the knowledge of OR across the world and to foster fruitful collaborations among communities.

In this issue we continue the well-established structure of the newsletter, which is composed by several stable sections. The *OR and Development* section presents an application developed by colleagues from Brazil to plan classrooms

considering social distancing, using mixed-integer and nonlinear techniques. This is an excellent example of contribution of OR to a relevant topic in the context of the current COVID-19 pandemic. In the *Tutorial* section, colleagues from the USA, present an open-source software package for infinite-dimensional optimization and its application to a stochastic optimal pandemic control problem aimed to minimize the economic impact of enforcing an isolation policy. This is another example of a relevant problem which currently affects our everyday life. The *OR Impact* section reports the work from colleagues from several European countries who developed a tool to support operational decisions at an Italian logistic company, showing the impact of the application of state-of-the-art OR methodologies over several dimensions of the company. In the *Conferences* sections, we report the activities carried out in 17 events covering several OR topics across different geographical locations. Moreover, this issue also includes a review of the book *Partitional Clustering via Nonsmooth Optimization* and a call for submissions of the new IFORS Journal *Sustainability Analytics and Modeling*.



We acknowledge the time and effort of all the authors who contributed to this issue. 🌐

A Web App Helping to Plan Classrooms Considering Social Distancing: Mixed-integer and Nonlinear Optimization Approaches



Luís Felipe Bueno¹ <lfelipebueno@gmail.com>

Antonio Augusto Chaves¹ <antonio.chaves@unifesp.br>

Luiz Leduino Salles-Neto¹ <luiz.leduino@unifesp.br>

Francisco Nogueira Calmon Sobral² <fncsobral@uem.br>

Horacio Hideki Yanasse¹ <horacio.yanasse@unifesp.br>

1. Universidade Federal de São Paulo

2. Universidade Estadual de Maringá

Since the beginning of the COVID-19 pandemic, researchers around the world, from the most diverse areas, have focused on the effort to understand the virus and the dynamics of the disease, as well as the development of measures to contain its advance. Vaccination is certainly the action with the greatest impact to control the pandemic, but personal and collective hygiene procedures as well as social distancing measures also play an important role. Even after collective immunization, they have been proved necessary, especially in the presence of variants.

In May 2020, several institutions and governments began debating and publishing protocols to resume face-to-face classes aiming to avoid or minimize the spread of SARS-CoV-2 in schools. One of the requirements in these protocols was the distancing of desks in classrooms. To help managers of schools and universities on this subject, we have coordinated the implementation of a free and user-friendly web application (<http://salaplanejada.unifesp.br>), whose associated scientific article can be seen at [4].

In general, the solution to the problem is obtained through an optimization problem: maximizing the number of students in a classroom subject to a minimum distance between occupied desks. On the other hand, a school may also want to maximize the distances between desks in a classroom subject to a fixed number of students.

Regardless of the objective, the app addresses two different cases: the case where the seats are fixed, therefore we must decide where each student should seat, and the case where we are free to move seats. In the first case, we have (mixed) integer mathematical programs (1) and (2), associated with p-dispersion (maximizing the number of students) or d-separation (maximizing the distance) problems as follows:

$$\begin{aligned} \max \quad & \sum_{i=1}^n x_i \\ \text{s. t.} \quad & x_i + x_j \leq 1, \forall i, j \in \{1, \dots, n\} : i < j, d_{ij} \leq d_{\min} \\ & x_i \in \{0, 1\}, \forall i \in \{1, \dots, n\}. \end{aligned} \quad (1)$$

and

$$\begin{aligned} \max \quad & d \\ \text{s. t.} \quad & d \leq M(2 - x_i - x_j) + d_{ij}, \forall i, j \in \{1, \dots, n\} : i < j \\ & \sum_{i=1}^n x_i = p, \\ & d \in \mathbb{R}, x_i \in \{0, 1\}, \forall i \in \{1, \dots, n\}, \end{aligned} \quad (2)$$

where n is the number of seats, d_{\min} is the required minimum distance, d_{ij} is the distance between seats i and j , M is any

number greater than all d_{ij} , p is the number of students to be seated, x_i is a binary variable that indicates if seat i is occupied or not and d is the minimum distance between two allocated seats.

In the case of seats that can be moved freely, we approach the problem as the nonlinear continuous problem related to packing circles into a rectangle such as:

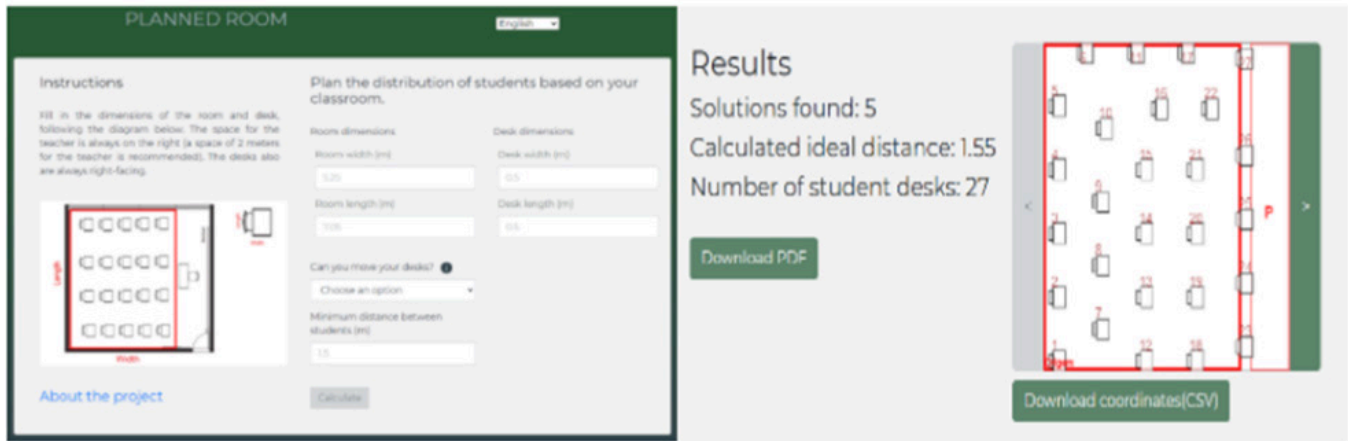
$$\begin{aligned} \min \quad & -d \\ \text{s. t.} \quad & (c_i^x - c_j^x)^2 + (c_i^y - c_j^y)^2 \geq d^2, \forall i, j \in \{1, \dots, N\} : j > i, \\ & 0 \leq c_i^x \leq b, 0 \leq c_i^y \leq h, \quad \forall i \in \{1, \dots, N\}, \\ & d_{\min} \leq d. \end{aligned} \quad (3)$$

where $b \times h$ is the dimension of the classroom, (c_i^x, c_i^y) is the position of seat i , d_{\min} is the required minimum distance and N is the given number of students or is gradually increased until we find the maximum number of students in the room.

During the development of the web application, some specificities of schools emerged, such as the need to keep the desks in a row. This requirement forced us to develop a specific heuristic for this situation. In fact, the solution given by the heuristic proved to be very efficient to be used as a starting point for the optimization process of solving (3). In addition, we proposed in [4] a penalty strategy that was also very successful for the resolution of (3).

In the app, the user can input the initial data according to Figure 1a. The solution is shown as in Figure 1b, along with a file with the seat coordinates, in the case of freely movable seats. A photo of a real room using the obtained configuration is presented in Figure 2.

It is worth mentioning that the web application has generated, until the beginning of January 2022, more than eight hundred thousand layouts of rooms with social distancing for 34 countries. The web app was used to plan the classrooms for the Brazilian National High School Exam, involving 6 million students interested in applying to universities, that were distributed over more than 100 thousand rooms. The web app was also used by companies, hospitals, among other institutions. In its current version, it is even possible to apply social distancing for airplane or movie theaters-like fixed seats, where rows have different distances. Behind the web application, there is a much powerful open-source tool, which can also consider obstacles and fixed places, being useful to plan restaurants and waiting rooms.



▲ Figure 1. a) Application interface for data entry.
 b) Application interface presenting the optimized configuration for the room.

Finally, we would like to highlight that, in Brazil, most initiatives for a better understanding of the disease and quantitative measures to support decisions came from public institutions, despite the policy of the federal government. Our work is just one among many others. For example, in the context of Operations Research, we cite works on effective data-driven responses to predict the Covid-19 in São Paulo and Brazil [1], optimal choices in pull testing systems [2] and [3], optimized planning of mobility restrictions [7] and of when to give the second dose of the vaccine [9], a molecular study of variants [8], stock control of supplies in hospitals [5], the use of logistic models presented in [10], physician rostering [11] and even about the impact of the pandemic on the world economy [6]. In difficult times like the ones we are facing, when many ask the people to Don't Look Up, we believe that trusting science is the best option. In particular, operational research contributions, made by each one of our community, can certainly positively impact the day-to-day around the world.



▲ Figure 2. Photo with a real room using the optimized configuration.

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InfiniteOpt.jl: A Julia Package for Infinite-Dimensional Optimization

Joshua L. Pulsipher <jpulsiph@andrew.cmu.edu>, **Victor M. Zavala** <victor.zavala@wisc.edu>

Department of Chemical Engineering

Carnegie Mellon University, Doherty Hall, 5000 Forbes Ave., Pittsburgh, PA 15213

Department of Chemical and Biological Engineering

University of Wisconsin-Madison, 1415 Engineering Dr, Madison, WI 53706, USA

1 Introduction

Infinite-dimensional optimization (InfiniteOpt) problems contain variables that live on infinite domains such as states over a space-time field or states under uncertainty [1]. This classification of problems commonly embed complex modeling elements that include: measures (e.g., multi-dimensional integrals), differential algebraic equations (DAEs), and partial differential equations (PDEs). InfiniteOpt problems encompass a wide breadth of optimization fields that include stochastic optimization [2], dynamic optimization [3], PDE-constrained optimization [4], and combinations (e.g., stochastic PDEs) [5].

In [6], we proposed a unifying modeling abstraction for InfiniteOpt problems and demonstrated how characterizing problems in this abstraction readily encourages new theoretical crossover and novel problem formulations, and even engenders new optimization fields (e.g., random field optimization). InfiniteOpt.jl is a Julia-based open-source software package that implements this abstraction to provide an intuitive symbolic interface to compactly model InfiniteOpt problems. Moreover, it is built modularly such that advanced users can quickly extend it to implement their cutting-edge modeling/solution techniques to make them accessible to a wide audience of individuals with a limited technical background. Furthermore, in comparison to other software tools such as Gekko, pyomo.dae, and ACADO, it is able to tackle a wider class of problems (e.g., stochastic PDEs) and it is fully decoupled from the transformation scheme (i.e., it can implement arbitrary solution techniques). All these aspects make InfiniteOpt.jl a powerful tool for both practitioners and advanced researchers alike in tackling advanced optimization problems.

In this tutorial, we highlight how to model/solve nonlinear, continuous-time optimal control problems via InfiniteOpt.jl. In particular, we consider a stochastic optimal pandemic control problem that seeks to minimize the economic impact of enforcing an isolation policy which is measured using general measure operators. Moreover, we demonstrate how this readily facilitates the transfer of risk measures from stochastic optimization to form new measures that shape time trajectories.

2 Optimal Pandemic Control

We adapt the pandemic control problem that seeks to choose an isolation policy to control the spread of a contagion, characterized via the susceptible-exposed-infectious-recovered (SEIR) model, that minimally impacts the economic impact (imposed by mandated isolation). Below we walk through the problem details and show how each portion of the formulation is implemented.

2.1 Preliminaries

First, we include necessary Julia packages for this tutorial which are InfiniteOpt.jl to model our problem, Distributions.jl to characterize random distributions, Ipopt.jl to solve the transcription model, and Plots.jl to plot the results. We define the SEIR model parameters which include the initial conditions $s_0, e_0, i_0, r_0 \in [0, 1]$, the infection rate $\beta \in \mathbb{R}$ and the recovery rate $\gamma \in \mathbb{R}$. Finally, we initialize the InfiniteModel object model that will contain our InfiniteOpt problem and will use Ipopt to solve the transformed finite problem (discussed more below).

Code Snippet 1: Preliminary setup.

```

1 using InfiniteOpt, Distributions, Ipopt, Plots
2
3 # Set the parameters
4  $\gamma, \beta = 0.303, 0.727$ 
5  $s_0, e_0, i_0, r_0 = 1 - 1e-5, 1e-5, 0, 0$ 
6
7 # Define the model
8 model = InfiniteModel(Ipopt.Optimizer)

```

2.2 Infinite Parameters

The infinite domain $\mathcal{D} := \mathcal{D}_t \times \mathcal{D}_\xi$ consists of the time horizon $\mathcal{D}_t = [0, 200]$ and the co-domain \mathcal{D}_ξ of the uncertain parameter ξ . Here $\xi \sim \mathcal{U}(0.1, 0.6)$ is a uniform random variable that denotes the uncertain incubation rate of the new contagion. We define the infinite parameters $t \in \mathcal{D}_t$ and $\xi \sim \mathcal{U}(0.1, 0.6) \in \mathcal{D}_\xi$ via the `@infinite_parameter` macro which adds t and ξ to model and specifies the number of support points that each should use when the model is transformed.

Code Snippet 2: Infinite parameter definition.

```

9 @infinite_parameter(model, t ∈ [0, 200], num_supports = 51)
10 add_supports(t, [0.001, 0.002, 0.004, 0.008, 0.02, 0.04, 0.08, 0.2, 0.4, 0.8])
11 @infinite_parameter(model,  $\xi \sim \text{Uniform}(0.1, 0.6)$ , num_supports = 5)

```

2.3 Decision Variables

The SEIR model defines state variables which are the populations of individuals susceptible to infection $y_s : \mathcal{D} \rightarrow [0, 1]$, exposed individuals $y_e : \mathcal{D} \rightarrow [0, 1]$, infectious individuals $y_i : \mathcal{D} \rightarrow [0, 1]$, and recovered individuals $y_r : \mathcal{D} \rightarrow [0, 1]$ (considered immune to future infection). Moreover, we exhibit control by imposing an isolation policy $y_u(t) \in [0, 0.8]$ that entails the separation of susceptible and exposed individuals ($y_u(t) = 0$ denotes no separation and $y_u(t) = 1$ denotes complete separation). These variables are infinite since they are functions of t and/or ξ (i.e., they are indexed by t and/or ξ which gives an infinite set of decision variables). Hence, we define these variables with their associated properties using the `@variable` macro with the *Infinite* designation.

Code Snippet 3: Infinite variable definition.

```

12 @variable(model, 0 ≤ ys ≤ 1, Infinite(t, ξ))
13 @variable(model, 0 ≤ ye ≤ 1, Infinite(t, ξ))
14 @variable(model, 0 ≤ yi ≤ 1, Infinite(t, ξ))
15 @variable(model, 0 ≤ yr ≤ 1, Infinite(t, ξ))
16 @variable(model, 0 ≤ yu ≤ 0.8, Infinite(t), start = 0.2)

```

2.4 Objective

The objective seeks to minimize the impact of the isolation policy enforced:

$$\min_{y_u(t)} M_t y_u(t) \quad (2.1)$$

where M_t is a time measure operator than scalarizes/summarizes the time trajectory $y_u(t)$. Conventional optimal control approaches use the integral measure $\int_{t \in \mathcal{D}_t} y_u(t) dt$ (Bolza-type objective), but we can also envision using nontraditional measures such as the conditional-value-at-risk (CVaR) used in stochastic optimization:

$$\min_{y_u(t)} \text{CVaR}_t(y_u(t); \alpha) \quad (2.2)$$

where $\alpha \in [0, 1]$ is a tuning parameter that uniformly summarizes $y_u(t)$ when $\alpha = 0$ in like manner to the classical integral measure and penalizes the $1 - \alpha$ fraction of high $y_u(t)$ values otherwise (penalizing the peak value when $\alpha \rightarrow 1$) [7]. We note that the CVaR measure is applied over the time domain (as opposed to the uncertain domain). With this, CVaR can be used on the dynamic trajectory $y_u(t)$. Objective (2.2) can be expressed:

$$\begin{aligned} \min_{y_u(t), z} \quad & z + \frac{1}{1 - \alpha} \mathbb{E}_t[y_m(t)] \\ \text{s.t.} \quad & y_m(t) \geq 0, \quad t \in \mathcal{D}_t \\ & y_m(t) \geq y_u(t) - z, \quad t \in \mathcal{D}_t \end{aligned} \quad (2.3)$$

where $z, y_m(t) \in \mathbb{R}$ are auxiliary variables and $\mathbb{E}_t[\cdot]$ is the time expectation. We can now define the objective following (2.3).

Code Snippet 4: Objective definition.

```

17 α = 0
18 @variable(model, z)
19 @variable(model, ym ≥ 0, Infinite(t))
20 @objective(model, Min, z + 1 / (1 - α) * E(ym, t))
21 @constraint(model, ym ≥ yu - z)

```

2.5 Constraints

The constraints are given by the SEIR equations:

$$\begin{aligned} \frac{\partial y_s(t, \xi)}{\partial t} &= (y_u(t, \xi) - 1) \beta y_s(t, \xi) y_i(t, \xi), & (t, \xi) \in \mathcal{D} \\ \frac{\partial y_e(t, \xi)}{\partial t} &= (1 - y_u(t, \xi)) \beta y_s(t, \xi) y_i(t, \xi) - \xi y_e(t, \xi), & (t, \xi) \in \mathcal{D} \\ \frac{\partial y_i(t, \xi)}{\partial t} &= \xi y_e(t, \xi) - \gamma y_i(t, \xi), & t \in \mathcal{D}_t \\ \frac{\partial y_r(t, \xi)}{\partial t} &= \gamma y_i(t, \xi), & (t, \xi) \in \mathcal{D} \\ y_s(0, \xi) &= s_0, y_e(0, \xi) = e_0, y_i(0, \xi) = i_0, y_r(0, \xi) = r_0, & \xi \in \mathcal{D}_\xi. \end{aligned} \quad (2.4)$$

Moreover, we exact that the fraction of infected individuals be kept below 0.02:

$$y_i(t, \xi) \leq 0.02, \quad (t, \xi) \in \mathcal{D}. \quad (2.5)$$

We add these constraints to the model using the `@constraint` macro. We note that `InfiniteOpt.jl` greatly simplifies the expression of derivatives.

Code Snippet 5: Constraint definition.

```
22 @constraint(model, ∂(ys, t) == -(1 - yu) * β * ys * yi)
23 @constraint(model, ∂(ye, t) == (1 - yu) * β * ys * yi - ξ * ye)
24 @constraint(model, ∂(yi, t) == ξ * ye - γ * yi)
25 @constraint(model, ∂(yr, t) == γ * yi)
26 @constraint(model, ys(0, ξ) == s0)
27 @constraint(model, ye(0, ξ) == e0)
28 @constraint(model, yi(0, ξ) == i0)
29 @constraint(model, yr(0, ξ) == r0)
30 @constraint(model, yi ≤ 0.02)
```

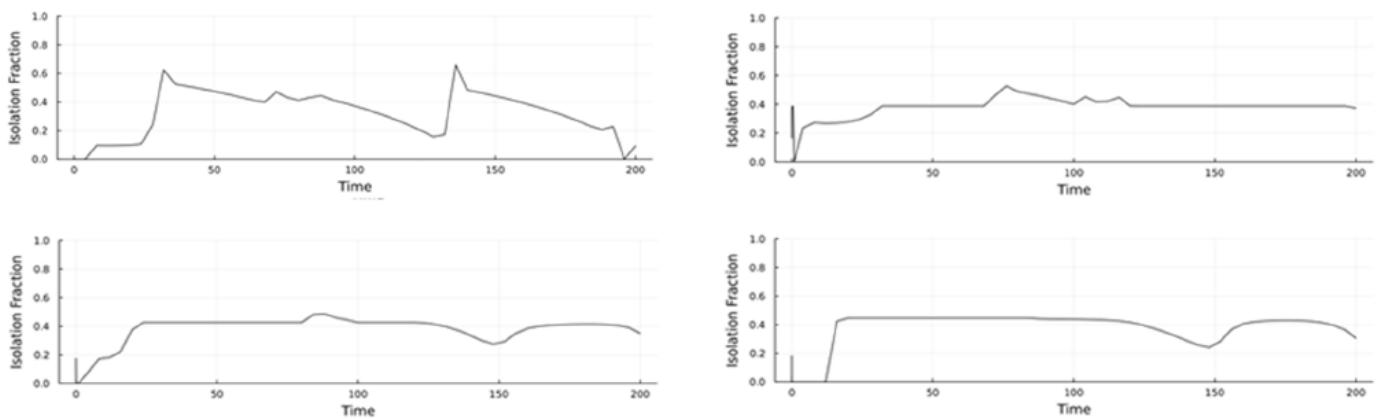
2.6 Solution

Now we solve our model by simply invoking `optimize!` which transforms the model into a finite JuMPjl model (using time discretization and Monte Carlo sampling by default) that is solved using Ipopt in this case. Note that a variety of other transformation methods (e.g., orthogonal collocation over finite elements) can be used to solve the model (and new ones can readily be implemented). We access the results using the value function and then plot them using Plots.jl.

Code Snippet 6: Model solution.

```
31 # Solve
32 optimize!(model)
33 yu_opt = value(yu)
34 ts = value(t)
35
36 # Plot the solution
37 plot(ts, yu_opt, xlabel = "Time", ylabel = "Isolation Fraction", ylims = (0, 1),
38      label = "", color = :black)
```

Figure 1 summarizes the results for $\alpha \in \{0, 0.5, 0.75, 0.99\}$. We observe how using CVaR enables us to change the shape of the optimal control policy. Increased values of α dampen the peak isolation policy instances and provide a smoother policy overall. This highlights how our unifying abstraction for InfiniteOpt problems allots us enhanced flexibility in shaping our optimal trajectories.



▲ Figure 1: The optimal policy trajectories $y_u(t)$. Top Left: $\alpha = 0$. Top Right: $\alpha = 0.5$. Bottom Left: $\alpha = 0.75$. Bottom Right: $\alpha = 0.99$.


3 Conclusion

InfiniteOpt.jl provides a compact syntax to symbolically model and solve InfiniteOpt problems. Moreover, the unifying abstraction behind it enables us to tackle a wide variety of problem classes and facilitates the use of new modeling elements (e.g., time-valued CVaR measures). Our implementation is also higher modular to facilitate user extensions. We invite the interested reader to learn more via the extensive documentation, examples, and tutorials available at <https://github.com/pulsipher/InfiniteOpt.jl>.

Acknowledgments

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Section Editors:

Sue Merchant

<suemerchant@hotmail.com>;

John Ranyard

<jranyard@cix.co.uk>

Sustainable and Efficient Logistics: How Optimization Transformed Italmondo's Cargo Loading Operations

Mikele Gajda¹ <mikele.gajda@unil.ch>, **Alessio Trivella**² <a.trivella@utwente.nl>,
Renata Mansini³ <renata.mansini@unibs.it>, **David Pisinger**⁴ <dapi@dtu.dk>

1. Mikele Gajda is PhD student in the Department of Operations at the University of Lausanne.
2. Alessio Trivella is Assistant Professor of Operations Research in the Department of Industrial Engineering and Business Information Systems at the University of Twente.
3. Renata Mansini is Full Professor of Operations Research in the Department of Information Engineering at the University of Brescia.
4. David Pisinger is Full Professor of Operations Research in the Department of DTU Management at the Technical University of Denmark.

Background

The logistics sector has undergone profound changes over the past decade, mainly due to growing demand and shipping time requirements. For example, the global volume of parcel shipment has doubled in the last five years and is expected to double again in the next five [1], even without considering the boost of e-commerce due to Covid-19. This pushes logistics companies to operate more efficiently in order to handle and ship large volumes of goods faster. Furthermore, growing environmental concerns put increasing pressure on logistics and freight operators to integrate sustainability goals into their strategy and reduce their typically high carbon footprint.

In this project, we have developed Operations Research (OR) methods at **Italmondo** (ITLM Group), an international transportation and logistics group with its headquarters in Italy, established in 1953 and employing at present over 1200 staff and collaborators [2]. Italmondo's operations integrate road, sea, and air transport. Truck transportation is a core activity as the company manages several large warehouses from which hundreds of trucks are loaded every day and shipped throughout Europe (Figure 1). Until 2018, most of the operational processes were carried out without the support of advanced analytical tools and OR. However, due to the aforementioned challenges and trends, Italmondo has decided to engage in a collaboration with academic institutions to make the key logistics process of truck loading more efficient and greener through the use of optimization models and algorithms

Problem and challenges

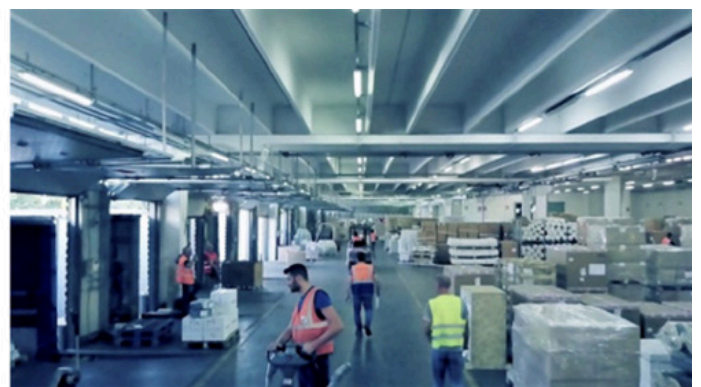
Despite its complexity, the packing and delivery chain in Italmondo can be simplified in the few steps illustrated in Figure 2. Items (typically boxes with a cuboid shape) are



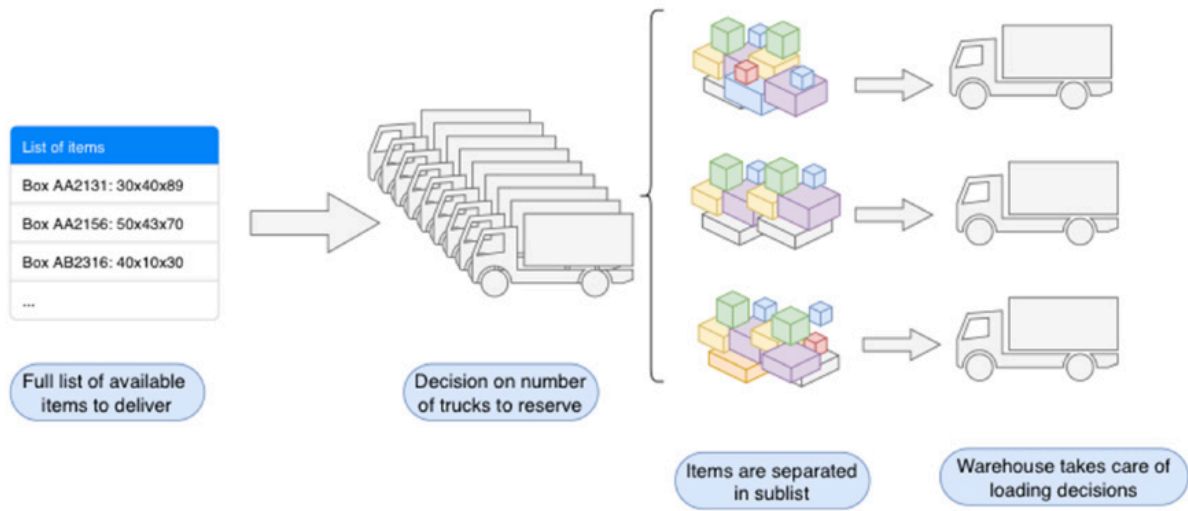
divided into lists based on destination and quantity, and trucks are reserved for each destination. Then the items from each list are loaded into the trucks. Our work focuses on the loading process, which is crucial since the number of trucks required is determined by how the space within each truck is utilized during loading.

The loading step involves selecting the cargo to load onto a truck from a group of heterogeneous boxes in order to maximize its value while complying with several constraints. Selection and positioning decisions are taken manually by the company staff based on experience and judgment. The value of the cargo is measured by its "chargeable" (or taxable) weight, which is a nonlinear function of volume and weight. This optimization problem belongs to the class of container loading problems (CLP), which is well known in the OR community. However, our specific formulation is particularly challenging (and interesting), since we face stringent computational requirements set by Italmondo as well as many practical constraints, some of which are new to the CLP literature.

More precisely, a packing solution must satisfy the following **practical constraints**: (1) the truck is subject to a weight limit; (2) the load must be distributed across longitudinal zones, (3) the centre of gravity of the goods must be balanced horizontally; (4) each item has a number of feasible orientations; >>



▲ Figure 1: Loading operations at one of Italmondo's warehouses: outside (left) and inside (right).

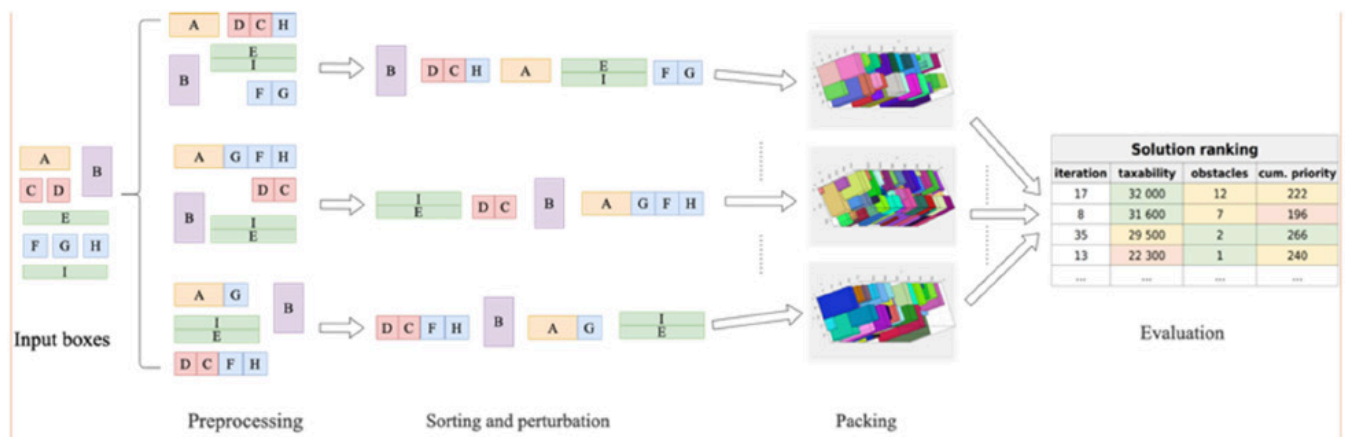


▲ Figure 2: The packing process.

>> (5) stacking constraints apply; (6) dangerous/flammable goods (known as “ADR”) are only allowed next to the unloading side; (7) the cargo has to be stable and each item sufficiently supported by the underlying items; (8) some items are mandatory while others are provided with a priority preference; (9) multi-drop shipments must minimize the number of “unloading obstacles”, i.e., we want to unload the boxes of a customer without moving others shipped to further destinations, since extra moves during unloading are time consuming and therefore expensive. Additionally, the algorithm must comply with the following **computational requirements**: (10) handle large-scale instances with up to 500 items; (11) handle strongly heterogeneous items in both size and weight; and (12) provide feasible and optimized solutions within 5-10 seconds. See [3] for more details on problem definition and constraints.

reducing the initial number of items. Then, the resulting items are **sorted** according to features that make the subsequent loading easier (e.g., place first larger items or items with high priority), and the sorted list is **randomized** to introduce diversification. Finally, we apply a **constructive packing** procedure that iteratively places items into the container by using promising candidate points inside the volume (Figure 5). For more details on the different algorithmic phases, we refer to [3].

These phases are repeated n times, and the algorithm provides the user with a small set of best loading solutions which are non-dominated in terms of cargo value and number of unloading obstacles. The user can then visualize and explore these solutions in 3D and choose the one considered the best. Trained personnel can indeed recognize which optimized



▲ Figure 3: Overview of the algorithm

Methodology

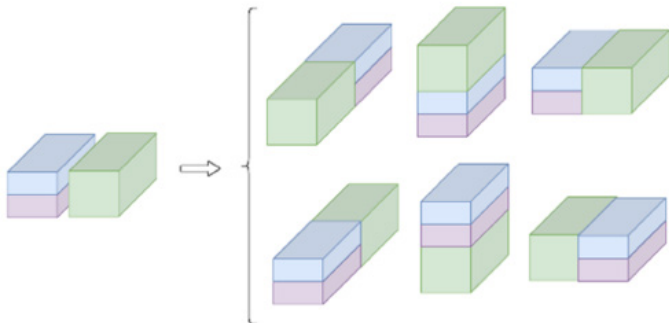
None of the existing approaches for the CLP (e.g., exact or meta-heuristic methods) can handle the variety of constraints we consider while solving large instances quickly. We have thus developed a novel randomized constructive heuristic able to deal with all the constraints while running in a few seconds. Our approach is outlined in Figure 3. At a high level, we combine newly designed preprocessing, sorting, and randomization rules with state-of-the-art construction methods in a multi-run fashion.

The algorithm starts by **building blocks** of multiple items of similar size (Figure 4); this procedure is useful to better fill the truck volume and to handle large-scale instances efficiently by

solutions may be harder to implement in practice, meaning that the human experience remains useful to complement the decision tool.

Results and impact

The new optimization algorithm could satisfactorily solve all test instances provided by Italmundo. In particular, it outperforms the company’s internal results by 10-20% in terms of average cargo value while at the same time complying better with all the constraints, which is a remarkable improvement. The solutions obtained by our heuristic also outperform commercial software [4] and have been benchmarked against dual bounds showing that many solutions are optimal or nearly optimal.

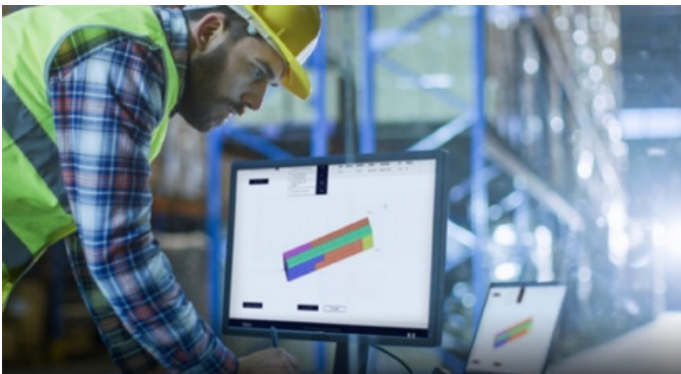


▲ Figure 4: Example of block construction using three items

For these reasons, the algorithm has been implemented in Italmundo's systems. Initially, we as the authors provided research support to the company's internal development team to create a commercial application embedding the algorithm as well as graphics and other functionalities, especially making sure that key knowledge about the logics of the algorithm was transferred. After testing and tuning phases lasting several months, the final version of the software, fully managed internally at the company and integrated in its workflow, was released in June 2021 and is currently in use. The software comes with an intuitive graphical interface allowing the user, e.g., to easily open instances and visualize packing solutions. This enables new loading staff to use the tool independently after only a short training either by colleagues from the development team or by other warehouse staff that already have experience with it.

The tool has been shown to have a significant impact on loading operations along four dimensions:

- **Revenue.** The optimization approach has significantly improved the average value of shipments compared to manual loading decisions made by the staff, which was the status in Italmundo (as well as in the vast majority of logistics and transport companies of similar or smaller size). In addition, fewer vehicles are needed to carry the same amount of cargo. Italmundo estimates that these improvements correspond to an annual cost reduction of approximately one million Euros.



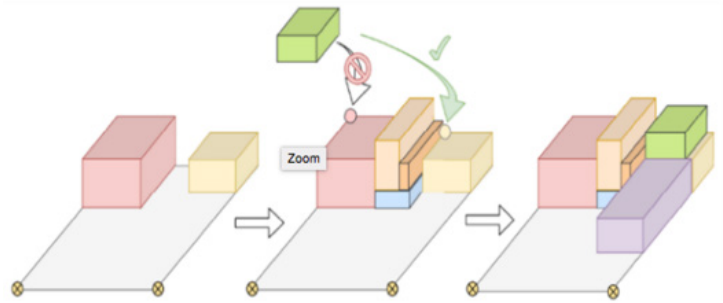
▲ Figure 6: Warehouse operator using the tool.

- **Safety.** By respecting all constraints, the packing patterns generated by the algorithm are distributed more evenly on the axles of the truck and are more stable while driving, which increases transport safety and reduces the movement of items and damages during the journey. This also helps preventing fines due to improper loading and reduces fuel consumption.

- **Efficiency.** Manual loading decisions made by the warehouse staff can lead to errors, e.g., the packing solution results in a wrong cargo balance. On the contrary, the new algorithm produces feasible packing patterns in a few seconds, as well as the correct order in which items must be loaded. This

significantly reduces the average time it takes for staff to load a unit volume of cargo into a truck, thereby increasing operational efficiency (Figure 7).

- **Environment.** By optimizing loading decisions and reducing the number of vehicles used, the developed tool represents a win-win situation for Italmundo to simultaneously increase profits and reduce emissions. According to the company, the reduction in CO2 emissions resulting from the systematic use of ten fewer trucks is estimated at around one thousand tons per year.



▲ Figure 5: Example of item loading in candidate point.


The project also received great appreciation by the company's management. Federico Pozzi Chiesa, the CEO of Italmundo, says that "the creation and release of a smart algorithm that could optimize and improve the way all our fleet is loaded has a major impact on our operations, remarkable cost saving compared to our previous status, and decreases carbon emissions and traffic congestion, which is part of a broader zero carbon emission program". Maria Antonietta Spera, the Head of IT & Digital, adds that "this project proved to be highly valuable for our Company and is helping us in our attempt of making logistics processes increasingly automated and more efficient. We look forward to use Operations Research to further strengthen the competitiveness of Italmundo."

Italmundo indeed intends to apply OR methods to other logistics processes. Some ideas under discussion are relevant to both business and research, such as combining the revenue management platform with loading optimization or integrating packing and routing decisions in case of multi-drop shipments.

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2. Some of the illustrations appeared in the paper published in *Omega* (Ref. [3]). They are reproduced here by kind permission of Omega under the Elsevier license number 5203791399328. 

Promoting Operational Research Activities in Africa - ORTASA 2021 in Benin, On-site and Online

Jules Degila <jules.degila@imsp.uac.org>, **Olabode Adewoye** <adewoye2012@gmail.com>

Jean Koudi <jean.koudi@imsp-uac.org>



▲ ORTASA 2021: Cross session of participants

After the 1st edition of ORTASA (<https://sites.google.com/imsp-uac.org/ortasa-2018>) in November 2018, the 2nd edition of the *Operations Research Techniques and Applications School for Africa (ORTASA)* (<https://sites.google.com/imsp-uac.org/ortasa-2021/intervenants?authuser=0>) took place in the same venue at Dangbo, Republic of Benin, from October 21-28, 2021.

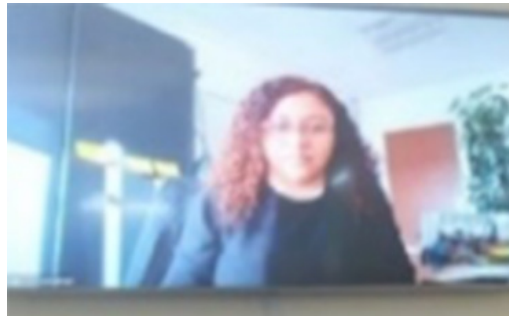
ORTASA 2021 brought together participants, scholars and practitioners from several sectors such as finance, business management, physics, mathematics, statistics and *operational research (OR)* to exchange on the applications of OR in addressing development challenges. The 2nd edition was organized by the *African Center of Excellence in Mathematics and Computer Sciences (ACE-SMIA)* hosted by the *Institute of Mathematics and Physical Sciences (IMSP)*, with the supports of the *Ministry of Higher education of the Republic of Benin* and the *International Federation of Operational Research Societies (IFORS)*. The selected 50 participants, out of the 300 applications, came from different African countries: Nigeria, Burkina-Faso, Togo, Benin, and Ghana. In addition, there were invited speakers from Nigeria, the USA, Canada, France and Benin. Unfortunately, due to the COVID-19 pandemic, the other speakers gave their lectures by video conference. The school's topics included financial engineering and risk management, microfinance, and nano-stores' management in emerging markets. In addition, logistics management in crisis, advanced statistical modelling, optimization and OR problem formulation were also part of the one-week rich programs to give more exposure to students and practitioners.

The first lecture entitled "*OR Problems Formulation with Applications*" was delivered by *Prof. Jules Degila*, the chairman of the organizing committee, to set the stage with OR definitions and applications. Furthermore, *Prof. Degila*

elaborated on the gray areas between OR and Artificial Intelligence (AI). The discussions were fostered among participants on understanding OR within the growing interest in AI. A takeaway from the first lecture is that: An AI software quick answer is more compelling than a perfect answer that takes hours longer. Nonetheless, one gets better decisions by combining AI and OR techniques. Many applications in telecommunications offer opportunities to the participants to gauge the complementarity of both AI and OR. In the third lecture, the second speaker, *Dr. Emile Comlan*, presented the "*Learning 6.5 system*". He demonstrated a novel and powerful software aiming at easing distance education, assessment and processing of any scientific document.

Dr. Olabode Adewoye from *Yaba College of Technology* who is the current Secretary General of the *Institute of Operations Research and Management Science of Nigeria (IORMS)* followed with financial engineering: requirements, opportunities and challenges. After a short break, he delivered his 2nd paper titled: "*Financial engineering and operations research, the relationship and implication for developing countries*". The fifth talk was given in three stages by *Christopher Mejia* from MIT on "*Applications of OR in Emerging Markets*." The headlines are the logistic distribution and commercial route-to-market conception on 50 million nano stores, a cost-efficient method to optimize package size in emerging markets and the incorporating compatibility constraints in the vehicle routing problem for urban freight operations. *Dr. Tekogan Hermazro*, in the sixth topic, talked about "*Market and Credit risks management*". *Dr. Ratheil Houndji* explained the basics of *Constraint Programming (CP)* in the seventh topic, which was derived from artificial intelligence, OR and algorithms, and can be used to solve combinatorial optimization problems. Next, *Prof. Guy Degla* talked about vector optimization and applications.

In a two-hour presentation, *Prof. Luciana Buriol*, former Vice President of IFORS and former IFORS Developing Countries Committee member, described three real-world problems solved with graduate students and institutions in Porto Alegre, Brazil. One issue concerned the pickup-delivery vehicle routing problem operated by a local company. Another was the allocation of doctors on time-slots at the Hospital de Clínicas de Porto Alegre. The third problem dealt with the logistics of home health care, including allocation and routing, combining knowledge of the previous two problems. Besides, she detailed the applied applications and techniques used to solve them, along with the path followed for scientific and technological production.



▲ Prof. Andrea Duhamel



▲ Prof. Christopher Mejia



▲ Dr. Tekogan Hermazro



▲ Prof. Luciana Buriol

Dr. François Guerin presented "Collective mobile robotics at the service of the environment, industry and safety" and *Prof. Andréa Cynthia Duhamel* closed the lectures with her presentation on "OR applications in crises logistics". Many references were given to the audience in each course.



▲ Prof. Jules Degila and participants



▲ Dr. Francois Guerin

During this school, the participants reflected on the OR society in Africa. This reflection assessed the evolution of OR in the sub-region and exposed the various obstacles to its emergence, which are academic and political. To encourage upcoming researchers, 6 PhD students showcased their ongoing research work.

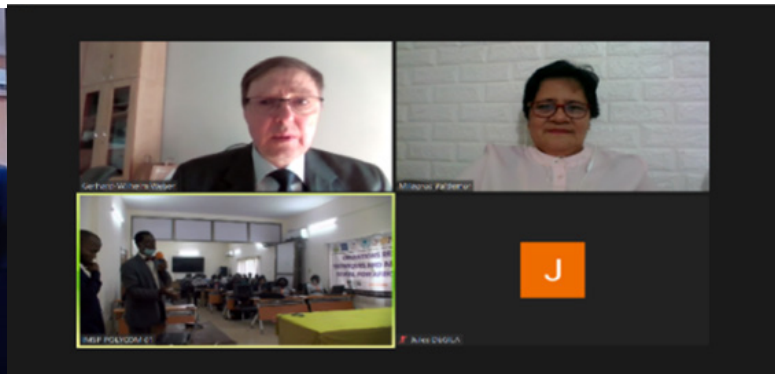
Prof. Milagros Baldemor, former Dean of Postgraduate School, DMMMSU Philippines, who was the co-chair of *EWGORD 2019* in Ireland, and *Prof. Solomon Adebola*, Vice Chancellor of Adeleke University, Nigeria.

ORTASA 2nd edition was graced by other OR giants and practitioners, who gave goodwill messages: Sue Merchant, former Vice President of IFORS, a member of IFORS Developing Countries Committee and AFROS Executive Committee; *Prof. Gerhard-Wilhelm Weber* from Poznan University of Technology, Poland, Advisor to EURO Conferences, member of IFORS DC Committee and many OR working groups including *EWG ORD*,

Despite the difficulties in organizing the second edition of *ORTASA* due to the COVID-19 pandemic, the participants were delighted with the different themes addressed. Their multiple questions were answered in this school. They strongly expressed their wish that this type of school, which brought together academics and professionals around OR applications, be renewed each year. The IMSP is ready to organize it again. For more on *ORTASA 2021* opening ceremony see <https://youtu.be/9GIFOGwwYIY> and <https://fb.watch/8PH2fopWXN/>. 🌐



▲ Sue Merchant and Prof. Adebola



▲ Prof. G.-W. Weber and Prof. Milagros Baldemor

Workshop on Agents Behaviour in Combinatorial Game Theory CRM Thematic Semester: The Mathematics of Decision Making, Montreal, Quebec, Canada, Online

Margarida Carvalho <carvalho@iro.umontreal.ca>

Patrice Marcotte <marcotte@iro.umontreal.ca>

Szilvia Pápai <szilvia.papai@concordia.ca>



▲ Organizers of Workshop 2021 in Montreal: Margarida Carvalho, Patrice Marcotte and Szilvia Pápai.

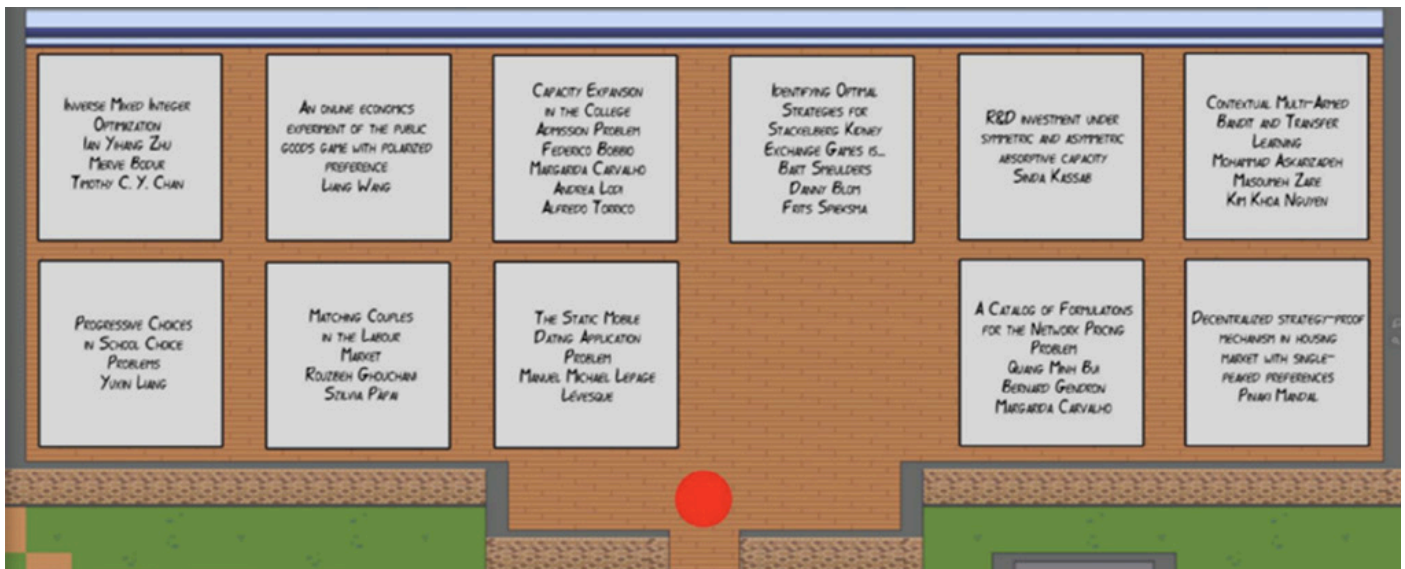
The Centre de Recherches Mathématiques (CRM) thematic program on “*The Mathematics of Decision Making*” consisted of a 6-month activity planned for the first half of 2020. The aim of this thematic program was to tackle mathematical issues and challenges pertaining to decision making that go beyond designing efficient algorithms for classical mathematical programs and involve up-to-date tools of artificial intelligence. One of the planned activities within the thematic program was the workshop titled “*Agents Behavior in Combinatorial Game Theory*”, scheduled for April 2020 at the Université de Montréal. Due to COVID-19, it was postponed to 16-18 November 2021 and the in-person format was changed to an *online* format. The workshop was organized by *Margarida Carvalho* (Department of Computer Science and Operations Research, Université de Montréal, specializing in integer programming games and optimization for matching markets), *Patrice Marcotte* (Department of Computer Science and Operations Research, Université de Montréal, specializing in bilevel programming and equilibrium models) and *Szilvia Pápai* (Department of Economics, Concordia University, specializing in matching theory and social choice theory). It was designed with the objective of bringing together and blending different perspectives on games, namely optimization, machine learning and economics. This was a three-day workshop starting with introductory tutorials on the first day, followed by two days of invited talks on recent game theoretical topics. There were 12 invited speakers (7 from North-America, 5 from Europe). A poster session was also organized in conjunction with the workshop, where posters were presented by young researchers. Many other junior researchers have also participated in the workshop.

Two tutorials were offered on the first day of the workshop which surveyed the areas of algorithmic game theory and bilevel programming optimization. *Bernhard von Stengel*, professor at the London School of Economics and Political Science, presented algorithmic approaches for the computation of Nash equilibria for bimatrix games and

extensive form games. The second tutorial, on the topic of bilevel programming, was delivered by *Patrice Marcotte* from Université de Montréal. The first part was devoted to formulations and properties of the subject, while the second part focused on three applications.

On the second day six 30-minute invited talks were delivered, followed by the poster session. The first talk of the day was given by *Péter Biró*, a senior research fellow at the Institute of Economics, Hungarian Academy of Sciences. His talk focused on recent developments on the stability and on the individual and collective fairness of European kidney exchange programs, which aim to maximize the number of kidney transplants. *Martin Bichler*, professor at the Technical University of Munich, talked about auctions and described a novel learning algorithm for the computation of Bayesian Nash equilibria in auction games. *Vincent Conitzer*, professor at Duke University, presented his work on automated mechanism design and the challenge associated with participants that have an incentive to misreport information. *Lars Ehlers*, professor at the Université de Montréal, introduced a unifying approach to stability comparisons for priority-based object allocation, establishing the robustness of a recent result on the top trading cycles mechanism. *Aditya Mahajan*, professor at McGill University, described multi-agent reinforcement learning and its modeling as Markov games. In particular, he showed some new results on the sample complexity of these games. *Nicolás Stier Moses*, director of Core Data Science at Meta Platforms (formerly Facebook), presented results pertaining to the worst-case inefficiency of congestion games where the probability of a player entering the game is fixed.

The poster session was held in *GatherTown*, where eleven exciting posters were presented by junior researchers. It was planned and prepared with the collaboration of *Justine Pepin* and *Federico Bobbio*, graduate students at the Université de Montréal.



▲ Workshop 2021 in Montreal: GatherTown map with the titles and authors of the posters.

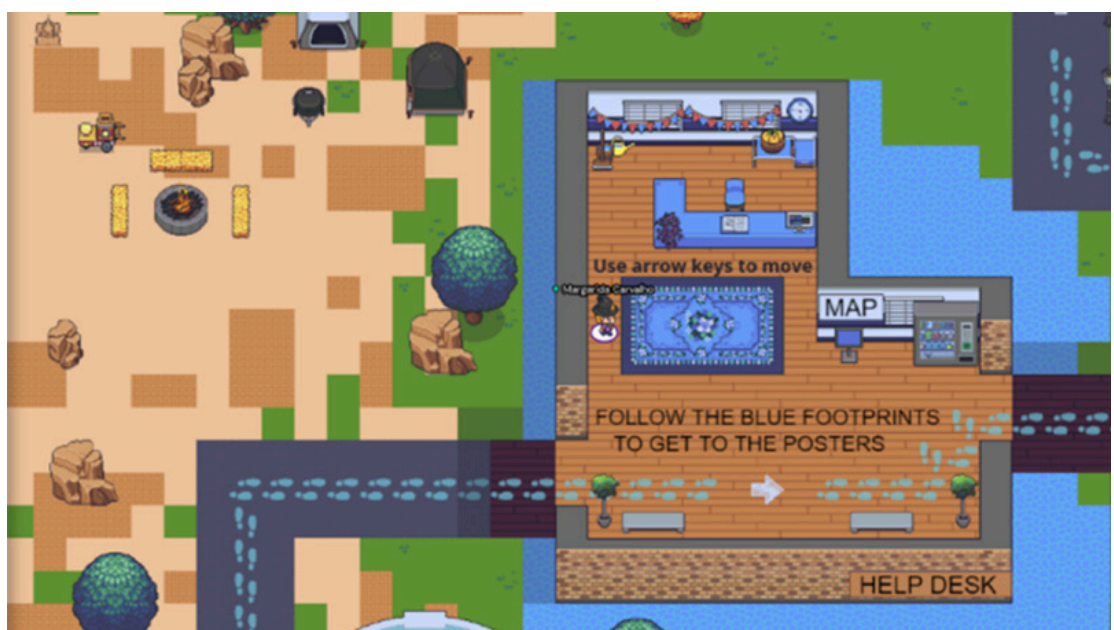
List of the posters is available here: http://www.crm.umontreal.ca/2021/Game21/pdf/Affiches_e.pdf.

This session reflected the different game theoretical communities that the workshop aimed to gather. Indeed, the presented posters spanned a wide variety of topics, from classical economic problems to combinatorial optimization and machine learning. Moreover, the poster session allowed participants to mingle and socialize.

The workshop concluded on the third day with six more 30-minute talks by invited speakers. *Milind Tambe*, professor at Harvard University and Director of AI for Social Good at Google Research India, discussed results on restless bandits and influence maximization which were used for the design of public health interventions, namely, in the context of HIV prevention and maternal and childcare initiatives. In her talk, *Martine Labbé*, professor at Université Libre de Bruxelles, addressed the theoretical complexity of Stackelberg games involving one or many followers, as well as the quality of various linear programming relaxations. *Tobias Harks*, professor at Augsburg University, provided a characterization of equilibria in generalized Nash games via a convexification technique involving the Nikaido-Isoda function. *Bernhard von Stengel* concentrated his talk on 2-player normal-form-games and described a polynomial time algorithm to compute Nash equilibria for those games which are rank-1. *Jakob Foerster*, professor at University of Oxford, using the explanation of the famous Hanabi game discussed new methodologies for multi-agent learning. The last talk was given by *Tuomas Sandholm*, professor at Carnegie Mellon University, about the computation of near-equilibrium

strategies for extensive-form imperfect information games.

This interdisciplinary workshop was planned with the vision of promoting the interaction and synergies of researchers from different game theoretical domains. In addition, it provided a broad landscape of decision support tools that take into account the preferences and behavior of multiple agents, thus underlining the important role of game theory in *Operational Research*. Although the workshop was held virtually due to the pandemic, we believe that it has contributed to the expansion of the horizons of the participants. Workshop details and presentation slides can be found on the workshop webpage: http://www.crm.umontreal.ca/2021/Game21/index_e.php (the workshop program and the slides can be found under "Schedule").



▲ Workshop 2021 in Montreal: Screenshot of part of the designed GatherTown space.

We take this opportunity to express our gratitude to all the invited speakers, who were also active participants in the workshop, as well as to the poster presenters and to the attendees. 🌐

IX Congress of the Mexican Society of Operations Research Successfully Celebrated, Virtually

Yasmín A. Ríos-Solís <yasmin.riossolis@tec.mx>
Raúl Pérez Gallardo <raul.perez@cimat.mx>

The *Aguascalientes Unit of the Center for Research in Mathematics, A.C. (CIMAT)*, Mexico, within the framework of the 25th anniversary of its foundation and, with the support of the *Mexican Society for Operations Research (SMIO)*, held the *IX Congress of the Society Mexican Operations Research* in virtual mode during October 13-15, 2021. The congress managed to bring together researchers, students and practitioners, both national and foreign, around the different areas of *Operational Research*.

As usual since its first editions, the congress maintained the purpose - typical of its nature as a meeting and debate forum - of contributing to the exchange of ideas and experiences related to the development and application of the tools of *OR*. Likewise, it gave the opportunity to strengthen ties with experts from different latitudes, national and foreign ones.

This ninth edition was inaugurated remotely by *Dr. Víctor Manuel Rivero Mercado*, General Director of CIMAT. It was attended by *M.C. Ángel de Jesús Jiménez Ochoa*, the Director of the Institute for the Development of the Knowledge Society of the State of Aguascalientes (IDSCEA) who gave a few words of welcome to the attendees. The local *organizing committee* led by *Dr. Jorge Raúl Pérez Gallardo* (CIMAT) and the president of the *scientific committee*, *Dr. Yasmín Ríos Solís* (Tecnológico de Monterrey), put together an interesting program, which included:

- o 4 plenary sessions by internationally renowned speakers: *Laura Albert* (University of Wisconsin-Madison, USA), *Roger Z. Ríos Mercado* (Autonomous University of Nuevo León, Mexico), *Safia Kedad-Sidhoum* (National Conservatory of Arts and Professions, France) and *Mauricio Santillana* (Harvard Institute



▲ The organizers of CSMIO IX in downtown Aguascalientes (from left to right): *Raúl Pérez*, *Yasmín Ríos-Solís*, *Roger Ríos*, *Iris Martínez* and *Fernando Camacho*.

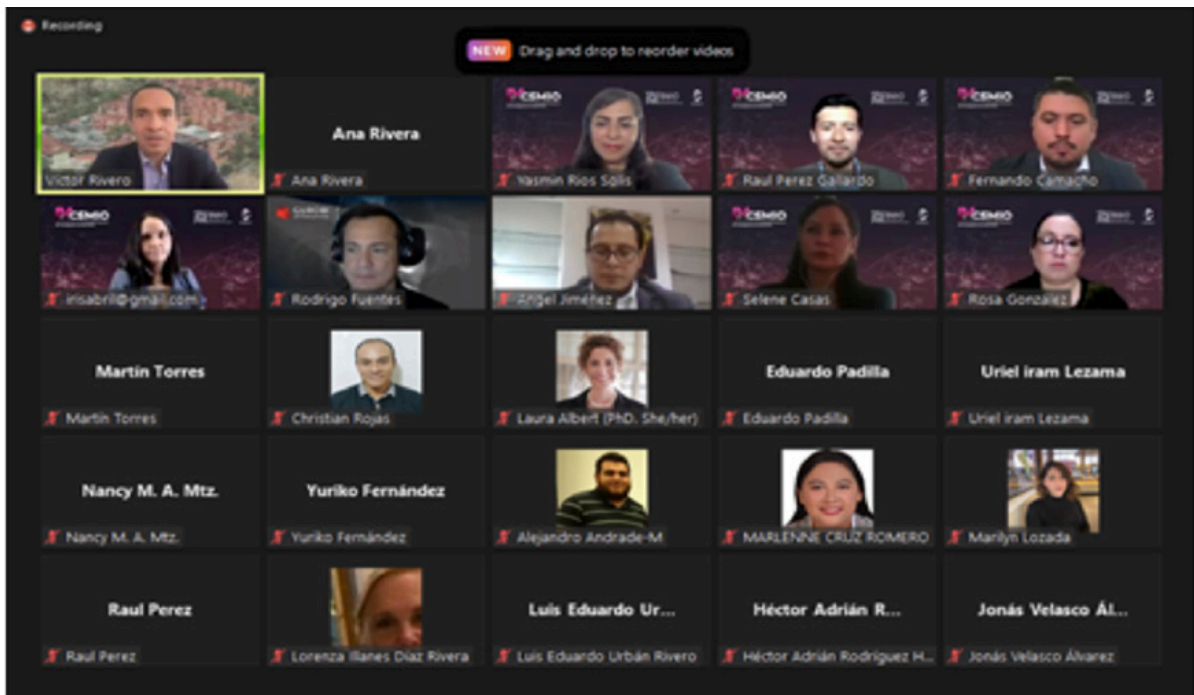
▲ Laureates of the SMIO 2021 Best Doctoral Thesis Awards.

for Applied Computational Science, USA). The exhibitors highlighted the role played by the different techniques that make up *OR*, whether it be addressing complex problems such as managing a pandemic, working with public institutions for better decision-making, and the importance of sustainability in the design of processes and products.

- o 1 workshop by the company Gurobi Optimization, sponsor of the event, which was given by *Rodrigo Fuentes*. The purpose of the workshop was to provide the participants with examples of the range of products that Gurobi offers in the field of mathematical optimization.

- o 18 contributed work sessions were scheduled where 74 investigations were presented in parallel, under the themes of *OR* for Society, Location, Transportation, Routing, Inventories and warehouses, Scheduling, Portfolios and Investments, *OR* and Resources Natural, as well as Theory and Graphs.

During the different sessions, it was possible to verify the diversity of applications of the *Operational Research* tools to solve current problems, as well as to favor better decision-making. It is noteworthy that some of the papers presented were authored not only nationally but also by researchers affiliated with foreign institutions. As an example of interest in working with their members, we highlight: Cornell University (USA), Technological University of Havana "José Antonio Echeverría" (Cuba), University of Brescia (Italy), Universidad de los Andes (Chile), Arizona State University (USA), University of Granada (Spain), among others.



▲ Inauguration of IX CSMIO: we highlight Víctor Rivero (CIMAT Director), Yasmín Ríos Solís (CSMIO IX Scientific Committee President), Raúl Pérez Gallardo (CSMIO IX President), Fernando Camacho (SMIO President), Iris Martínez (SMIO Treasurer), Rodrigo Fuentes (Gurobi), Rosa González (SMIO secretary) and Laura Albert (plenary speaker at IX CSMIO).

The first edition of the SMIO Award for the best thesis was also held. Title papers were received in the areas of OR distributed in the categories of Bachelor's, Master's and Doctorate. On behalf of CIMAT, works carried out by students of the postgraduate programs of Aguascalientes and Guanajuato were registered. Remarkable is the first place of the graduate of the Master's program on Process Modeling and Optimization, *Salvador de Jesús Vicencio-Medina*, in the Master Thesis category.



▲ Laureate of SMIO 2021 award: *Salvador J. Vicencio-Medina* (best Major Master Thesis).

The congress was attended by more than 120 participants from 36 institutions, not only educational but also governmental ones as well as from the private sector, both national and international, mainly residents of Colombia, Chile, the United States and Peru. Researchers and students from the campuses of Aguascalientes, Guanajuato and Monterrey were present. There was a high level of participation in both the plenary sessions and the presentation blocks by thematic areas.

It is important to highlight that about 60% of the attendees

to the congress indicated that they were between the ages of 20 and 34, mostly undergraduate and masters students. This figure demonstrates the interest of young people in sharing and learning about the work carried out in the fields of OR. In addition, the participation of women in the event is remarkable, exceeding 40% of the participants.

Throughout the more than ten years of SMIO's existence, it has been possible to appreciate the relevance of the discipline to contribute elements in the solution of problems thanks to the academic achievements promoted by its members. Thanks to them once again, this congress was a success from the academic point of view, without forgetting the social part.

Finally, *Dr. José Fernando Camacho Vallejo*, President of SMIO, closed the event with a cordial invitation to participate not only in the X National Congress in 2022, but also in the different activities that SMIO has scheduled for the next time. An invitation is made to consult both the society's website (<http://www.smio.org/>) as well as the Facebook page (@SMIOMexico) for more information on the activities to be carried out.

In 2022, SMIO will also host the "Escuela Latinoamericana de Verano en Investigación Operativa XXIV" (ELAVIO; <https://sites.google.com/view/elavio2022/home>), which is a summer school promoted by the Asociación Latino-Ibero-Americana de Investigación Operativa (ALIO) and supported by IFORS. It is mainly aimed at young researchers and graduate students (doctorate and master) from Latin-Ibero-American countries, with exceptional performance and interested in the areas of OR, Systems Engineering and Applied Mathematics. ELAVIO purposes to promote new collaborations and motivate the new generation in OR through mini-courses and plenary sessions which address emerging issues and current research areas. ELAVIO XXIV will be celebrated in Nuevo León, Mexico, during June 13-17, 2022, at the facilities of the Tecnológico de Monterrey Campus Monterrey. 🌐

DAMSS 2021 in Lithuania: 12th edition in a new Conference format - Data Analysis Methods for Software Systems

Tatiana Tchemisova <tatiana@ua.pt>

Jolita Bernatavičienė <jolita.bernataviciene@mif.vu.lt>



▲ Participants of DAMSS 2021.



▲ Venue of DAMSS 2021: Europa Royale Hotel, Druskininkai.

DAMSS-2021 was the 12th international conference on Data Analysis Methods for Software Systems, organized by the Institute of Data Science and Digital Technologies of the Vilnius University, the Lithuanian Academy of Sciences and the Lithuanian Computer Society (<http://www.mii.vu.lt/DAMSS>).

The tradition began in 2009 with a relatively small group of researchers working in the fields of data science, artificial intelligence and software systems, and *Operational Research* organized and participated in the 1st Workshop DAMSS. The main objective of DAMSS workshops was to provide an opportunity for researchers to meet, present their research results, and discuss perspectives for collaboration and new research directions. Since then, the number of participants in the DAMSS series of workshops has steadily grown and attracted new national and international participants. A peculiarity of this workshop series is that it always involved a large number of young researchers and provide them with an excellent opportunity to get acquainted with the most promising directions of research in the fields of data science, computer science, and OR. Since 2014, more than 100 participants have taken part in each of the DAMSS editions, so starting from the 12th edition, it was decided to rename the workshop into a conference.

DAMSS Workshops (and now conferences) are held annually in early December, in the same place: in the beautiful resort town of Druskininkai in the eastern part of Lithuania. The exception

was 2020, when the world was gripped by the COVID-19 pandemic, and the movement of people was severely restricted. The traditional venue for DAMSS is the *Europa Royale Hotel*, located in the center of Druskininkai, offering its guests the best conditions for work, leisure and activities such as bowling, swimming, spa, and thermal treatments.

DAMSS 2021 took place on December 2-4, 2021. The Chairs of the Organizing Committee were Prof. Habil Dr. Gintautas Dzemyda and Prof. Dr. Jolita Bernatavičienė from the Institute of Data Science and Digital Technologies of Vilnius University.

Despite the pandemic, the conference had a great success: it had brought together researchers from six Lithuanian universities and seven universities abroad, making it the main annual meeting place for computer scientists and OR researchers in Lithuania. Six plenary talks were presented at DAMSS 2021: Prof. Dr. Rytis Maskeliunas from Kaunas University of Technology, Lithuania presented "Deep learning in Alzheimer's disease", Prof. Dr. Audris Mockus from the University of Tennessee, USA, was speaking on the "World of Code: Enabling a Research Workflow for Mining and Analyzing the Universe of Open Source VCS Data"; Prof. Dr. Tatiana Tchemisova from the University of Aveiro, Portugal, presented the talk "Generating of non-regular instances of semidefinite programming problems", Prof. Dr. Pasi Fränti from the University of Turku, Finland, dedicated his talk to "Web tools for analysing location-based data", >>



▲ Invited speakers of DAMSS 2021 (from left to right): Rytis Maskeliūnas, Audris Mockus, Tatiana Tchemisova, Pasi Fränti, Remigijus Paulavičius and Ernestas Filatovas.

>> and Prof. Dr. Remigijus Paulavičius and Prof. Dr. Ernestas Filatovas, co-founders of the Blockchain Technologies Group, and researchers of the Institute of Data Science and Digital Technologies, Vilnius University, Lithuania, presented the two connected talks “Empirical Analysis of Selected Blockchain Simulators” and “Application of MCDM Techniques for Consensus Protocol Selection”.

The number of oral and poster presentations at DAMSS 2021 was 63 and the number of registered participants was 92. There were significantly fewer participants who came from abroad due to concerns about the safety of long-distance travel.

The Organizing Committee of DAMSS is inspired by the success of the conference and will do everything possible to ensure that the next editions of the conference will be as successful.

The 13th Conference “Data Analysis Methods for Software Systems” will be held on December 1- 3, 2022, in Druskininkai, Lithuania, and all interested to participate in it are welcome <https://www.mii.lt/damss/index.php>. The topics of DAMSS include but are not limited to artificial intelligence, big-data, bioinformatics, blockchain technologies, business rules software engineering, data science, deep learning, digital technologies, high-performance computing, visualization methods for multidimensional data, machine learning, medical informatics, modelling educational data, ontological engineering, operational research, optimization in data science, and signal processing. Selected works of DAMSS 2022 will be published in the *Proceedings* volume issued by Lithuanian Computer Society and Vilnius University and in a Special Issue of *Baltic Journal of Modern Computing* (www.bjmc.lu.lv). 🌐



▲ Poster session and the organizing committee of DAMSS 2021.

How a Regional Meeting Turns out a Global with OR Studies - DMV-ÖMG Annual Conference 2021 in Passau and Virtually

Burcu Gürbüz <burcu.gurbuz@uni-mainz.de>

Brigitte Forster-Heinlein <brigitte.forster@uni-passau.de>

Gerhard-Wilhelm Weber <gerhard.weber@put.poznan.pl>

The joint Annual Conference of the German Mathematical Society (DMV) and the Austrian Mathematical Society (ÖMG) 2021 was held with the participation of over 700 scholars from 36 countries from all over the world. It was successfully held from September 27 to October 1, 2021, and hosted by the University of Passau. The conference took place in a virtual format due to the current COVID-19 circumstances while the participants could find a chance to interact through a number of engaged discussions on *Wonder.me* platform. The program included over 420 talks (<https://www.uni-passau.de/en/dmv-oemg-jahrestagung-2021/home/>).

The prestigious event was organized by outstanding scientists from Germany and Austria (<https://www.uni-passau.de/en/dmv-oemg-jahrestagung-2021/committee/>). The keynote speakers were carefully selected distinguished scholars who introduced their research studies to the participants. *The Opening Ceremony* joyfully started with a musical concert which was motivating and welcoming the participants. A virtual tour of the history and campus of the University of Passau was presented by *Mario Puhane* (University of Passau).

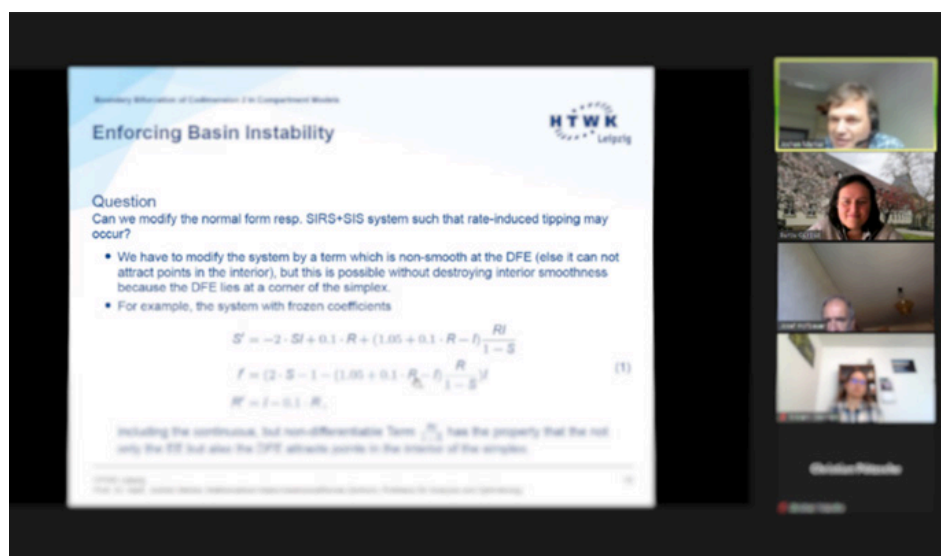
During the meeting, various OR-related studies were featured. The importance of interdisciplinary studies and their real-world applications were also indicated. One of the keynote speakers, Anita Schöbel (TU Kaiserslautern), introduced emerging news. Main concepts about robust optimization were illustrated on real-world problems which are currently tackled at Fraunhofer ITWM. The OR-related part of DMV-ÖMG Annual Conference 2021 was generally appreciated as one of the core attractors and driving forces of the congress, and as one of the most important bridges of today between mathematics and the real life.



▲ DMV-ÖMG Annual Conference 2021: Map of the countries of the participants.

Keynote speakers and their titled talks were Julian Fischer (IST Austria): “Interface evolution problems in fluid mechanics and geometry”, Nina Gantert (TU Munich): “Exclusion processes: some new results and open questions”, Martin Grötschel (TU Berlin) “Moderne Mathematik”, Christian Hesse (University of Stuttgart): “Mathematik und Schach”, Stefan

jahrestagung-2021/minisymposia/) and 14 Sections (<https://www.uni-passau.de/en/dmv-oemg-jahrestagung-2021/sections/>). On the other hand, the program was enriched by many different events such as Maths Teachers Day and Students Conference and Lunchtime Seminar “Mathematics in Industrial Applications”, to gather attention of young scholars as well as experienced teachers and experts from the industry.



▲ DMV-ÖMG Annual Conference 2021: Jochen Merker, Burcu Gürbüz, Josef Hofbaer, Miriam Steinherr and Christian Pötzsche (top-down) at Section “Dynamical Systems” organized by Josef Hofbaer (University of Wien) and Timo Reis (University of Hamburg).

This esteemed event was successfully moderated by Brigitte Forster (University of Passau). Prof. Dr. Forster also introduced the program daily based and informed every details to the participants with her endless support and diligent work in the organization. Burcu Gürbüz also presented her joint research study on a dynamical system study with an application on a medical model which can stimulate further OR-related investigations. Besides, she introduced news such as on related special issues of journals, and especially meetings and events from our organizations of IFORS and EURO. Consequently, she gave information about the upcoming main OR event of EURO 2022, Espoo, Finland, July 3-6, 2021 (<https://euro2022espoo.com/>). 🌐

Kebekus (University of Freiburg): “Minimale Modelle und die Klassifikation algebraischer Varietäten”, Anke Pohl (University of Bremen): “Automorphic functions, transfer operators, and dynamics”, Joscha Prochno (University of Graz): “The asymptotic structure of Schatten classes”, Karin Schnass (University of Innsbruck): “Conditioning of random submatrices”, Anita Schöbel (TU Kaiserslautern): “Robust optimization: Real-world applications imply a challenging topic”, Gabriele Steidl (TU Berlin): “Motion and Deformation in Images”, and Angela Stevens (University of Münster): “Mathematics in Epidemiology”. Moreover, DMV-ÖMG Annual Conference 2021 offered 28 Minisymposia (<https://www.uni-passau.de/en/dmv-oemg->

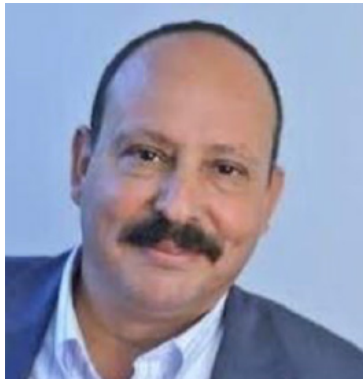


▲ DMV-ÖMG Annual Conference 2021: Prof. Anita Schöbel gives her talk on “Robust Optimization”.

Europe, Middle East, and Africa Conference on Business Analytics: EMEA 2022 - Successfully Celebrated, Virtually

Hatem Masri <hmasri@uob.edu.bh>
Fouad ben Abdelaziz <fba@neoma-bs.fr>

The Europe, Middle East, and Africa conference on Business Analytics (EMEA 2022), January 17-19, 2022, kindly sponsored by INFORMS, was initiated by Professor Hatem Masri and Professor Fouad Abdelaziz, from the University of Bahrain and NEOMA Business School respectively, who were keen to raise awareness of Business Analytics methods amongst students in the three regions.



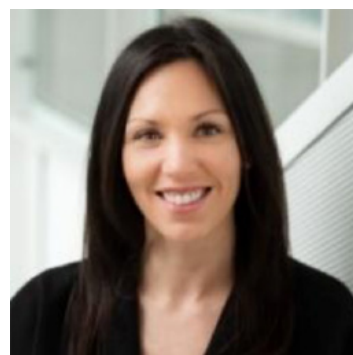
Fouad Ben Abdelaziz
Distinguished Professor,
NEOMA Business School,
President of the Tunisian Decision Aid Society

The organising team also included Salah Ben Abdallah (Tunis Business School, Tunisia) and Mohamed R. Qader, Mohammad El-Hilo, and Dr. Sawsan Hilal from the University of Bahrain

At the start of the virtual conference, the chair of INFORMS' International Activities Committee (Professor Miguel Anjos) gave a short introduction to INFORMS, then a fascinating mixture of keynote talks, presentations and Python workshops took place over three days. The presentations included a wide range of topics with PhD and Master degree students from Neoma Business School in France, University of Tunis, University of Tlemcen, American University of Beirut in Lebanon and University of Bahrain (cf. <https://analytics.tdasociety.org>).



▲ *El-Ghazali Talbi*,
University of Lille, France



▲ *Marie-Ève Rancourt*,
HEC Montréal, Canada



▲ *Davide La Torre*,
SKEMA Business School, France

The three excellent plenary talks covered machine learning in metaheuristics: "Review and taxonomy" by El-Ghazali Talbi,

"Applied network design problems to support humanitarian operations" by Marie-Ève Rancourt, and "Fractal Measures in Multisector Endogenous Growth Models" by Davide La Torre.

The three day conference hosted 82 attendees, with a broad international representation from several countries, including Algeria, Bahrain, Canada, France, Lebanon, Mauritania,

Morocco, Oman, Senegal, Saudi Arabia, South Africa, Tunisia, UK, and United Arab Emirates. The Python workshop was jointly organized by TDAS (Houda Alaya) and INFORMS Bahrain International group (Murad Masadia) as hands-on training for the students on linear programming and machine learning models.

The conference was an excellent opportunity to highlight the impact of OR-Analytics methods on different fields such as engineering, medicine, finance, business, computer science, and industry. It demonstrated the need for additional efforts to engage students from different backgrounds in a combination of business analytics and specialized knowledge. These young researchers with the help of analytics professionals could work on practical problems and have an impact on society beyond the development of models and methods.

At the end of the conference, participants were congratulated and invited to join INFORMS and INFORMS' Bahrain International Group activities for the coming period, among them the 2022 International Conference on Decision Aid Sciences and Applications that will take place in Thailand during March 23-25, 2022 (<https://dasa22.mfu.ac.th/>). 

This report was communicated by dear Sue Merchant. G.-W. Weber

EURO HOPE Mini Conference 2021

Mimmi Pöysti <mimmi.poysti@hanken.fi>

Kristjana Adalgeirsdottir <kristjana.adalgeirsdottir@hanken.fi>



The *European Working Group on Humanitarian Operations (EURO HOPE)* and the *HUMLOG Institute* at *Hanken School of Economics* organized the *fifth EURO HOPE mini conference* in Helsinki, Finland, on the 24-25 November 2021. For the first time, the event was held in *hybrid format*. This year's theme was *Financial, Cash and Voucher Assistance in Humanitarian Supply Chains*.

Humanitarian Operational Research studies decision-making problems related to providing logistical assistance for humanitarian purposes, and in response to humanitarian crises. The primary objective of humanitarian operations is to save lives, alleviate suffering, and maintain human dignity. Scientific interest and research output on the topic have seen a rapid increase within the last decade.

The purpose of the *EURO* working group is to create a platform that facilitates communication among the interested parties and forms an active group working towards achieving these objectives. It constitutes a reference point for the active research community to advance the development and application of *Operational Research* methods, techniques, and tools to the field of Humanitarian Operations. Meetings encourage the exchange of information among practitioners and researchers in this area and stimulate the work on



▲ *EURO HOPE 2021* audience at *Hanken* and online.

emerging issues with sound scientific methods.

EURO HOPE mini conference 2021 comprised of 11 thematic sessions, held in two parallel tracks online and at the physical conference at *Hanken School of Economics* in Helsinki. The conference was free of charge for all participants and supported by grants from the *Academy of Finland* and *The Foundation for Economic Education (Liikesivistysrahasto)*. Online participants could listen to presentations given from all around the world or tune in to the presentations held at *Hanken*. Participants in Helsinki had the option to follow presentations in the main conference room or pop out to smaller meeting rooms to listen to online presentations. This hybrid format worked remarkably well for the over 200 participants and enabled the presentation of a total of 44 papers.

The conference began with greetings from *Hanken's Rector, Karen Spens*, followed by welcoming words from the *EURO-HOPE* Board by *Professor Nico Vandaele* from *KU Leuven*. The official opening of the conference was made by the Director of the *HUMLOG Institute, Dr Wojciech Piotrowicz*, who also chaired the conference.

The keynote speaker was *Kalle Löövi*, newly appointed Honorary Doctor at *Hanken School of Economics* and former Head of Disaster Operations at the *Finnish Red Cross*. His presentation, "*Right time, right place*" included many personal anecdotes from various humanitarian operations that he had been involved in and highlighted the important role of logistics in a disaster setting.



▲ *Dr Wojciech Piotrowicz*, Conference Chair and Director of the *HUMLOG* Institute.

The 11 sessions comprised of various themes, including Cash in Humanitarian Supply Chains, COVID-19 Response and Case Studies, Localisation & Network Design, Operational Research, Health and Technology & Innovation.

A highlight of the conference was the presentation of the new *Luk Van Wassenhove Award*. Professor Van Wassenhove joined the conference online via Teams, and the first award was given to Professor Gyöngyi Kovács, who is one of the *HUMLOG Institute's* founders and Professor in Humanitarian Logistics. The award honours Professor van Wassenhove's commitment to relevant research in humanitarian operations as well as his commitment to his coauthors, students and the academic community. Professor Kovács received the award for her outstanding work in linking theory and practice, her generosity and her service to the humanitarian operations academic community.

Day 1 of the conference culminated in a visit to *HEUREKA Science Center*, where the participants were given a private tour of the exhibition *Facing Disasters*, of which the *HUMLOG Institute* is a partner. The exhibition lets visitors practise their crisis tolerance – resilience – in gamified exhibits and experience the forces of nature as audiovisual art installations. The exhibition was followed by a dinner at *HEUREKA*. Thanks to an interactive first day and a relatively small group of in-person participants, the ambience was very relaxed and allowed for an active exchange of ideas and experiences between all participants and organisers.

To quote one participant: "Overall, the conference was one of the best I have attended. All the organizers and staff who put the conference together should be proud for creating a friendly and learning environment". Another one commented on the hybrid nature of the event: "Great Job for organizing a hybrid conference. It is difficult. Thanks for everything. It was a real pleasure to be there!". The majority (65%) of the participants were academics, while NGO and private company participants represented equal shares of the non-academic participants.

The conference was closed in the evening of November 25, 2021, after which discussions continued in an open and relaxed manner at restaurant *Töölö* in Helsinki. The conference was a great opportunity for the humanitarian operational research community to get together and share



▲ Professor Gyöngyi Kovács is handed the Luk Van Wassenhove (on screen) award by Professor Maria Besiou and Professor Nico Vandaele.



▲ Conference participants at the start of the exhibition *Facing Disasters* at *HEUREKA Science Center*.



▲ Online and in person participants at the closing of the conference.

knowledge, and for many participants this was the first time they had participated in a conference in person since the very start of the pandemic. As one participant concluded: "I am really glad I attended the conference as there was so much learning from the presentations. I like that researchers have this medium to share their work and receive feedback from industry experts." 🌐

Intelligence Infused Systems meet OR, in Sofia and Online - 16th Conference on Computer Science and Intelligence Systems

Respectfully submitted to OR by the FedCSIS 2021 Conference Series Chairs

Maria Ganzha <m.ganzha@mini.pw.edu.pl> **Leszek Maciaszek** <leszek.maciaszek@mq.edu.au>

Marcin Paprzycki <paprzyck@ibspan.waw.pl> **Dominik Ślęzak** <slezak@mimuw.edu.pl>

The 16th edition of the Conference on Computer Science and Intelligence Systems (*FedCSIS 2021*; www.fedcsis.org) was to be held in Sofia, Bulgaria, on September 2-5, 2021. Unfortunately, again, due to the COVID-19 pandemic, it had to be transformed into an online conference.

Bulgaria Section, IEEE Czechoslovakia Section Computer Society Chapter, IEEE Poland Section Systems, Man, and Cybernetics Society Chapter, IEEE Poland Section Control System Society Chapter, IEEE Poland Section Computational Intelligence Society Chapter, Bulgarian Section of SIAM, Committee of Computer Science of Polish Academy of

Title	Acronym	Source	Rank	DBLP	hasData?	Primary FOI	Comments	Average Rating
CONFERENCE ON COMPUTER SCIENCE AND INTELLIGENCE SYSTEMS	FedCSIS	CORE2021	B	view	Yes	4602	0	N/A

CORE2021 Summary:
A* - 7.15% of 811 ranked venues
A - 15.91% of 811 ranked venues
B - 37.24% of 811 ranked venues
Australasian B - 1.6% of 811 ranked venues
C - 36.37% of 811 ranked venues
Australasian C - 1.73% of 811 ranked venues
Other - 165 total

▲ *FedCSIS* conference series: ranked high in CORE system.

Before proceeding further, let us share a very important information. In June 2021 *FedCSIS* conference series has been ranked B in the *CORE* ranking system. This constitutes a major achievement for the series. This is particularly valuable achievement since the series was not ranked before. We would like to thank *Prof. Paweł Sitek* for leading our efforts and preparing the necessary documentation.

Let us also note a name adjustment. The *FedCSIS* conference series is evolving with the world. This evolution is based on recognizing changes around us. One of them is the raise of artificial intelligence, machine learning and data analytics. As a result, it is our belief that “information systems” of the old are becoming “intelligence infused systems” of today. As a matter of fact, it becomes difficult to point to information systems that do not contain components realizing some form of, broadly understood, artificial intelligence. Hence, we have decided that from this year on the name of the conference series will become “Conference on Computer Science and Intelligence Systems (*FedCSIS*)”. As can be seen, we are the same *FedCSIS* (acronym stays unchanged and our goals remain the same), but adjusted to the world of the 2020s and beyond.

FedCSIS 2021 was organized by the Institute of Information and Communication Technologies (IICT) of the Bulgarian Academy of Sciences, with support from the Polish Information Processing Society (Mazovia Chapter), IEEE Poland Section Computer Society Chapter (C-16), Systems Research Institute Polish Academy of Sciences, Warsaw University of Technology and Wrocław University of Economics and Business.

Technical co-sponsors included: IEEE Poland Section, IEEE

Sciences, Eastern Cluster ICT Poland, Mazovia Cluster ICT.

As in the past year, *FedCSIS 2021* consisted of 5 Tracks divided into Technical Sessions:

Track 1: Advanced Artificial Intelligence in Applications (16th Symposium AAIA'21)

o Computational Optimization (14th Workshop WCO'21)

Track 2: Computer Science & Systems (CSS'21)

o Computer Aspects of Numerical Algorithms (14th Workshop CANA'21)

o Multimedia Applications and Processing (14th International Symposium MMAP'21)

Track 3: Network Systems and Applications (NSA'21)

o Internet of Things - Enablers, Challenges and Applications (5th Workshop IoT-ECAW'21)

o Cyber Security, Privacy and Trust (2nd International Forum NEMESIS'21)

Track 4: Advances in Information Systems and Technologies (AIST'21)

o Data Science in Health, Ecology and Commerce (3rd Special Session DSH'21)

o Information Systems Management (16th Conference ISM'21)

o Knowledge Acquisition and Management (27th Conference KAM'21)

Track 5: Software, System and Service Engineering (S3E'21)

o Cyber-Physical Systems (8th Workshop IWCPs-8)

o Software Engineering (41st IEEE Workshop SEW-41) Artificial Intelligence and Cybersecurity (1st Young Researchers Workshop YRW'21)

During the *FedCSIS'2021*, the *Keynote Lectures* were delivered by:

- *David Bader*, Distinguished Professor, New Jersey Institute of Technology, USA: “*Solving Global Grand Challenges with High Performance Data Analytics*”,
- *Rajkumar Buyya*, Director, Cloud Computing and Distributed Systems (CLOUDS) Lab, The University of Melbourne, and CEO, Manjrasoft Pvt Ltd, Melbourne, Australia: “*Neoteric Frontiers in Cloud and Edge Computing*”,
- *Hristo Djidjev*, Los Alamos National Laboratory, USA: “*Using quantum annealing for discrete optimization*”,
- *Moshe Y. Vardi*, Professor, Rice University, USA: “*Lessons from COVID-19: Efficiency vs Resilience*”;

slides and videos of the presentations are available at <https://fedcsis.org/2021/keynotes>.

FedCSIS 2021 was chaired by *Prof. Stefka Fidanova*, while *Dr. Nina Dobrinkova* acted as the Chair of the Organizing Committee.

During *FedCSIS 2021*, for the first time, the *Professor Zdzisław Pawlak* award was elevated from the AAIA Track award to the award presented to the best papers across the whole conference. It was done to further integrate the conference, following the fact that scientific achievements of *Professor Pawlak* had gone far beyond artificial intelligence. This year the following Awards have been given:

- In the category Best paper: *Anh Nguyen Mac* and *Hung Son Nguyen* for the paper “*Rotation Variance in Graph Convolutional Networks*”.
- In the category Young Researcher: *Christian Leyh*, *Konstanze Köppel*, *Sarah Neuschl* and *Milan Pentrack* for the paper “*Critical Success Factors for Digitalization Projects*”.
- In the category Industry cooperation: *Lov Kumar*, *Mukesh Kumar*, *Lalita Bhanu Murthy*, *Sanjay Misra*, *Vipul Kocher* and *Srinivas Padmanabhuni* for the paper “*An Empirical Study on Application of Word Embedding Techniques for Prediction of Software Defect Severity Level*”.
- In the category International Cooperation: *Arman Ferdowsi*

and *Alireza Khanteymoori* for the paper entitled “*Discovering Communities in Networks: A Linear Programming Approach Using Max-Min Modularity*”.

English was the exclusive conference language. *FedCSIS 2021* attracted 129 submissions. Out of submitted contributions, after obtaining at least 2 reviews for each paper, 32 articles were accepted as regular full papers (acceptance rate: 24.8%), 30 articles were accepted as regular short papers. Conference Proceedings include also 5 invited contributions from current and past *FedCSIS* keynote speakers. The 2nd volume consists of 5 position papers, and 20 communication papers. The latter include 6 contributions from the 1st *Young Researcher Workshop*. Accepted contributions represented more than 30 countries.

Conference materials were initially published on the conference WWW site (as preprints).

After the conference, full and short papers have been indexed in the IEEE Digital Library (ISBN Web 978-83-959183-6-0, ISBN USB 978-83-959183-7-7, ISBN Art 978-83-959183-8-4, IEEE Catalog Number CFP2185N-ART (ART), CFP2185N-USB (USB), ISSN 2300-5963); furthermore, they will be sent to the Clarivate Web of Science for indexing. Position Papers and Communication Papers were published as a separate volume (ISSN 2300-5963, ISBN Web 978-83-959183-9-1, ISBN USB 978-83-962423-0-3). Moreover, Proceedings, Position Papers and Communication Papers of the *FedCSIS 2021* Conference (in their final version) were posted at the conference WWW site, available through the Archive section of the www.fedcsis.org web-site (alongside publications from all past conferences). It should be stressed that only papers presented in the conference were published in either form (*FedCSIS* conference series strictly adheres to the “IEEE No-show Policy”).

We observe that there is broad and exciting interface of the subjects of *FedCSIS* conference series with fast growing *Operational Research*. Therefore we would like to express our interest in close and fruitful relations and collaboration with the worldwide community within *IFORS*. 🌐

Advancing OR for Good – 54th Annual Convention and AORBI Conference by ORSI, India

Jinal Parikh <jinal.parikh@ahduni.edu.in>
Gerhard-Wilhelm Weber <gerhard.weber@put.poznan.pl>
Chitaranjan Sharma <drcsharma3@gmail.com>



Continuing with its scholarly academic tradition of organizing a convention and an annual international conference to provide impetus to rigorous academic research, the *Operations Research Society of India (ORSI)* (<https://orsihq.org/>) organized its *54th Annual Convention and International Conference on Applications of Operations Research in Business and Industries (AORBI)* from December 17-19, 2021. ORSI which was established in 1957 by one of the most erudite mathematicians of that time, *Professor P.C. Mahalanobis*, provides a fascinating platform for both theoreticians and practitioners of OR to widen their horizons via exchange of knowledge and applications.

Since 1968, *ORSI* has organized 53 Annual Conventions at different locations in India. This convention which was the 54th in the series of its Annual Conventions, was organized at Indore, India, and hosted by the *Indore Chapter of ORSI* (<https://orsiindore.in/>). *Professor J K Sharma*, the President of ORSI India, expressed his gratitude towards *Professor Chitaranjan Sharma*, the President of Indore chapter of ORSI, who took the lead and played an active role in organizing this entire event. While addressing the audience, he reinstated the crucial role that OR plays in helping make more effective decisions and building more productive systems.

The event was graced by the august presence of the then President of *International Federation of Operation Research Societies (IFORS; <https://www.ifors.org/>)*, *Professor Grazia Speranza*. She enlightened the audience by delivering a talk on *“Contributions of Operational Research to Sustainability in Transportation”*. *Prof. Sunity Shrestha Hada*, the then Vice-President representing *Asia-Pacific OR Societies (APORS)* in the Administrative Committee of *IFORS*, aptly justified the theme of the conference by delivering a talk on *“Applications of Operational Research in the Nepalese Banking Industry”*. Other interesting keynote sessions included those by *Prof. Nachiappan Subramanian*, professor of Operations & Logistics Management and Supply Chains, University of Sussex Business School, UK, which stressed the importance and relevance of *innovation analytics and its applications* in supply chain management in today’s dynamic scenario, and by *Prof. S. Dharmaraja*, Department of Mathematics, IIT Delhi, on *“Markov regenerative credit rating models”*. Like every year, in the year 2021 too, the convention provided thrust to academics and scholars to promote the usage and application of mathematics and OR by conferring the prestigious *P.C. Mahalanobis* and Fellowship Awards on distinguished academics and scholars in the field of OR, mathematics and statistics. *Prof. S. Dharmaraja* also delivered the renowned *Professor PRS Reddy Endowment Lecture*, aimed at promoting excellence in applications of OR, mathematics and related disciplines titled - *“Study of*



▲ AORBI 2021: Prof. M.Grazia Speranza, President of IFORS, and Prof. Sunity Shrestha Hada, Vice-President of IFORS (until end of 2021).

by researchers and academics from all over India and abroad during the five plenary sessions planned during the event. Of those presented, 45 have been identified and selected for being published in the Proceedings of the conference by Springer. The applications presented were contemporary and relevant as well as spanned across a set of diverse topics ranging from *supply chain performance of dry chillies, to selection of cars through DEA, to energy efficiency of crops, to stochastic modelling of wireless networks, to portfolio optimization, to primary healthcare, to distribution of COVID vaccines, to Industry 4.0, to modeling and analysis of photovoltaic power, to AI and data driven product management, so on and so forth...*



▲ Impressions at AORBI 2021 (from left to right): 1. President of ORSI, *Professor J. K. Sharma*, and President of ORSI, Indore chapter, *Professor Chitaranjan Sharma*, 2. Academics and experts on the inaugural day of the conference, 3. Gathering of attendees at Holkar Science College, Indore, India.

Stochastic Systems with Catastrophe and Its Jump-Diffusion Approximation”.

AORBI 2021 conference which was concurrently organized with the 54th Annual convention, overtly achieved its aim of bringing together a galaxy of leading international experts, eminent academicians, researchers and post-graduate students in the fields OR, production systems and business from across the academia, industry, and government. The conference clubbed with the convention provided a platform to discuss various interesting issues in intelligent manufacturing, operations management, financial management, supply chain management, and Industry 4.0 in the current pandemic-hit yet Artificial Intelligence-prone paradoxical scenario. Industry leaders and renowned academicians shared their viewpoints and insights through industry and business essences. An academia-industry interaction was held on December 18, 2021, to explore ways and means to bridge the gap between academics and industry in the field of OR as also to strengthen the ties between them.

More than 120 original research papers from different fields of OR based on the identified sub-themes were presented

The first author, *Dr. Jinal Parikh*, is grateful to the first co-author *Dr. Gerhard-Wilhelm Weber* for not only being an ever-inspiring mentor to her but also for identifying this event, for motivating her to participate in it and for playing an instrumental role in helping her write this report. She is also grateful to the second co-author *Professor Chitaranjan Sharma* and to the ORSI for granting her access to the materials required to prepare this report and for their continuous encouragement throughout the event and thereafter.

The first author, *Jinal's*, paper titled *“A Comparative Analysis for Mapping Relative Position of Bank Brands: An Application of Attribute-based Perceptual Mapping Using Factor Analysis and Data Envelopment Analysis”* is one of the 45 selected papers featured in the souvenir of the conference proceedings. Through this paper, we bring to the fore a novel and first of its kind way of applying OR to banking in India to map the relative positions of bank brands based on customer perceptions. To this aim, we have first applied Attribute-Based Perceptual Mapping using Factor Analysis (ABMFA) and Data Envelopment Analysis (DEA) to map the relative positions of ten bank brands considered for the study. Second, we analyze and report an empirical comparison of the results so obtained in terms of their similarities and differences.

Accordingly, the common inference drawn from the results obtained through both the techniques enabled us to identify and categorize brands as relatively strong and weak based on customers' perceptions. A closer examination of the results indicated and corroborated the differences amongst the various bank brands. For instance, it showed that although a particular brand has a 100% relative perceptual efficiency obtained through DEA, the results of ABMFA suggest that it is still negatively rated in terms of one of the attributes. Finally, we examined the results obtained through gap analysis in ABMFA and DEA to find out the gaps in the current position of each of the bank brands and to suggest the scope for improvement in their current positioning strategies.

Similar to other conferences of international repute, this conference too has a Question-and-Answer round followed by a presentation wherein researchers get constructive insights about strengthening their researches in terms of contents, methodology and outcomes. The conference session chairs, rapporteurs and the academic & industry experts present during the sessions share their knowledgeable insights with the presenters to sharpen their researches and make them analytically more rigorous.

Founded in 1957, *ORSI*, was one of the very first societies to join *IFORS* in 1960. Ever since its inception, *ORSI* has been playing a pivotal role towards the development and advancement of the theory and practice of *OR*. With this we wish that *ORSI* continues to advance and expand the *OR* community further



▲ Dr. Gerhard-Wilhelm Weber (left) - "A brilliant OR propagator and an inspiration for budding young OR researchers and scholars" - Dr. Jinal Parikh (right).

and that it organizes many more such events which enable researchers, academics and industry to showcase the critical role that *OR* plays in addressing real-time industry and societal issues.

References

1. <https://www.ifors.org/>
2. <https://orsihq.org/>
3. <https://orsiindore.in/>

SIMANTAP – Online and On-site: International Conference “SIMANTAP 12th” Celebrated in Universitas Potensi Utama, Medan, Indonesia

Herman Mawengkang <hmawengkang@yahoo.com> **Gerhard-Wilhelm Weber** <gerhard-wilhelm.weber@put.poznan.pl> **Budi Triandi** <buditriandi@gmail.com>

SIMANTAP 12th 2021 was an international and national conference for sharing knowledge and research in mathematics, *Operational Research*, and their applications. It offered a forum for researchers, teachers and practitioners from academia as well as industry to gather and discuss about cutting-edge evolvments of mathematics and *OR*, and educational research in these areas.

The congress took place at *Universitas Potensi Utama (UPU) Convention Center*, Medan, North Sumatra, Indonesia. It was collaboration between *Universitas Potensi Utama (UPU)-Medan* and *IndoMS SUMUT-ACEH*, Indonesia, on November 28-29, 2021, was dedicated to a motto from *Operational Research*: “*Advancing Mathematically from Deep Learning*”, which is of a vast importance worldwide, especially, for an emerging nation like Indonesia with its very young population. This conference aimed (a.) to bring together the scientists, engineers, researchers, practitioners, academicians, and representatives of civil society organizations within a scientific forum; (b.) to share and to discuss theoretical and practical *OR* knowledge about innovations in applied mathematics, statistics and mathematics education. This congress was especially used as a scientific stage for facilitating and hosting exchange between young researchers, mostly from Indonesia, in different fields of applied mathematics and *OR*. Hence, a number of the invited

speakers and many of the regular participants at this conference were young promising investigators who are now becoming well-known more and more, and respected around the globe. In fact, at *SIMANTAP 2021 OR* as well as mathematics served as a unique link to the real world with its diverse economic and industrial, environmental and social, educational and developmental challenges, and as a chance for the youth to get further involved into today's scientific research and our *OR* community.

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A majority of the presentations by the main speakers and parallel speakers put their focus onto OR, applied mathematics, OR education, management, and computer science. They elaborated some cherished areas of emerging OR, computational and applied mathematical issues and advancements, e.g., in theoretical foundations of mathematics, applied sciences and artificial intelligence, mathematics education, population and pandemic dynamics - with a future promise to OR Applications and Education. The congress was attended by overall 1329 participants.



▲ SIMANTAP 12th 2021: Cheerful regards to the worldwide OR community from the local team.

There were seven keynote speakers of the conference. These were the local leaders and representatives *Dr. Roslina, Politeknik* (Negeri Medan, Indonesia), *Prof. Dr. Herman Mawengkang* (Universitas Sumatera Utara, Medan, Indonesia), and the international guests *Prof. Dr. Vince Geiger* (Institute of Learning Science, and Teacher Education Australian Catholic University): *“Using mathematics to solve real world problems: The role of enablers”*, *Prof. Dr. Dorien DeTombe* (Amsterdam, The Netherlands; chair of EURO Working Group on Ethics and OR): *“Unnecessary production, a wicked complex problem”*, *Prof. Dr. Gerhard-Wilhelm Weber* (Poznan University of Technology, Poland, and METU, Ankara, Turkey): *“Target-Environment Networks Under Uncertainty Geometric and semi-algebraic regression strategies based on nonlinear optimization”*, *Prof. Dr. Masaji Watanabe* (Okayama University, Japan), and *Prof. Dr. Milagros Baldemor* (Don Mariano Marcos Memorial State University, the Philippines).

Among the co-organizing institutions, a driving force for SIMANTAP 12th 2021 was *University of Sumatera Utara (USU)*, a leading university in Sumatra Island, Indonesia. The friends

there successfully organized and conducted 5 conferences called *InteriOR*, *“The International Conference on Operational Research”*. This series is celebrated every 2 years. The friends there participated at our *IFORS* and *EURO* conferences for which they prepared streams and sessions. *InteriOR* series has ever been a source of inspiration for the *SIMANTAP* series as well.

During *SIMANTAP 12th 2021* in lovely city *Medan*, pearl of Sumatra near to world-famous *Lake Toba*, the 75th birthday of *“Professor Herman”* was cheerfully and solemnly celebrated in the great friendship so characteristic for our Indonesian and worldwide OR families.

As always, *Willi* invited to our OR-community within *IFORS* and to the next conference highlights, such as *EURO 2022* in Helsinki, Finland.

As the Conference Host and the *Editor-in-Chief* the first author, *Prof. Dr. Herman Mawengkang*, extends his deepest appreciation to all local organizers, the team around the Conference Chair, *Bob Subhan Riza* (The chairman of Universitas Potensi Utama Foundation) and *Mr. Budi Triandi*, who worked very hard and showed a great care and passion, to all the keynote



▲ Mentor and mastermind of SIMANTAP 12th 2021 and of OR in Indonesia: Professor Herman Mawengkang (USU Medan).

speakers, attendees and all the many dear friends from near and far. Without their commitment, this congress would not have become such a success story. Finally, we wish you all a robust health, a big happiness and fulfillment in 2022 and for all years to come. We from Sumatra Island hope to welcome you in person at *SIMANTAP 13th 2022!* 🌐

A Return to In-person Meetings: 2021 INFORMS Annual Meeting and 2022 INFORMS Business Analytics Conference

This article is comprised of content that previously appeared in an issue of **OR/MS Today** magazine, as well as content contributed by the 2022 INFORMS Business Analytics Conference Chair **Erick Wikum** (erick@wikalytics.com) for use in an upcoming issue of the magazine.

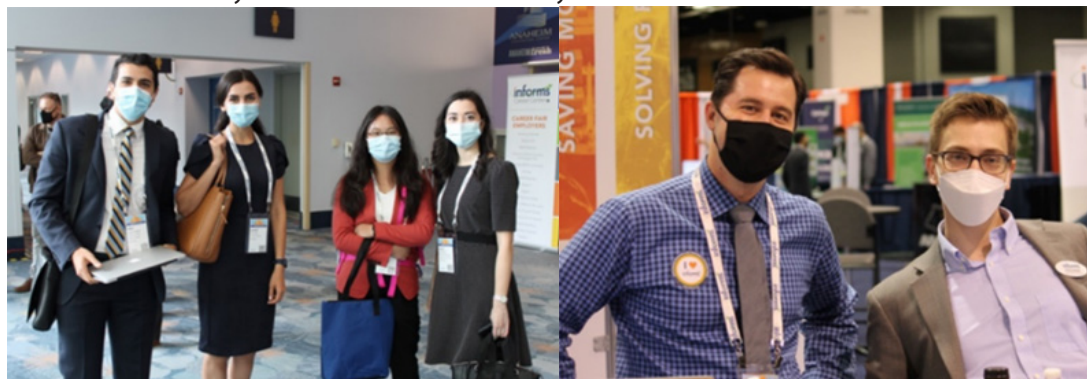
Fall 2021 signaled a much-anticipated return to in-person meeting opportunities with the flexible 2021 INFORMS Annual Meeting held October 24-27. The meeting featured both a virtual and in-person attendance option in Anaheim, California. Attendees had access to 1000s of presentations showcasing the latest research and discoveries sharing how *operational research (OR)* and *analytics* are saving lives, saving money and solving problems.

Given the capriciousness of the COVID-19 virus and its variants, the 2021 Annual Meeting required all in-person attendees to be fully vaccinated against the virus and adhered to guidance and leading practices for events from the CDC and WHO. Whether in person or virtual, attendees experienced a plethora of amazing content (including plenaries, keynotes and tutorials), networking events, Exhibit Hall and Career Fair experiences.

For those attending the meeting virtually, there were a number of unique benefits. Thousands of cutting-edge presentations, including daily plenary and keynote sessions, were presented live to both in-person and virtual audiences, covering topics relating to the advancement of urban analytics and more. Specially-selected sessions highlighted the diversity of the meeting tracks (presented in person and available via livestream for virtual attendees). The full meeting program remained accessible virtually for 3 more months.

The *plenary* and *keynote lectures* at the Annual Meeting shed light on the interplay of societal challenges, both long-standing and emerging, with innovations in *OR/MS* methodology. Speakers brought their methodological expertise and innovations in areas such as AI, optimization, probabilistic methods and statistical learning, and their experience in public health, energy markets, transportation, operations engineering and supply chains. These talks both challenged and intrigued attendees, and offered an exceptional opportunity for growth of the discipline and the *INFORMS* community at large. Here is a sample of just some of the topics addressed in the *plenary talks* (cf. <https://pubsonline.informs.org/magazine/orms-today/news>):

- Companies such as *Airbnb* and *Uber* have fundamentally transformed society with their revolutionary business



▲ Annual Meeting attendees and INFORMS staff alike were excited to once again meet and interact in person.



▲ The 2021 INFORMS Annual Meeting signaled a much-anticipated return to in-person meetings, while also featuring a virtual attendance option.

models. But with these novel changes come new challenges, the solutions to which *Martin Savelsbergh*, Georgia Tech, explored in his plenary talk, “*Challenges and Opportunities in Crowdsourced Delivery Planning and Operations*”.

- In his session “*Roles of Optimization in Managing Amazon’s Supply Chain*”, *Huseyin Topaloglu* took meeting attendees behind the scenes of Amazon’s inventory management and shared his personal experiences working with Amazon.

- The COVID-19 pandemic brought to light vulnerabilities in global supply chains, resulting in prolonged shortages of PPE, vaccines and more. *Chris Tang*, UCLA, shared his observations and discussed potential steps forward in his session, “*Improving Supply Chain Resilience: Looking Back and Looking Forward*”.

The 2021 INFORMS Annual Meeting had a few new additions to the organized program and schedule. From the *more than 5,500 abstracts* submitted for the Annual Meeting program, the organizing committee curated a collection of sessions identified as “*The Committee’s Choice*”. These sessions called attention to important challenges – climate change and policy, pandemic response, vulnerable populations, disparities and equity in well-being, urban public service, urban sustainability, and diversity, equity and inclusion. In addition,

Technology Showcases were 30-minute virtual-only sessions launched to complement the in-person Exhibit Hall experience. Session attendees had the chance to learn about a range of vendor products and services at a high level, and each showcase included time for questions.

Continuing with the return to in-person *INFORMS* events, from April 3-5, more than 750 fellow industry and academic experts will gather in person in Houston, Texas, for the 2022 *INFORMS Business Analytics Conference* (<http://meetings.informs.org/wordpress/analytics2022/>). There will be more than 100 engaging talks featuring carefully honed best practices and real-world case studies that highlight how *OR*, data science and *advanced analytics* professionals are empowering organizations to make data-driven decisions.

The 2022 *Business Analytics Conference* will also be a vaccine-mandated event, as will all *INFORMS* meetings in 2022. *INFORMS* will continue to follow the guidance of the CDC and WHO regarding large events.

The opening keynote session, sponsored by the *INFORMS Roundtable*, will feature *Talithia Williams*. A host of the PBS series, *“NOVA Wonders”*, *Williams* is a groundbreaking professor, popular TED speaker, inspiring author, passionate STEM/STEAM advocate, associate dean for research and experiential learning, and associate professor at Harvey Mudd College, where she develops statistical models emphasizing the spatial-temporal structure of data and applies them to real-world problems.

Another keynote session, sponsored by the *INFORMS Analytics Society*, will feature *Russell Allgor*, chief scientist of Amazon’s Worldwide Operations and Logistics organization, and *INFORMS Fellow 2021*. His team utilizes scientific innovation and invention to support the more than 1 million Amazon employees and partners at fulfillment centers, sortation centers and delivery stations worldwide, who ensure that customers get their packages as reliably and safely as possible.

The winner of the prestigious 2022 *Edelman Award Competition* will deliver a reprise of their presentation during the *Business Analytics Conference*. The winner is chosen annually from among 6 finalist teams. Since the award’s inception, finalist teams have yielded cumulative benefits totaling \$336 billion - a testament to the impact of advanced analytics and *OR*.

Conference track sessions will feature relevant topics and quality speakers carefully selected by the organizing committee. The collection of conference tracks includes emerging analytics, life sciences, revenue management and pricing, decision and risk analytics and supply chain. New this year is a track on *cyber-analytics*.

During the *Business Analytics Conference*, winners of several prestigious awards honoring those who practice and teach analytics, data science, operations research or management science will be selected. Finalist presentations not only demonstrate what is possible, but will also inspire you to pursue similar achievements. Among these awards are the



▲ In-person attendees at the 2021 Annual Meeting listened to live presentations from plenary and keynote speakers.


Franz Edelman Award Competition, the “*Super Bowl of OR and analytics*”; the *UPS George D. Smith Prize*, created in the spirit of strengthening ties between industry and schools of higher education; the *Innovative Applications in Analytics Award*, promoting the creative combination of analytics techniques in innovative applications to provide novel insights and create economic or social value.

COVID-19 resulted in 2 consecutive *Virtual Business Analytics Conferences*, which created some barriers to staying connected with former colleagues and peers, and made it difficult to meet and connect with new ones. The schedule for the in-person 2022 *Business Analytics Conference* includes ample opportunities for attendees to (safely) connect during receptions and meals. The conference also includes a *Career Fair* with different activities taking place each day of the conference, providing employees and employers with an opportunity to make productive connections. Last, but not least, the exhibit hall provides attendees with the opportunity to browse the latest technological offerings and speak with top solutions providers.



▲ 2022 *INFORMS Business Analytics Conference* will be the first in-person *Analytics Conference* since the start of the COVID-19.

This conference provides numerous additional opportunities, including the following:

- *Executive Forum*: An exclusive gathering for senior executives and managers that provides a special opportunity to network with colleagues and discuss important issues in *analytics*.
- *Early Career Professionals’ Network*: A group designed to help recent graduates, soon-to-be graduates or anyone entering the field of *OR-analytics* to build their professional networks and learn the practicalities of working in the field from experienced practitioners.
- *Meeting of Analytics Program Directors*: Designed to provide program directors of analytics programs with a forum for discussion, networking and the sharing of best practices. 

In addition to the *OR/MS Today* team and the author *Erick Wikum* who is the 2022 *INFORMS Business Analytics Conference Chair*, we cordially thank dear *Ashley Kilgore*, for communication and help to make this composed reprint and preprint possible. *G.-W. Weber*

Machine Learning NeEDS Mathematical Optimization and NeEDS has more News for you in 2021 and 2022

Emilio Carrizosa <ecarrizosa@us.es> **Dolores Romero Morales** <drm.eco@cbs.dk>
Kseniia Kurishchenko <kk.eco@cbs.dk> **Cristina Molero-Río** <mmolero@us.es>

The Online Seminar Series “Machine Learning NeEDS Mathematical Optimization” is 100% virtual and takes place on Mondays. After a successful start of three months, the series continued running from April through December 2021. The full program for this period is given below. The presentations covered important topics such as enhancing the transparency of black box Machine Learning models through counterfactual explanations, the impact of AI in medical diagnosis, the use of Machine Learning to enhance Mathematical Optimization solvers, as well as some of the latest Mathematical Optimization contributions to train state-of-the-art Machine Learning models such as Optimal Classification and Regression Trees and Deep Learning. Session 3 will start in February 2022 and will run until May.



2021 KPIs of the Online Seminar Series “NeEDS”:

- 44 speakers from 15 countries
- up to 250 weekly attendees
- > 1000 people from > 80 countries subscribed to the mailing list to receive weekly updates
- > 5000 views on NeEDS YouTube Channel
- > 3500 views on IMUS YouTube Channel

▲ Poster of the Online Seminar Series “Machine Learning NeEDS Mathematical Optimization”.

Economics of Copenhagen Business School,
 Cristina Molero-Río, PhD student at IMUS-Instituto de Matemáticas de la Universidad de Sevilla.

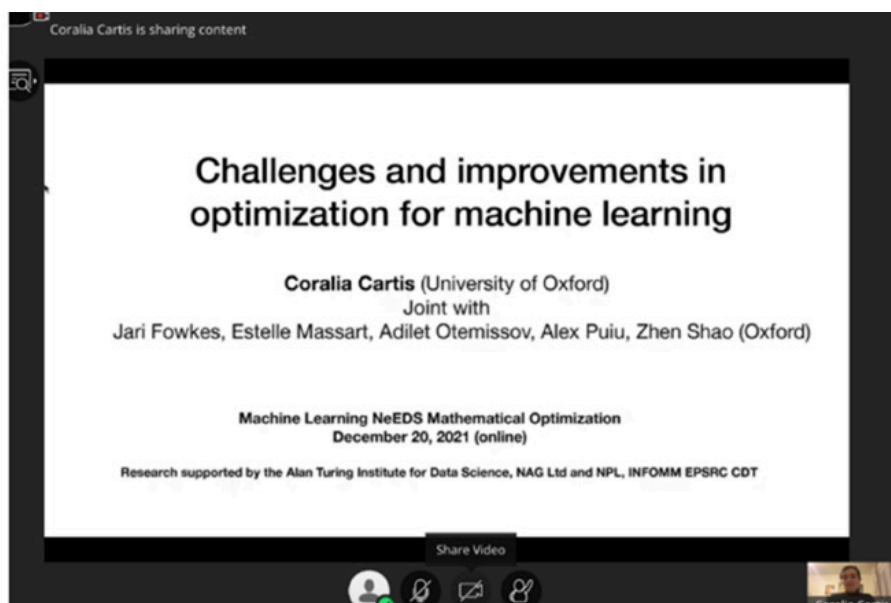
The Online Seminar Series has been widely advertised by *EURO*, *ALIO*, and *IFORS*, and this support is highly appreciated by the organizers:

Prof. Emilio Carrizosa, IMUS-Instituto de Matemáticas de la Universidad de Sevilla,
 Prof. Dolores Romero Morales, Department of Economics of Copenhagen Business School,
 Kseniia Kurishchenko, PhD student at Department of

Program of the Online Seminar Series “NeEDS Mathematical Optimization” (April-December 2021):

April 12, 2021: Prof Wolfgang Härdle (Humboldt-Universität zu Berlin, Germany) on “*Trespassing Random Forests with a pointed stick for self defence*”;

April 19, 2021: Prof Ruth Misener (Imperial College London, UK) on “*Partition-based formulations for mixed-integer optimization of trained ReLU neural networks*”;



▲ NeEDS 2021: Dr C. Cartis, University of Oxford, UK, talking on “Challenges and improvements in optimization for machine learning”.

April 26, 2021: Dr Phebe Vayanos (University of Southern California, USA) on “*Integer optimization for predictive and prescriptive analytics in high stakes domains*”;

May 3, 2021: Prof Laura Palagi (Sapienza University of Rome, Italy) on “*Block-and-Sample Decomposition in Deep Network Training*”;

May 10, 2021: Prof Antonio Frangioni (University of Pisa, Italy) on “*Optimize to learn to optimize: the Algorithm Configuration Problem*”;

May 17, 2021: YOUNG with Miren Jasone Ramírez Ayerbe (IMUS-Instituto de Matemáticas de la Universidad de Sevilla. Spain) on “*A unified approach to Counterfactual Explanations by means of Mathematical Optimization*”, >>

>> *Gabriele Iommazzo* (Institut Polytechnique de Paris, France) on *“Optimize to learn to optimize: getting down and dirty”*, and *Dr Victor Bucarey López* (Vrije Universiteit Brussel, Belgium) on *“End-to-end decision-focused learning over combinatorial problems”*;

May 23, 2021: Prof Dorit S. Hochbaum and Jon Bodine (University of California, Berkeley, USA) on *“The Max-Cut Decision Tree: Improving on the Accuracy and Running Time of Decision Trees and Random Forests”*;

June 7, 2021: Dr Stefan Wager (Stanford Graduate School of Business, USA) on *“Diffusion Asymptotics for Sequential Experiments”*;

September 20, 2021: Prof Leo Liberti (IX CNRS École Polytechnique, IPP, France) on *“Random Projections in Mathematical Programming”*;

October 4, 2021: YOUNG with M. Remedios Sillero-Denamiel (Trinity College Dublin, Ireland) on *“On linear regression models with hierarchical categorical variables”*, Manuel Navarro García (Universidad Carlos III de Madrid, Spain) on *“On a Mathematical Optimization approach to constrained smoothing and out-of-range prediction”*, and James Fitzpatrick (University College Dublin, Ireland) on *“Learning to Sparsifying Travelling Salesman Problem Instances”*;

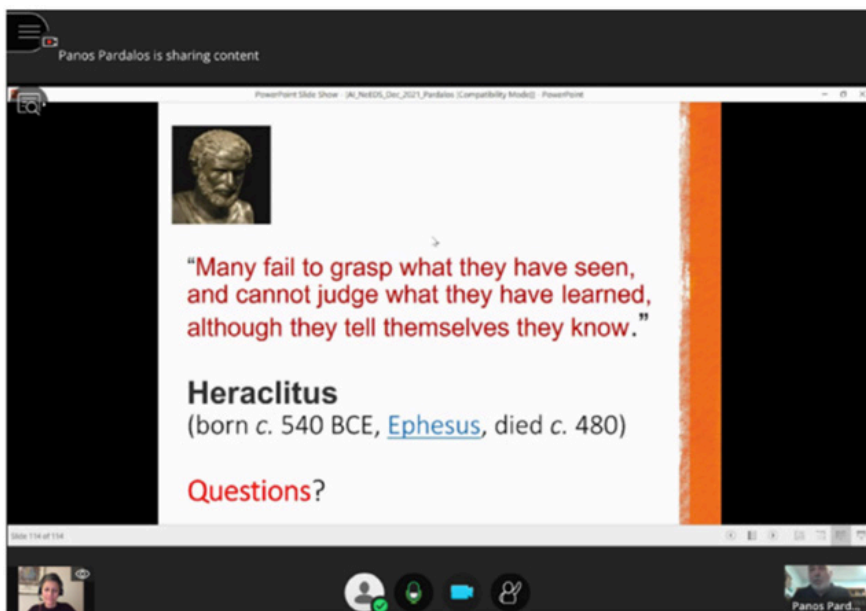
October 11, 2021: Dr Tias Guns (KU Leuven, Belgium) on *“Learning from user and environment in combinatorial optimisation”*;

October 18, 2021: Prof Thibaut Vidal (Polytechnique Montréal, Canada) on *“Optimal counterfactual explanations in tree ensembles”*;

November 1, 2021: Prof Andrea Lodi (Cornell University, USA) on *“Heuristics for Mixed-Integer Optimization through a Machine Learning Lens”*;

November 8, 2021: Prof Christina Pagel (University College London, UK) on *“Using location-allocation optimisation to support specialised children’s ambulance services in England and Wales”*;

November 15, 2021: YOUNG with Marcela Galvis Restrepo



▲ *NeEDS 2021: Prof P. Pardalos, University of Florida, USA, talking on “AI and the 5th Industrial Revolution”.*

(Copenhagen Business School, Denmark) on *“Improving the interpretability and fairness of (Generalized) linear models with categorical predictors”*, Dr Lavinia Amorosi (University of Rome Sapienza, Italy) on *“A Mathematical Programming Approach to Sparse Canonical Correlation Analysis”*, and Yujia Chen (University of Edinburgh, UK) on *“Effects of Imbalanced Datasets on Interpretable Machine Learning”*;

November 22, 2021: Prof Katya Scheinberg (Cornell University, USA) on *“Stochastic Oracles and Where to Find Them”*;

November 29, 2021: Prof Paula Brito (University of Porto, Portugal) on *“Bored by Simple Numbers? Discriminant Analysis of Distributional Data”*;

December 6, 2021: Prof Panos M. Pardalos (University of Florida, USA) on *“AI and the 5th Industrial Revolution”*;

December 13, 2021: YOUNG with Antonio M. Sudoso (University of Rome Tor Vergata, Italy) on *“SOS-SDP: an Exact Solver for Minimum Sum-of-Squares Clustering”*, and Dr Giorgio Grani (SINTEF Digital, Norway) on *“Job shop and the train dispatching via deep reinforcement learning”*;

December 20, 2021: Dr Coralia Cartis (University of Oxford, UK) on *“Challenges and improvements in optimization for machine learning”*. 🌐



▲ *YOUNG Online Seminar Series with junior speakers from Belgium, Denmark, France, Italy, Spain and UK.*

Building a community of practitioners: report back from “Sharing Experiences, Building Networks”

Ruth Kaufman <ruth.kaufman@btinternet.com>

In November 2021, the *EURO Working Group on Practice of OR/Practitioners' Forum* leapt into the unknown, by using meeting platform *gather.town* for a half-day event: EWGPOR | Gather (<https://gather.town/app/wAGsqYOsk876z1eR/EWGPOR>).

First, some background. The *EURO Working Group on Practice of OR* was established a few years ago, in order to develop networks and resources to support *OR practitioners*, especially those working outside academia who are often isolated from the wider *OR* community. We have always described ourselves as a forum for sharing experience, learning from each other, building networks and enjoying the opportunity to meet; so we were delighted when the *EURO* executive suggested we re-brand as a *Forum* rather than a Working Group.

Like everyone else, since the pandemic struck, we have pivoted to online: running a monthly ‘*First Friday*’ webinar, our third annual workshop in autumn 2020, and the three-day stream ‘*Making an Impact*’ at *EURO21*. But after nearly two years of pandemic, many people are beginning to disengage from standard one-way online platforms. Could *gather.town* restore enthusiasm?

If you have not yet experienced an event on *gather.town*, I’m afraid you’re not going to learn about it from this article, as I don’t have the words to describe it. What I *can* say is that it enables you to bump into and have chats with strangers, to seek out people you know and invite them into a corner for a private conversation, to participate in a breakout group whilst keeping an eye on everyone else in the meeting, or to sit quietly in a virtual auditorium listening to speakers. The visuals are a cross between 1970s *Space Invaders* and 2020s *Zoom*, thus making our whole age demographic feel equally at home (or lost).

Our event had three aims: to bring the *Practice of OR community* together; to provide opportunities to meet and share some of what is going in in the world of practice; and to launch the ‘*Practitioners' Forum*’. You might think that is a lot to squeeze into four hours, and you’d be right, especially since the organising team decided to cram in as many different types of session as we could think of: free mingling; a plenary talk with Q&A; structured speed networking; discussion groups; and a series of lightning talks. Admittedly, this may have been the cause of some chaos at some points in the proceedings, but it was great fun both to design and to participate in, with a buzz almost as tangible as with a physical meeting.

Our opening speaker, *Dick den Hertog*, spoke on *Analytics for a Better World: using OR to help achieve the Sustainable Development Goals*. *Dick* described the *Analytics for a Better World (ABW)* initiative, and two associated projects. The first was



▲ EWGPOR | *Gather 2021*: Reception area, with video island portal bottom right.

for the *World Food Programme* (a UN programme addressing chronic hunger), where the *OR* team combined nutritional and supply chain modelling to improve efficiency: for example in Syria enabling supply to 5 million people compared with 4 million the year before. The second is a current project, helping improve accessibility of health care in Timor Leste. Judging from the questions and the subsequent discussions later in the afternoon (see below), *Dick's* presentation was inspirational. More information about the initiative is here: *Analytics for a Better World | Working towards a better world with Analytics* (analyticsbw.org).

Next up, virtual speed networking tested to the full our ability to follow instructions, and enabled many of us to have conversations that we would never have otherwise considered, and discover common ground with people we had not known at the start of the day.

After a short break came the formal launch of the *Practitioners' Forum*. Technically, a *EURO Forum* is a different instrument from a *Working Group*. *Working Groups* generally aim to advance the discipline within a specific methodology or application area, such as combinatorial optimisation or transportation; whereas *Forums* aim to support people with a shared characteristic, across all methodologies and application areas. The first two forums established by *EURO* were *WISDOM (Women in Society Doing OR and MS)*, and *EUROYoung* (what it says on the tin).

In “supporting people” we are of course interested in promoting and improving *Practice of OR* and knowledge about *Practice of OR*; but in a way that helps practitioners, rather than for the sake of the discipline itself.

As part of the launch we split into breakout groups to review possible activities, for example joint events between the *Practitioners' Forum* and specialist *EURO Working Groups*, exploring areas of common interest on putting *OR* into action.>>

>> A more ambitious proposal was inspired by our plenary talk: to harness practitioner resources to support an ABW project. This is easier said than done, but there was genuine enthusiasm from representatives of a couple of large European OR groups, and we will hopefully be able to move this forward. If you would like to participate or keep in touch with progress, please contact us. A long list of other ideas is now being worked through by the Forum committee.

The event ended with six 5-minute 'lightning talks', showcasing the enormous variety of OR practice. Patrick Schittekat of SINTEF led the way, explaining how optimisation is improving coordination between Air Traffic Controllers and reducing delays. Next up, Yi (Joy) Kuo, from Decision Lab, described their work integrating simulation and reinforcement learning to overcome real-world problem features which prevent effective optimisation. Emily Curry, from the Rostering Optimization team at Boeing in Gothenburg, described how her team adapted crew rostering to meet the North American practice of giving priority to senior crews' preferences.

Next, Juan-Manuel Garcia-López of FICO discussed the use of scenarios combining OR and expert assessment to explore resilient supply chains in the face of disruptions such as – well, the list of possible disruptions could be longer than this article. Cicely Striolo of Copperleaf Technology discussed how her team used the 'six capitals' objective approach to enable UK water industry clients to constrain on specific performance targets during optimisation. And finally, Baris Cem Sal of Deutsche Post DHL, shared the story of how they built their team from scratch to 12 scientists and shifted the organizational mindset when it comes to Operational Research.

Collectively, these talks gave fascinating insights into different worlds with shared challenges of problem structuring, communicating and implementation.

The afternoon as a whole was wonderfully collaborative and interactive, with a stimulating and friendly atmosphere which did, as we had hoped, come close to the experience of a physical workshop.



▲ EWGPOR | Gather 2021: Through the portal to Video Island.

Like our previous physical workshops, the event was not recorded. Much of the value of our events is in the ability to speak freely, confidentially, about things that have gone wrong as well as things that have gone right, and to ask questions and have discussions without worrying about anyone who is not in the room. So, you really do have to be there. If you're interested in the Practitioners' Forum, I hope that next time we meet up, you will be!

Practical information: Practitioners' Forum members are a mix of in-house practitioners, commercial consultants, and academics interested in the practical end of OR. To join, and/or to access all the recordings referred to here: <https://www.euro-online.org/websites/or-in-practice/>.

First Friday webinar: <https://www.eventbrite.co.uk/o/euro-working-group-on-practice-of-or-30568884730> and the new webinar blog, with links to all recordings: <https://practiceofor.wordpress.com/home/>.

Future events:

Online: 4 February, 10am CET, ZoRo: Human-centric Routing for the last mile, Baris Cem Sal, Deutsche Post DHL;
Physical, COVID-19 permitting: 3-6 July: Making an Impact at EURO 2022. 🌐

The Impact of Online Growth: EWG on Retail Ops' focus on Omnichannel Operations at 4th Digital Meeting

Alexander Hübner <Alexander.Huebner@tum.de> Frederik Eng Larsson <fredrik.englarsson@sbs.su.se>

The purpose of the EURO Working Group on Retail Operations (denoted as EWG on Retail Ops; <http://www.ewg-retail-ops.eu>) is to advance the development and application of Operational Research (OR) methods, techniques, and tools in the field of Retail Operations. The 4th digital meeting of the EWG Retail Ops took place on December 4, 2021, with around 60 participants, from the US, Asia and Europe. It was organized by Frederik Eng Larsson (Stockholm University, Sweden) and Alexander Hübner (Technical University of Munich, Germany).

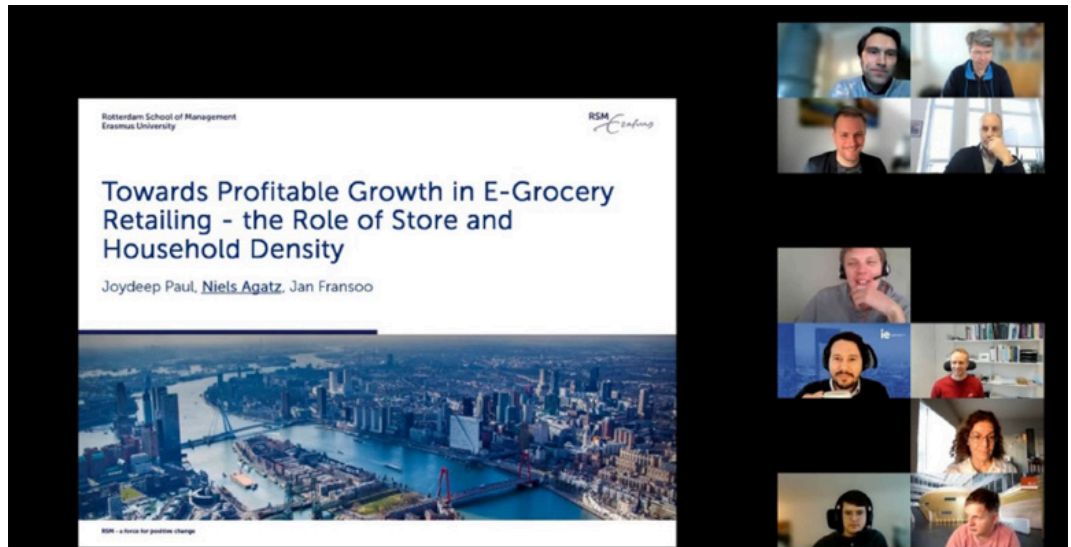
Retailing is a large and growing sector of the economy in most countries, both developing and developed. It is a dynamic

sector in which changes in markets, firms, and products occur rapidly. In particular, the past few years have seen one of the biggest disruptions ever. This is driven by the massive growth on online business. The COVID-19 pandemic has further accelerated this development. In this setting, retailers are themselves enabling a seamless shopping experience across channels and applying new technologies and approaches to serve customers. For example, a seamless shopping experience across online and bricks-and-mortar channels requires setting up fulfillment options for "buy online and pickup in store" and "buying instore and getting home delivery". >>

>> Another example is the impact of digitalization and data availability on decision making. During store visits, customers are collecting information not only based on the offers in the shelves, but also using mobile devices to compare prices, alternative offers of competitors or of the retailer in the webshop. Omni-channel retailing and digitalization result in considerable challenges for the management and optimization of retail operations. It raises many new challenges and research opportunities for the OR community, which were discussed at the meeting. The workshop was composed of four invited presentations.

Niels Agatz from Rotterdam School of Management (the Netherlands) gave the first presentation on *“Towards Profitable Growth in E-Grocery Retailing - the Role of Store and Household Density Authors”*. Despite the continued growth of e-grocery sales, few companies actually make any profits in this retail segment. The results of his studies indicates that e-grocery may become profitable when household density is high and store density is low.

This was followed by Robert Rooderkerk from Rotterdam School of Management (the Netherlands), who talked about *“The Value of Experience-Centric Stores in Omnichannel Retail”*. He showed that the COVID pandemic has accelerated a trend of store closures across many retail sectors such as consumer electronics and apparels. At the same time, online-first retailers, such as Amazon and Alibaba, continue to open more brick-and-mortar stores. Robert Rooderkerk analyzed the value of a store in an omnichannel context of



▲ 4th Digital Meeting on Retail Ops: invited lecture by Niels Agatz.

an consumer electronics retailer.

Frederik Eng Larsson from Stockholm University (Sweden) gave a presentation on *“Home delivery, in-store pick-up, or something in between? Customer preferences for fulfillment methods in omnichannel retail”*. Although the number and types of omnichannel fulfillment methods have proliferated over the last years, many retailers struggle with which capabilities to invest in, and for which stores to make which type of investments. Frederik Eng Larsson showed that an important input to these decisions is understanding how customers value the price and the service elements of different fulfillment solutions.

Finally, Peter Berling from Lund University (Sweden) presented his topic on *“Controlling Inventories in Multi-Channel Distribution Systems with Channel specific service-constraints”*. His presentation addresses the omnichannel challenge of service differentiation across channels when upstream central warehouses satisfy both direct customer demand and replenishment orders from downstream retailers. Motivated by industry collaboration, his study

addresses this issue by developing a combined stock method for control of multi-channel one-warehouse-multiple-retailer inventory systems with direct customer demand at the central warehouse.

Subsequently, all participants had a lively discussion with the audience in order to elaborate on tools and techniques for an enhancement of omnichannel operations. 🌐



▲ 4th Digital Meeting on Retail Ops: online growth and omnichannel operations.

The Synergy of OR Theory and Practice - SYM-OP-IS 2021 in beautiful Banja Koviljača, Serbia On-site and Online

Zorica Stanimirović <zoricast@matf.bg.ac.rs>

Faculty of Mathematics at University of Belgrade and Mathematical Institute of the Serbian Academy of Sciences and Arts, in cooperation with other higher education and research institutions, as well as several scientific societies, organized XLVIII Symposium on Operational Research - SYM-OP-IS 2021 (www.symopis2021.matf.bg.ac.rs). The symposium took place in Hotel "Royal Spa" in Banja Koviljača, one of the most beautiful spas in Serbia, during September, 20-23, 2021.

SYM-OP-IS is an International Symposium that has been organized since 1974. It presents an annual gathering of OR researchers, both theoreticians and practitioners, in order to exchange scientific and technical information, convey experiences and present new results achieved in the development and application of OR methods. The conference topics include 29 thematic areas, including combinatorial optimization, game theory, graphs and networks, heuristics, mathematical programming, logistics and supply chain management, OR in civil engineering, OR in military defense, OR software, etc.

Initially, 128 papers and abstract was submitted to SYM-OP-IS 2021 conference, which is a respectable number having in mind COVID-19 circumstances. The Program Committee of SYM-OP-



▲ SYM-OP-IS 2021: Plenary Lecture by Prof. Nenad Mladenović. A special session on VNS was dedicated to him, since he celebrated his 70th birthday and 45 years of research work in 2021.

IS 2021, led by co-chairs Prof. Milan Dražić from Faculty of Mathematics-University of Belgrade, and Prof. Dragan Urošević from Mathematical Institute, coordinated the reviewing process of submissions. After revision, 106 papers and 11 abstracts were accepted for presentation and publishing in Conference Proceedings. The accepted papers and abstracts were divided in 18 sections which were held in 4 conference days. Various sections ensured a valuable mixture of theoretical and practical aspects of OR. A special section on the VNS (Variable Neighborhood Search) method and its applications was dedicated to Prof. Nenad Mladenovic celebrating his 70th birthday and 45 years of research work.

Due to the global COVID-19 situation, most of the conferences in the past 2 years were held online. But the Organizing Committee of SYM-OP-IS 2021, chaired by Prof. Zorica Stanimirović from Faculty of Mathematics, University of Belgrade, put significant effort to enable a hybrid format of the conference. As the result, a large number of participants from Serbia (over 80) was physically present at the conference site, attending the lectures or giving their presentation in sections. As it was expected, the majority of participants from abroad used the possibility to join the conference and give presentation online. In total 89 out of accepted 117 papers or abstracts were presented, which is around 76% of the planned talks. Among them, 56 presentations were given on-site, while 33 were held online.



▲ SYM-OP-IS 2021: The team of leaders (from left to right): Prof. Dragan Urošević (PC Co-chair), Prof. Zorica Stanimirović (OC Chair, and PC member), and Prof. Milan Dražić (PC Co-chair).



▲ *SYM-OP-IS 2021*: Participants visiting in front of the famous spring “*Devet Jugovića*” nearby *Monastery Tronoša*.

This year, we had 3 eminent OR researchers as invited speakers, who gave interesting and valuable talks. *Prof. Natasha Shakhlevich Chakhlevitch* (School of Computing, University of Leeds, UK) gave a lecture entitled “*Optimization under Uncertainty: a New Take on an Old Problem*”. The title of the talk of *Prof. Nikolaos Matsatsinis* (School of Production Engineering and Management, Technical University of Crete, Greece) was “*Intelligent Multi-Criteria Decision Support Systems and their Applications*”. *Prof. Nenad Mladenović* (Department of Industrial and Systems Engineering, at Khalifa University, Abu Dhabi, UAE) presented recently proposed philosophy for heuristic design “*Less is more approach in Optimization - possible road to Artificial Intelligence*”.

All accepted papers and abstract were published in the *Proceedings of the XLVIII International Symposium on Operational Research* (editors: *D. Urošević, M. Dražić* and *Z. Stanimirović*) by Faculty of Mathematics, University of Belgrade, ISBN 978-86-7589-151-2, pp. 1-706. The proceedings of *SYM-OP-IS 2021* contain 117 works, which means a significant

increase compared to *SYM-OP-IS 2020*, and comes very close to the number of *SYM-OP-IS* papers in the period before the pandemic. An electronic version of all accepted papers of *SYM-OP-IS 2021* is available at <http://www.symopis2021.matf.bg.ac.rs/index.php?page=publications>. Selected papers will have the opportunity to be published in *Special Issues* of the following journals: *Yugoslav Journal of Operations Research, YUJOR* (<http://yujor.fon.bg.ac.rs/index.php/yujor>), *International Journal for Traffic and Transport Engineering, IJTTE* (<http://ijtte.com/>), and *Military Technical Courier* (<http://www.vtg.mod.gov.rs/>).

This year’s winner of the traditional *SYMOPIS Charter* is *Prof. Dragan Urošević* from Mathematical Institute SANU. The *Charter* is established in 1983, and it is awarded in recognition of researcher’s achievements for the development of OR in Serbia. The winners of the *Charter* are distinguished researchers who have raised the reputation of this scientific discipline both domestically and internationally. The evaluation is based on pedagogical, scientific, practical and organizational contributions by the proposed candidates.



▲ *SYM-OP-IS 2021*: a great opportunity to see colleagues and friends after a long time, like here during a break between sessions.

At the end we may conclude that *SYM-OP-IS 2021* achieved its planned goals: improving the theory and practice of OR, computer science, management and related disciplines, providing a forum for discussion of the modern OR topics, and exchanging the latest information, ideas and innovative solutions in the fields of OR and its applications. Through successfully held working sections, as well as social events, *SYM-OP-IS 2021* brought together the domestic and international academic and scientific public, representatives of the corporate, public and non-governmental sectors, as well as undergraduate, master and PhD students in various fields of OR. 🌐

New Australian Workshop WICO 2021 - Cross-Disciplinary, OR Connections with Computation and Optimisation, Online

Lindon Roberts <lindon.roberts@anu.edu.au>

The Mathematical Sciences Institute of the Australian National University was pleased to host the inaugural *Workshop on the Intersections of Computation and Optimisation (WICO)*, from 22 to 25 November 2021. Although we had originally hoped to welcome participants to Canberra, ongoing travel restrictions meant that the workshop was held entirely online.

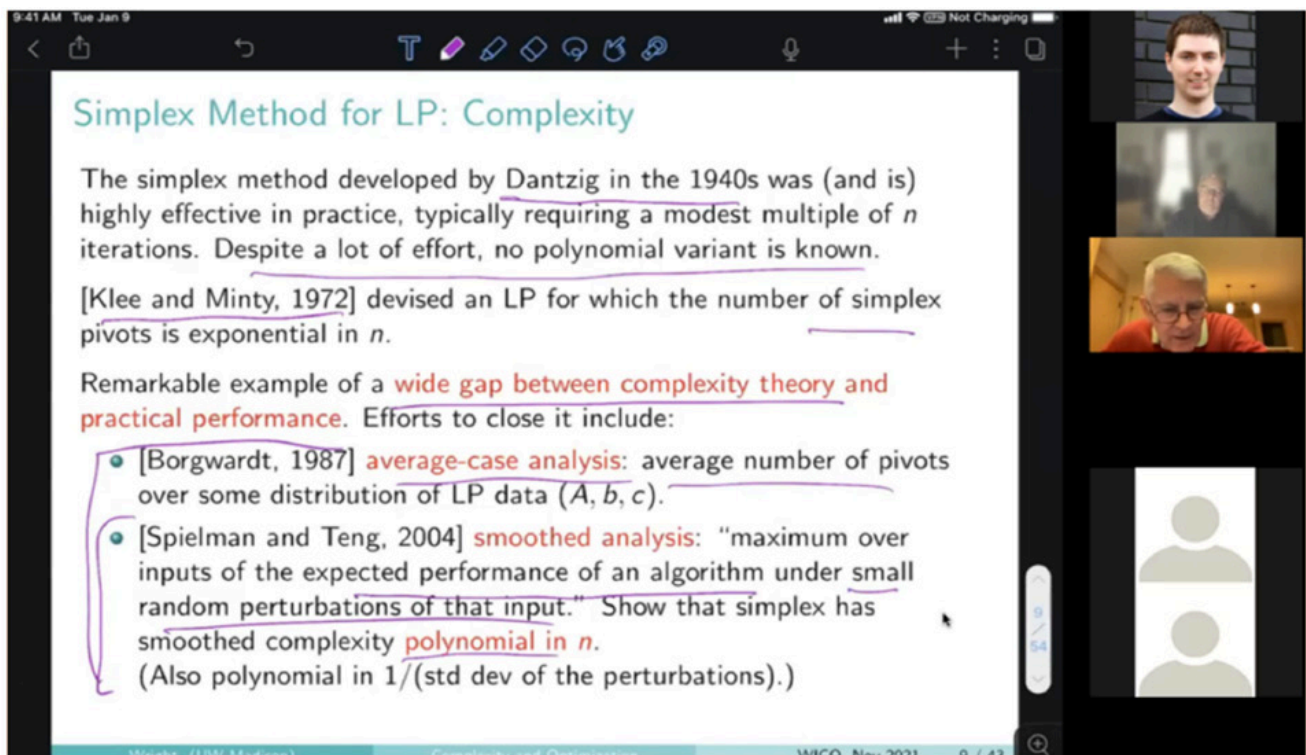
WICO is a new initiative of the *Mathematics of Computation and Optimisation (MoCaO)* special interest group of the Australian Mathematical Society. Its aim was to bring together researchers from the areas of computation, optimization, operations research, computing sciences and engineering interested in the cross-fertilization of ideas. In the end, we had over 100 participants from 23 countries.

This is an important collection of fields, where closer collaboration could be very beneficial. *Operational Research* heavily relies on techniques from both optimization and computational mathematics. Furthermore, efficient optimization methods are heavily reliant on sophisticated ideas in computational mathematics. So, *MoCaO's* aim was to bring together researchers in these fields to spark new ideas, informing future progress in optimization, Operational Research, and many other areas.

We were privileged to have keynote presentations on a wide array of topics:

- “Acoustic optimization: surprises and challenges” by Martin Berggren (Umeå University, Sweden),
- “High Dimensional Integration and Approximation: The Quasi-Monte Carlo (QMC) Way” by Frances Y. Kuo (UNSW Sydney, Australia),
- “From ESPRIT to ESPIRA: Estimation of Signal Parameters by Iterative Rational Approximation” by Gerlind Plonka-Hoch (University of Göttingen, Germany),
- “Global convergence and linear rate of descent methods: a bundle-like view” by Claudia Sagastizábal (IMECC-Unicamp and CEMEAI, Brazil),
- “Modelling anomalous diffusion in lignocellulosic biomaterials using a fractional subdiffusion equation” by Ian Turner (Queensland University of Technology, Australia),
- “Exploiting Structure in Derivative-Free Nonlinear Optimization to Advance Science and Engineering” by Stefan M. Wild (Argonne National Laboratory, USA),
- “Optimization in Theory and Practice” by Stephen J. Wright (University of Wisconsin-Madison, USA).

To spark more informal and collaborative interactions, we were grateful that our keynote speakers were able to participate in extensive post-talk discussions of up to 1 hour. This was an interesting approach that gave us more time to think about the connections between different ideas and to learn more about unfamiliar topics.



▲ WICO 2021: Stephen J. Wright (University of Wisconsin-Madison, USA) discussing the history of complexity theory for linear programming during his keynote presentation “Optimization in Theory and Practice”. Pictured (top to bottom): Lindon Roberts, Andrew Eberhard and Stephen J. Wright.

We benefited from 22 contributed talks on a wide variety of topics, from optimization theory and numerical analysis to diverse applications including data science, signal processing, climate and transport. Throughout the week we also had time to informally collaborate on three open problems suggested by participants, covering linear programming, stabilisation of numerical PDE schemes, PDE-constrained optimization for plasma physics. Of particular interest to the OR community, we collaborated on an open problem about formulating and solving structured linear programs, and had talks covering areas such as complexity of linear programming, studying the structure of convex sets and projective varieties, algorithms for feasibility problems, and applications such as road trajectory optimization and electric vehicle route optimization.

Signal model and reconstruction problem

Consider

$$f(t) = \sum_{j=1}^M \gamma_j e^{\phi_j t} = \sum_{j=1}^M \gamma_j z_j^t \quad \gamma_j \in \mathbb{C} \setminus \{0\},$$

with $z_j = e^{\phi_j} \in \mathbb{C} \setminus \{0\}$, $j = 1, \dots, M$, pairwise distinct.

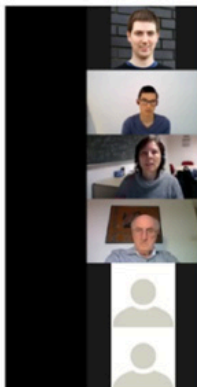
Problem: How to reconstruct the parameters determining $f(t)$,

$$M \geq 1, \quad \gamma_j, z_j \in \mathbb{C} \setminus \{0\},$$

from a finite number of equidistant function values

$$f_\ell = f(\ell), \quad \ell = 0, \dots, 2N - 1?$$

Gerlind Plonka (University of Göttingen) From ESPRIT to ESPIRA WICO 2021, ANU, Canberra 5 / 31



▲ *WICO 2021: Gerlind Plonka-Hoch (University of Göttingen, Germany) discussing algorithms for reconstructing a periodic signal from equally spaced observations during her keynote presentation "From ESPRIT to ESPIRA: Estimation of Signal Parameters by Iterative Rational Approximation". Pictured (top to bottom): Lindon Roberts, Matthew Tam, Gerlind Plonka-Hoch and Ian Sloan.*

We are grateful to ANU, MoCaO and the Australian Mathematical Society for providing financial support for this event, and the MoCaO executive for their assistance getting *WICO* off the ground. We are already looking forward to the next workshop! 🌐

News from the EURO WISDOM Forum: Winter Event 2021 and the finalists of the YoungWomen4OR initiative



Paula Carroll <paula.carroll@ucd.ie> **Annunziata Esposito Amideo** <annunziata.espositoamideo@ucd.ie>
Tatiana Tchemisova <tatiana@ua.pt> **Ozgen Karaer** <okaraer@metu.edu.tr>

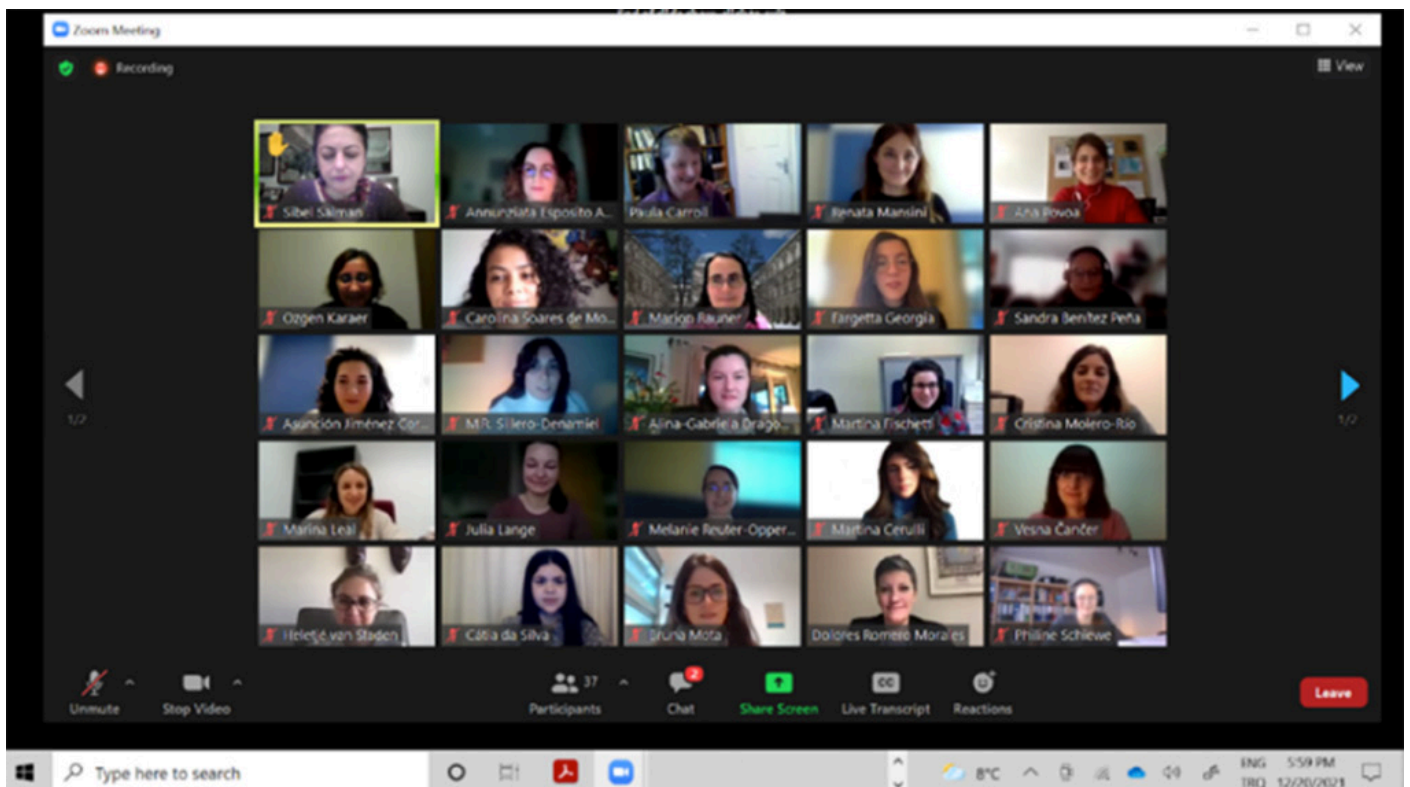
The *EURO WISDOM Forum (Women In Society: Doing Operational Research and Management Science)* was launched in January 2020 and since that time is actively working on promoting gender equality in OR. Here we present the most important events from WISDOM in December 2021.

WISDOM Winter Event 2021

The *EURO WISDOM Forum Winter Event 2021* was successfully held on December 20th, 2021. The webinar started with introductions and a few words about webinar etiquette by *Dr Paula Carroll*, *EURO WISDOM Forum Chair*, while next on the agenda was a farewell to the *YoungWomen4OR 2020-21* and a welcome speech for the *YoungWomen4OR 2021-22*. >>



▲ *YoungWomen4OR 2021-22 awardees.*



▲ Screenshot from the *WISDOM Winter event 2021*.

>> The *WISDOM* activities were reported afterwards, by *Dr Paula Carroll* on behalf of the *WISDOM* Research Subcommittee, *Prof Renata Mansini* on behalf of the *WISDOM* Events Subcommittee and *Assist. Prof Özgen Karaer* on behalf of the *WISDOM* PR Subcommittee. The event closed with an open discussion and closing remarks by *Dr Paula Carroll*.

The results of the YoungWomen4OR initiative

To support and motivate more active participation of young women in *OR*, *WISDOM* launched an initiative in 2021 called *YoungWomen4OR*. This initiative aims to introduce to our community emerging young women working in *OR*, either in academia or industry. Every year, the *WISDOM* Forum will promote the selected young women by spotlighting their work through *EURO* channels and providing networking and mentoring opportunities.

The 2021 call received over 20 applications from 13 different countries from both young women Early Researchers and last year PhD students. Twelve young women from seven countries were selected, eight of them Early Career and four in the last year of their PhD studies, who are working in a set of diverse areas within *OR*.

The names of the *twelve awardees* were announced during the *WISDOM* Winter event 2021 (they are also available in the figure below) and are as follows:

- o *Asunción Jiménez-Cordero*, University of Malaga, Spain,
- o *Carolina Soares de Moraes*, IST, University of Lisbon, Portugal,
- o *Cristina Molero-Rio*, University of Seville, Spain,
- o *Georgia Fargetta*, University of Catania, Italy,
- o *Julia Lange*, University of Kaiserslautern, Germany,
- o *Layla Martin*, Eindhoven University of Technology, Netherlands,

- o *Lorena Silvana Reyes Rubiano*, Otto von Guericke University Magdeburg, Germany,
- o *M Remedios Sillero-Denamiel*, Trinity College Dublin, Ireland,
- o *Marina Leal*, Universidad Miguel Hernandez, Spain,
- o *Martina Cerulli*, LIX - CNRS, Ecole Polytechnique, France,
- o *Philine Schiewe*, Technical University Kaiserslautern, Germany,
- o *Sandra-Benitez-Pena*, Universidad Carlos III de Madrid, Spain.

WISDOM plans for 2022

In 2022, *WISDOM* plans to continue its active work in research on specifying gender equality research questions of interest to, or answerable by the broadest definition of the *OR* discipline, identifying and gathering data sources in line with all GDPR and relevant ethics guidelines, and identifying academic and other publication opportunities.

The main events planned for 2022

EURO 2022

WISDOM will participate in the 32nd *European Conference on Operational Research* on 3-6 July 2022 organized at Aalto University, Espoo, Finland. During *EURO 2022*, *WISDOM* plans to organize special sessions for the *YoungWomen4OR* initiative, and a tutorial on understanding gender dimensions in *OR*. More details are available on the conference website <https://euro2022espoo.com/>.

WISDOM Webinars

Linking the *YoungWomen4OR* with subject matter experts in the *OR* community, we plan to hold a series of webinar. You can find more information on our website at <https://www.euro-online.org/web/pages/1654/wisdom>, and can support the *WISDOM* initiative by becoming an ordinary member. 🌐

IFORS' newest journal, Sustainability Analytics and Modeling (SAM), is one year old! Building on the Brundtland Commission 1987 report titled, 'Our Common Future,' where the expression sustainable development was defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs, this journal contributes through mathematical modeling, optimization, data analytics and other quantitative methods, to this battle for sustainable development of our planet. The challenges to our planet are numerous and relate to poverty, hunger, health, well-being, education, equality, access to clean water, sanitation, energy, economies, industry, infrastructure systems, consumption and production, climate, peace, and justice, among other topics, all of which are targeted by the sustainable development goals (SDGs) of the United Nations (<https://sdgs.un.org/goals>). The journal aims to contribute to tackling these challenges through the publication of quantitative studies that create deeper understanding of the mechanisms of their cause, provide situational awareness or future predictions, uncover interconnections and their role in creating the problem, and develop potential solutions.


The journal has already had an impact across varied challenge areas through its publications. The journal's articles tackle issues ranging from protecting rare species through wildlife corridors, reducing industrial energy consumption, and proposing measures to support sustainability in healthcare, among others. While varied in their application, at the core of these works is a reliance on techniques from operations research and data analytics in creating their impact.

The journal welcomes your submissions: <https://www.journals.elsevier.com/sustainability-analytics-and-modeling>. The journal is open access. The Article Publishing Charge fee will be covered by IFORS for articles submitted by 31st

December 2022. The journal has calls for publications in three areas, with more coming soon: (1) Sustainability in Retail Supply Chains: Making a Better World in Retailing from Sourcing to Consumption; (2) Low Carbon Cities and Urban Energy Systems; and (3) Frontier Methods for Sustainability Challenges.



The journal is led by Editor-in-Chief Elise Miller-Hooks, Associated Editors Sibel Salman, Majid Sarvi and Vedat Verter, and 29 additional editorial board members (Fabrizio Ascione, Burcu Balcik, Vedat Bayram, Cynthia Chen, Lauren Gardner, Caitlin Grady, Shabtai Isaac, Hans Ittmann, Gulgun Kayakutlu, Pramod Khargonekar, Amy Kim, Jairo Montoya-Torres, Pedro Munari, Shmuel Oren, Debjit Roy, Guvenc Sahin, Joseph Sarkis, Amir Sharif, Sheetal Silal, M. Grazia Speranza, Mersedeh Tariverdi, Valerie Thomas, Satish Ukkusuri, Halit Uster, Luk Van Wassenhove, Gerhard-Wilhelm Weber, Prashant Yadav and Haoran Zhang), together from 14 different nations of six of the world's seven continents. Board members have expertise chosen to cover six main categories: (1) climate & disaster risk management; (2) health, nutrition, sanitation & water; (3) infrastructure systems & smart cities and communities; (4) economies, industry & consumption and production; (5) well being, poverty & equality; and (6) peace, justice & equity.

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“Partitional Clustering via Nonsmooth Optimization - Clustering via Optimization” by Adil M. Bagirov, Napsu Karmitsa, Sona Taheri

Unsupervised and Semi-Supervised Learning
Springer Nature Switzerland AG, Cham, Switzerland, 2020,
ISSN 2522-848X, ISSN 2522-8498 (electronic),
ISBN 978-3-030-37825-7, ISBN 978-3-030-37826-4
(eBook), <https://doi.org/10.1007/978-3-030-37826-4>

OR-Analytics for Tomorrow

Gerhard-Wilhelm Weber <gerhard-wilhelm.weber@put.poznan.pl>
Marta Kanczorzewska <marta.kanczorzewska@put.poznan.pl>



▲ Coauthors on clustering-analytics (from left to right): Adil M. Bagirov, Napsu Karmitsa and Sona Taheri.

Organizing objects in a datasets into clusters based on their similarities is the main challenge and purpose of cluster analysis. It is among the most important tasks in *OR-analytics*, data science, and deep, machine or statistical learning. *Clustering* also comes along with names like automatic data classification, numerical taxonomy and unsupervised data classification. It occurs in business and management, economics and banking, science and engineering, social and environmental sciences, and extends into the arts, artificial intelligence, biology, chemometrics, cybersecurity, ecology, medicine, neuroscience, etc. In general, unlabeled data are considered where objects in a cluster should be similar to each other inside, but dissimilar to the objects outside of the cluster.

All clustering algorithms involve some process for measuring the similarity among the data. If there are only numeric attributes, different norms can be used to define the *similarity measure*, in general, a Minkowski norm. Then a clustering problems can be written as a global *optimization problems*, but not every such a norm leads to efficiently tractable problems. The authors prefer *squared Euclidean norm* as well as the L_1 - and L_∞ -norms.

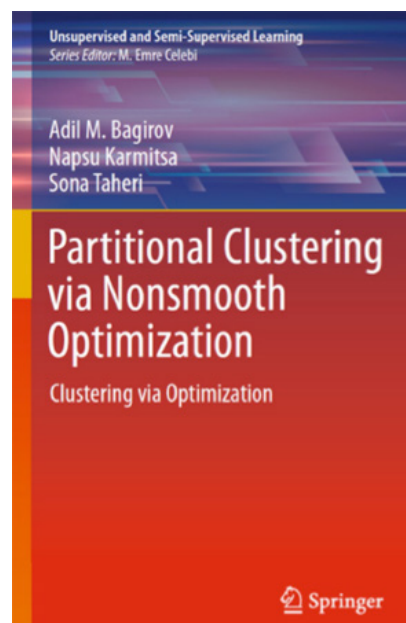
Pioneers of clustering algorithms were *Steinhaus, Lloyd, Ball and Hall and MacQueen* (during 1956-1967); ever since, cluster analysis strongly emerged. Numerous techniques have been developed to solve clustering problems. The book authors concentrate on optimization, especially nonsmooth optimization. They particularly acknowledge *Alexander Rubinov* (1940-2006) with whom coauthor *A.M. Bagirov* collaborated on the subject of this book. Together with their respected colleagues at University of Ballarat, now Federation University, they built a strong research school on optimization and informatics which became a leading *OR* research center.

For all of those reasons we may call cluster analysis as *cluster*

analytics. It is of a great promise in all sciences and many applications. We give the examples of *gene-environment* or, more generally, *target-environment networks* which rely on data from biology or chemistry, ecology or economics, psychology or social sciences. Sophisticated regulatory models offer a deeper understanding of unknown or hidden functional relationships between genetic and environmental factors, while various kinds of uncertainty can arise and interfere with the system's evolution. There are polyhedral, ellipsoidal, fuzzy, linguistic, stochastic or semialgebraic networks. Clustering methods for network pruning in large control or regulatory systems, which lead to mixed-integer and continuous programming programs, serve to reduce complexity.

Among the various areas of these networks is neuroscience, a multidisciplinary science concerned with the study of the structure and functions of our and vertebrate nervous systems. It consists of physiological, cellular, molecular-biological, behavioral and cognitive aspects. Novel optogenetic, vitro and in vivo multielectrode recording, brain and neuroimaging provide high-quality big-data. This fast growing pool of data triggers the development of models which can provide a new understanding of the nervous system at various scales, from molecular biology to the organizational principles of behavior and cognition. Sophisticated analyses of intracellular signaling or dynamics in heterogeneous neural networks, conditional behavior or connections of brain regions in decision-making lead to theoretical problems which are now approached with *OR*. *Clustering analytics* is at the beginning and remains at the core of the most advanced methods.

This book is very well suited for everyone who learns and investigates cluster analysis, as for practitioners and researchers interested in its *OR*- and optimization-based approaches. This can also be a hand- or reference book for experts of *clustering analytics*.

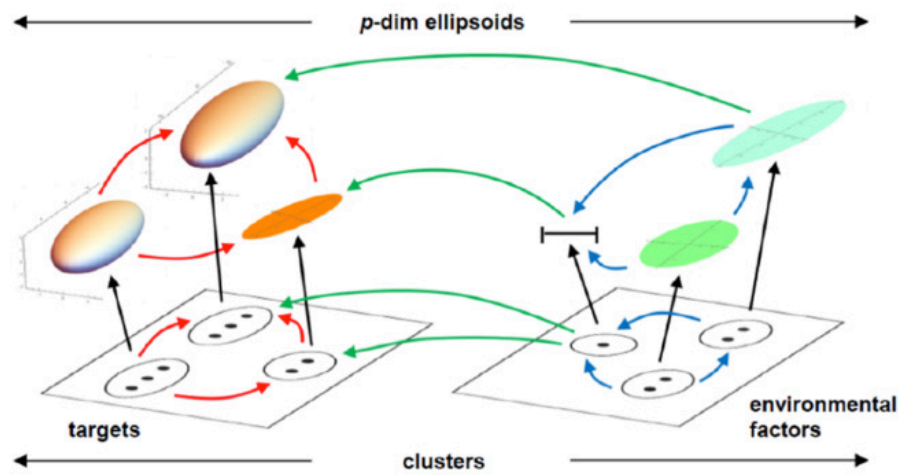


▲ *OR-Analytics with Operational Research in Clustering*.

This book consists of 3 parts. *Part I* introduces into clustering, theoretical results needed to model the clustering problems, and methods of nonsmooth optimization applied to design algorithms for solving the problems. Flowcharts are used throughout, whereas mathematical proofs are avoided; the reader will find them elsewhere. In *Part II*, optimization models as well as traditional clustering and optimization-based clustering algorithms are presented with flowcharts and explanations. These range from heuristic algorithms like *k*-means, global *k*-means, *k*-medians and *k*-medoids algorithms, along metaheuristics or evolutionary clustering algorithms like tabu search, simulated annealing, genetic and artificial bee colony clustering algorithms, to nonsmooth optimization. Several incremental clustering algorithms using nonsmooth and DC optimization approaches are given (“DC” means “differences of convex functions”). These algorithms are based on a combination of local search optimization procedures and incremental approach, presented with flowcharts and described step-by-step. *Part III* implements the algorithms using real-life data. Different evaluation measures for clustering, including cluster validity indices and performance profiles, are applied. Results of numerical experiments are reported and concluding remarks made.

Distributed over these 3 parts, the 12 chapters are: 1. Introduction to clustering, 2. Theory of nonsmooth optimization, 3. Nonsmooth optimization methods, 4. Optimization models in cluster analysis, 5. Heuristic clustering algorithms, 6. Metaheuristic clustering algorithms, 7. Incremental clustering algorithms, 8. Nonsmooth optimization based clustering algorithms, 9. DC optimization based clustering algorithms, 10. Performance and evaluation measures, 11. Implementations and data sets, 12. Numerical experiments, and 13. Concluding remarks.

The authors derive that non-smooth optimization approaches in clustering allow for better models along with fairly accurate and efficient algorithms. The results given demonstrate that *clustering analytics* based on nonsmooth optimization constitute a solid foundation to develop programs for solving clustering problems of up to very large datasets whenever the entire “big data” cannot



▲ *Clustering-analytics* within the principle of modeling of target-environment networks [1].

be saved in the memory of a computer.

This timely compendium provides for the reader a number of benefits: *i*. It represents main foundations in mathematics which cluster analysis has from practical and scientific viewpoints; *ii*. It permits enjoyable and helpful flowcharts and applications of clustering methods, and reliably guides into future application and professional work; *iii*. It stimulates own research work in *OR-analytics* in a wider frame and all emerging areas.

Further research extensions and advancements in theory, methods and applications could be provided by the authors and the academic and practical communities of *OR-analytics*. These may be initiated and stimulated by this monograph, with discrete-continuous or hybrid variables, gaining from new schemes and elements on simulation and discretization schemes, elements like thresholding, switching, robustification, stochastic programming or control. With present and future contributions of *clustering-analytics*, *OR* will proceed its service in industrial, environmental, life- and space-sciences, developmental and societal applications, for a delight of humanity.

Reference

[1] E. Kropat, G.-W. Weber and E. Babae Tirkolae, Foundations of Semialgebraic Gene-Environment Networks, *Journal of Dynamics and Games* 7, 4 (October 2020) 253–268; doi: 10.3934/jdg.2020018. 🌐

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