

IFORS



NEWS

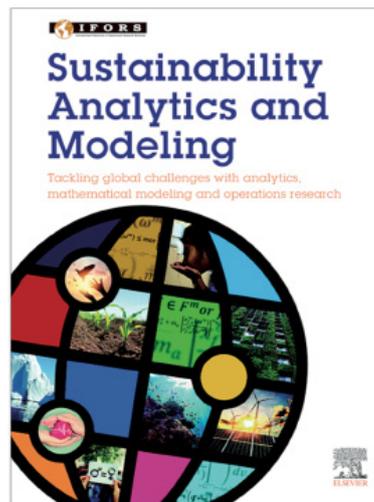
International Federation of Operational Research Societies

From the President

A New IFORS journal is Born!

Grazia Speranza <grazia.speranza@unibs.it>

The International Transactions in Operational Research (ITOR) has been the flagship journal of IFORS since its launch in 1994. The journal has served the IFORS community for a number of years with publishing the proceedings of conferences and the biographies of key figures in the OR field, who now belong to the IFORS Hall of Fame (<https://www.ifors.org/ifors-hall-of-fame/>) The scientific editorial world substantially evolved over time, furthermore the ITO mission expanded and began to publish high-quality scientific papers, capable of attracting citations. The initial goal for ITO was to be indexed and then to increase the value of the key indicator of the success of a journal, its impact factor. Thanks to the commitment of the Editor-in-Chief, Celso Ribeiro, and the editorial board of the journal, year after year, ITO has improved its impact factor (current impact factor: 2.987) and has become one of the leading journals for the OR community.



In addition to a well-established flagship journal, a global society such as IFORS has the responsibility to introduce new ventures. We asked ourselves: What should be the mission of a new IFORS journal? What will make it different from the other OR journals, in particular, from those related to scientific societies? IFORS gathers the global OR community. Therefore, we focused on a journal with a theme of global interest. This is how the new IFORS journal on Sustainability Analytics and Modeling (SAM) was born.

Sustainability is a word that is often associated with climate change, but has in fact a much broader meaning. In 1983 the United Nations General Assembly realized that there was a deterioration trend of the human environment and of the natural resources that needed to be reversed. The so-called Brundtland Commission was established with the mission to unite countries to pursue sustainable development. The Commission was chaired by Gro Harlem Brundtland, a former Prime Minister of Norway, chosen for her strong background in the sciences and public health. The Brundtland Commission released in 1987 a 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. The three main pillars of sustainable development are: economic growth, environmental protection, and social equality. While most people agree that each of these three pillars contribute to the overall idea of sustainability, unequal levels of initiatives are observed for the three pillars in countries' policies worldwide. While an overwhelming number of countries put economic growth on the forefront of sustainable development, the other two pillars have been suffering.

With the launching of the journal Sustainability Analytics and Modeling, IFORS aims at attracting the interest of our community to the topic of sustainable development in the broadest sense. Papers published in SAM will contribute through mathematical modeling, optimization, data analysis, and other analytical approaches to the battle for a sustainable development of our planet. 

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Sunity Shrestha Hada <sunity.shresthahada7@gmail.com>

The March issue includes all the permanent sections articles and some more interesting news revolving around OR community. This issue starts with the editorial from the president of IFORS Grazia Speranza who shares information about the new IFORS **Journal Sustainability Analytics and Modeling** (SAM). This issue covers the news about the IFORS-ITOR-Wiley best paper awards. The extended abstracts of IFORS Award 2020 are being presented in the newsletter from September issue. Two papers in each issue among six finalists are published. This issue presents last two finalist papers from Vietnam and India.

The Tutorial section presents an article on 'Integer Programming formulations for the Vertex Coloring Problem'. The OR Impact section comes up with an article on 'Transforming Food Production and Supply with OR/Analytics'. The OR Development section covers the paper from Africa on 'Disaster Mitigation: Leveraging Community Involvement to Improve Water Access in sub-Saharan Africa'.

The 4th IFORS global webinar organized by NORAM has been reported by Karla Hoffman. The 5th IFORS global webinar will be held in late March 2021 by AFROS, the African OR community. The book review section includes an edited book 'Even

Convexity and Optimization Handling Strict Inequalities' reviewed by Gerhard-Wilhelm Weber, Joanna Małeczka and Dominik Czerkawski .

There have been many webinars being organized around the world during the COVID-19 period. In this issue Gerhard-Wilhelm Weber has a collection of 25 conferences reports.

And finally, the news on Francisco Sagasti, the President of Peru, is covered by Paul Randall. Mr. Sagasti is an OR personality and him being the president of Peru is really a great pride for OR community.

There are still the presences of Corona in various places in the globe due to which we are having hybrid conferences (mix of physical and virtual meetings). Let's hope the situation will improve soon and the world will come together with no social distancing. 🌐



OR Impact

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Transforming Food Production and Supply with OR/Analytics

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OVERVIEW

The world food supply is insufficient to feed millions of people and the current COVID-19 pandemic is making matters worse by disrupting food supply chains, crippling economies and eroding consumer purchasing power. Paradoxically, this is happening at a time of enormous global food surpluses [1]. The growing use of data collected via sensors, drones, satellites, mobile phones and other novel technologies, enables farms and farmers to produce more for less – less fertilizer, less water and less land. The revolution is happening in both developed and developing countries, but there's a big gap between the two worlds.

In this article the contributions of several organisations which focus on these problems are first described, together with some of the rapidly increasing research studies and applications from the OR/Analytics community. These involve the use of agricultural data bases and modern analytics and OR techniques to transform the efficiency of food production and supply globally, but particularly in



the developing world. Then we describe in detail a recent award-winning project in Mexico.

ORGANISATIONS' CONTRIBUTIONS

The annual INFORMS **Edelman** competition awards a prize for the best implemented OR application from many submissions. In 2015 the prize was awarded to Syngenta for "Good Growth through Advanced Analytics", which is enabling the creation of an efficient and effective soybean breeding strategy. Key to the new strategy is the combination of advanced analytics and plant-breeding knowledge to find opportunities to increase crop productivity and optimize plant-breeding processes, which was estimated to save more than \$287 million between 2012 and 2016 [2].

Following this achievement, the INFORMS' Analytics Society and Syngenta sponsored an annual competition, *the Syngenta Crop Challenge in Analytics*, in 2016, which aims to stimulate the use of OR and Analytics to improve agricultural practice [3]. As world population increases and arable land decreases, it becomes vital to improve the productivity of the agricultural land available. Companies like Syngenta strive to provide varieties of their crops to meet this need. In 2018 a team, including joint authors of this article, Daniel Jimenez and Julian Ramirez, from The International Center for Tropical Agriculture (CIAT) in Colombia won the Syngenta Crop Challenge [4].

The INFORMS Analytics Society also promotes an annual *Innovative Applications in Analytics Award (IAAA)*, which in 2020 was won by an agriculture project based in Mexico, which is the main focus of this article (See MAIN PROJECT below).

In addition, the INFORMS *Daniel H. Wagner Prize for Excellence in the Practice of Advanced Analytics and Operations Research* for 2020 was awarded to Saurabh Bansal et al for their work on the commercial growth of corn seed to improve the distribution and performance of crops to achieve monetary and non-monetary benefits [5]. The work generates long-term solutions to the challenges of planning and supplying corn seed to meet farmer and consumer demand.

The Consortium of International Agricultural Research Centres (CGIAR) is a global partnership that plays a major role in improving agriculture in developing countries. CGIAR aims to reduce rural poverty, increase food security, improve human health/nutrition and the sustainable management of natural resources. Fifteen international research centres pursue these goals. CGIAR has set up a "Platform for Big Data in Agriculture", which seeks to stimulate innovations around big data that can transform farming in developing countries. Robin Lougee, co-author of this article, was the founding Steering Committee Chair for the Platform.

The International Maize and Wheat Improvement Centre (CIMMYT), a non-profit Mexico-based international organization, is a CGIAR centre that researches maize and wheat production systems in the developing world to improve, sustainably, their productivity and the livelihood of farmers.

MAIN PROJECT: Integrated Analytics for Sustainable Agriculture in Latin America.

Authors: Ricardo Curiel, Andrea Gardeazabal, Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT); Daniel Jimenez, Hugo Durado, Alliance Bioversity - CIAT; Steffen Fritz, Juan Carlos Laso, International Institute for Applied Systems Analysis (IIASA)

The 2020 INFORMS Innovative Applications in Analytics Award was awarded to CIMMYT, the Alliance of Biodiversity International, CIAT, and IIASA. They developed a smartphone App, *AgroTutor*, which helps smallholder farmers in low-income nations, previously disconnected from technology and data analyses available to wealthier nations and big producers, to increase productivity, use more sustainable practices and access markets directly. *AgroTutor* is now helping over 150,000 farmers in Mexico. "The award from this collaboration highlights the strengths of bringing together our research centres under one CGIAR," said Daniel Jiménez, an Alliance scientist who was part of the winning team. "It



▲ Fig 1. A farmer in Mexico uses the AgroTutor application in the field. (Press release for the winner of IAAA 2020, Photo: Francisco Alarcón/CIMMYT)

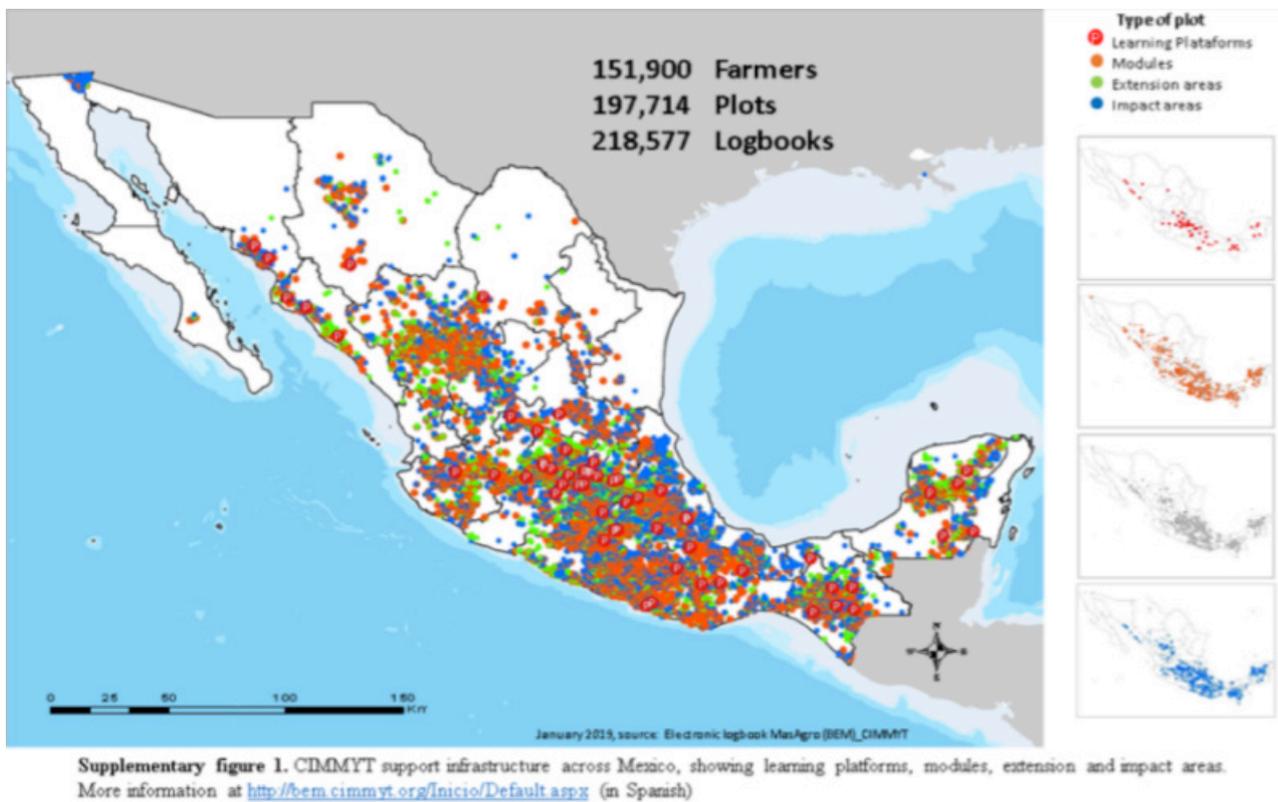
shows that we can collaborate and compete at the highest level when it comes to applying science to global challenges." A detailed description of AgroTutor is given in [7].

Background. In addition to the activities described above, CIMMYT also makes farming more sustainable by improving growing practices and introducing new affordable technologies to the field. This research, capacity building and technology transfer model relies on innovation hubs, or networks, for the exchange, evaluation and improvement of farming knowledge, practice, technologies and traditions. To this end CIMMYT collects observational data from roughly 150,000 plots of farmers that participate in publicly funded projects for sustainable maize, wheat and rotation crops production (Figure 1). The organization analyses over 500 variables from each plot of land per crop cycle but also crowd-sources information from different geographic, demographic and weather databases. To issue sound crop and natural resources management and public policy recommendations, CIMMYT has developed several data collection, cleaning, analysis and visualization tools that monitor, assess, and support decision making processes for sustainable maize and wheat systems.

Analytics Components

CIMMYT developed an electronic log called *MasAgro* Electronic Field Book (BEM, in Spanish) to standardize data collection practices from the field. The log registers crop management practices, important dates in the production cycle, inputs, costs and yields achieved. See 'Analytics Use' below for more information.

Descriptive analytics are generated using several scripts in a code for statistical computing and graphics (R-language) to obtain data from an Excel file that automatically identifies and separates outliers, and graphs variables of interest, such as yield variations, net income by crop, regions and production system types. For *predictive* and *prescriptive* analytics, CIMMYT -in collaboration with IIASA and the Alliance of Biodiversity International, CIAT- pools and combines the data received from farmers' plots, including soil analysis results, with weather records and geographic information. >>



▲ Fig 2. CIMMYT Support Infrastructure across Mexico [6]

>> Researchers use empirical modelling techniques, such as *clustering, Principal Component Analysis, regression and machine learning processes, (random forests and artificial neural network)*, to mine the databases and to look for correlations, understand trends or patterns that help identify limiting factors and the best management practices for each plot. The resulting analytics feed the aforementioned smartphone application *AgroTutor*, which includes the following free services: historic yield potential, benchmarking of local information, windows of opportunity, recommended agricultural practices and commodity price forecasting, which are described more fully in the following sections

Historic Yield Potential

As a result of a combined analysis of i) the geo-location of the field and associated data (i.e., soil); ii) climate; iii) topography and growing season; iv) selected representative cultivars; and, v) water management (rain-fed or fully irrigated), farmers are provided with historic, non-nutrient and pest-limited yield potential estimates as a benchmark derived a priori from crop model outputs for the time period 1980-2010. The results then provide information about the maximum yield potentially attained, as well as the variability of these results for the selected location. Crop model simulations have been carried out with the well-established field-scale model, Environmental Policy Integrated Climate (EPIC), within a spatial computational framework running the model for specific climate, soil, topography, and growing seasons in each pixel (the smallest unit of information in an image or raster map). The yield potential provided targets the farmer's plot locations and is currently limited to maize due to the availability of relevant data.

Benchmarking Local Information

The historical income, costs, profits and yield statistics shown in *AgroTutor* are based on geo-tagged historical data from 197,714 experimental, demonstrative and pioneer farmers'

plots across Mexico. Since the historical data are geo-tagged, the information displayed is targeted to registered plots, crops and products, allowing the farmer to compare their own production costs, yields and profit against those from nearby fields to estimate their chances of improvement using real cases.

Windows of Opportunity

This functionality suggests the ideal time frame for executing agronomic management activities on the selected plot, based on the responses of a given cultivar type (see Table 1). These windows of opportunity are then shown to the farmer in the *AgroTutor* calendar. Currently, suggestions to the farmer include the optimal nitrogen fertilizer split application for maize, which allows for more efficient fertilizer use by minimizing losses compared to applying the full rate at planting. This approach typically consists of a smaller start-up fertilizer dose applied at planting, followed by a second larger dose administered when the crop enters the phase of rapid linear biomass accumulation (growth spurt), which is closely monitored.

Recommended Agricultural Practices

The recommended practices are derived from analyses performed by the Alliance of Biodiversity International, CIAT, on field data already collected by CIMMYT (see Figure 1). Using machine learning algorithms, management practices associated with higher yields are identified and subsequently shown as recommended practices for the area.

Commodity Price Forecasting

This module provides farmers with information of estimated prices at trading hubs for commodities such as wheat and maize, with predictions from one to 12 months in advance. These models are validated with out-of-sample forecasting exercises based on historical data, profit and loss performance measures.

Analytics Use

CIMMYT started to develop and implement this knowledge strategy in 2012 with *MasAgro*, a project aiming to generate local collaborative research and to help smallholder farmers make informed decisions on how to grow the best varieties with sustainable production practices in Mexico. *MasAgro* started to build a highly detailed field data base with approximately 500 variables per monitored plot and per production cycle including management practices, dates, costs, yields, pests and diseases. Having collected this significant dataset, eight years later, innovative analytical techniques were required to leverage observational data and transition from pure descriptive analytics to predictive and prescriptive.

The latest data available shows that the productivity of participant maize farmers was 54 percent higher than the average productivity of other maize farmers in Mexico, under rain-fed conditions, in the 2017 spring–summer season. As a result, the average revenue of participant maize farmers grew 61 percent.

Impact

“Although sophisticated data analyses have been used in agriculture before, small and medium-sized farmers have seldom benefited from a combination of systems and tools that offer predictive and prescriptive site-specific analytics,” said Andrea Gardeazabal, Information and Communication Technology for Agriculture, Monitoring & Evaluation Manager for CIMMYT’s Integrated Development programme. “*MasAgro* and *AgroTutor* have proven that resource-constrained farmers can benefit from high-end innovative analyses.”

FINAL COMMENT

The impact of the COVID-19 pandemic on the overall food system has stimulated increased support from the OR/Analytics community and there is much potential for redesigning a better, more resilient, more sustainable and more equitable food system.

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4. <https://www.informs.org/About-INFORMS/News-Room/O.R.-and-Analytics-in-the-News/2018-Syngenta-Crop-Challenge-in-Analytics-winner-announced>

	Application of soil improvers	Organic fertilizer
		Lime application
		Residues management
		Other soil improvers
	Sowing	Traditional sowing
		Cover crop added
		High value crop added
		Other sowing
	Ground preparation	Contour lines setting
		Plot leveling
		Soil leveling
		Agricultural implements (e.g. discs) for conservation agriculture
		Fertilizer for Cons. Ag
		Soil opening (de-compacting)
		Permanent beds
		Multi-use/crop machinery
		Other soil preparation activity
	Fertilization	Soil fertility analysis
		Tissue analysis
		Rich band
		GreenSeeker
		GreenSat
		Fertility - Other
		Inorganic fertilizer: manually buried
		Inorganic fertilizer: mechanically buried
		Inorganic fertilizer: buried with animals
		Inorganic fertilizer: Superficial application
		Inorganic fertilizer: foliar application
		Inorganic fertilizer: application with irrigation
		Biofertilizer: manually buried
		Biofertilizer: mechanically buried
		Biofertilizer: buried with animals
		Biofertilizer: Superficial application
		Biofertilizer: foliar application
Biofertilizer: application with irrigation		
Other fertilization activity		
	Irrigation	Sprinkler irrigation
		Drop irrigation
		Rolled irrigation
		Other type of irrigation
	Weed control	Pre-sowing herbicide
		Post-sowing herbicides
		Manual control of weeds

Table 1. Sample of plot activities available in AgroTutor [6]

5. Saurabh Bansal et al Distribution Estimation and Efficient Optimization for Portfolio Management in Agribusiness: Analytical Developments and Benefits,” Winner INFORMS Daniel H. Wagner prize, 2020. <https://www.informs.org/About-INFORMS/News-Room/Press-Releases/Research-Team-Recognized-with-INFORMS-Daniel-H.-Wagner-Prize-for-Solutions-to-Increase-Efficiency-in-Production-Planning-in-Agribusiness>
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Disaster Mitigation: Leveraging Community Involvement to Improve Water Access in sub-Saharan Africa

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Access to water remains a significant problem for poor communities in many developing countries. In 2017, over 207 million people walked more than 30 minutes to get water each day, 135 million of whom lived in sub-Saharan Africa (SSA) (UNICEF and WHO 2019). Carrying a 45-pound jerrycan full of water, walking in a hot deserted area, day after day, year after year, is certainly not an easy task. Moreover, such a burden disproportionately affects women and children. Collectively, women and girls spend 200 million hours every day collecting water. Furthermore, access to drinking water is a building block of disaster mitigation because water is an essential relief item in the aftermath of disasters. It is also at the heart of the United Nations Sustainable Development Goals (UNSDGs). UNSDG 6 - Clean Water and Sanitation aim to achieve universal and equitable access to safe and affordable drinking water for all by 2030 (UNSDG 2015). Understandably, this goal emphasizes the need to involve local communities in improving water and sanitation management (UNSDG 2015)

There are advantages and challenges in involving the community to improve access to drinking water. The Core Humanitarian Standard has identified that community involvement is essential to ensure the efficiency of the aid (OCHA 2020). Involving the local community can increase the impact of aid since the communities will receive services that are adapted to their needs. Furthermore, by involving the communities in the management and provision of aid services, such as using local physical and human resources, governments and humanitarian organizations can boost economic growth and ensure the sustainability of the development programs aimed at improving water access. A large challenge in involving the community in a water project, however, is adapting the program to the local context and respecting the existing local culture, practices, and customs. A subsequent challenge is to integrate those existing mechanisms into the decision support systems for tasks such as building, managing, and maintaining the water projects. Recognizing the advantages and challenges of involving the community in aid delivery, we study how to leverage community involvement to improve the accessibility of drinking water in developing countries.

New water projects, such as building water wells, have been the primary operational response to mitigate the drinking water crisis in developing countries. These projects can reduce households' distance to safe drinkable water, improving the water accessibility level. Thus, *where to build additional water projects* to achieve such a goal is *the consistent question* among non-governmental organizations (NGOs) dedicated to improving access to clean water and it is of vital importance due to limited financial resources.

Field research informs our approach and analysis. As part of the collaboration with a local NGO, one of the authors spent a full week in Ethiopia to visit water sites, interview employees from the Relief Society of Tigray (REST), a local NGO, and researchers from a local university, and observe local culture and water collection practices. Ethiopia is one of the fastest-growing economies in sub-Saharan Africa (The World Bank 2019). However, in 2017, only 72% of the urban population and only 5% of the rural population had access to improved drinking water sources (UNICEF and WHO 2019). The fast-growing economy, the unsatisfactory water accessibility situation, and the uneven progress made in rural and urban areas all make Ethiopia an interesting and representative SSA country to investigate.

From our field research in Ethiopia, we learned that currently the local NGO in Tigray, as in many other NGOs in the world, uses a naive decentralized or bottom-up approach when deciding where to build a new water project. Such an approach considers the specific need of the local community and its unique characteristics. In contrast, a fully centralized decision-making system at the national level would not be feasible due to cultural, social, and political differences and boundaries. We further learned that the local communities are highly involved in the water projects: from the initiative to start the project by working with the local NGO to identify and prioritize their needs to the future day-to-day maintenance, which includes establishing a water committee for fee collection and basic maintenance. The community ensures that the water projects are well-maintained.



Under the current decentralized decision-making system, however, the overall water accessibility level may continue to remain low due to the uneven distribution of groundwater and population. Since the other extreme, a fully centralized system is not implementable, we propose leveraging the current community involvement, to integrate two neighboring communities that can work together to improve the water accessibility level. We thus test a slightly more centralized model that can improve water accessibility levels while respecting the current community involvement. In our setting, a decentralized approach (defined as 1-degree of centralization) would be to apply the location model to each specific area (one “community”) under consideration. An n-degree centralized approach would be to allow combining at most n physically adjacent areas (“communities”) as one focal area.

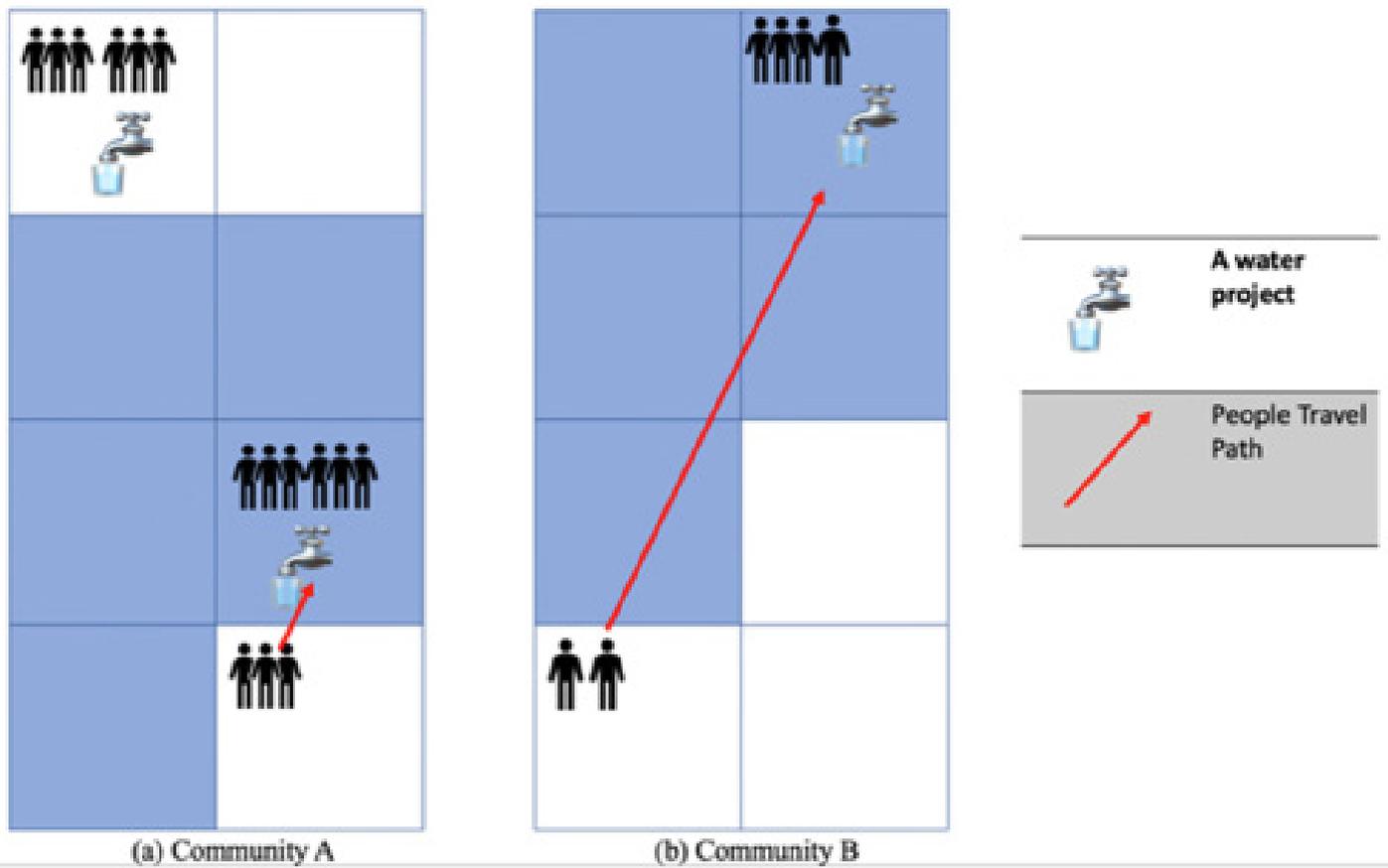
Based on what we learned from our field research and related literature, we develop a two-objective water project location optimization model that decides where to build additional water projects in a community. Following the United Nation’s (UN) definition of the human right to water, we use the one-way travel distance of beneficiaries to get water to measure drinking water accessibility. We minimize both the total travel distance to water across all beneficiaries and project cost while imposing an upper limit on the individual beneficiary’s travel distance. We account for the water projects’ feasibility constraints such as the necessity for groundwater, the budget for building new water projects, and the matching of supply and demand for drinking water. We believe that our evidence-based model accurately reflects reality, solves a critical problem, and is general enough to be applied to different settings. We applied our water project location model to the Tigray Region in Ethiopia. Access to data is a major challenge in humanitarian operations management (Starr et al., 2014). We overcame this challenge by combining multiple sources of data. From our fieldwork in Ethiopia, we obtained unique data from the local NGO, such as budget, targeted consumption level, and water project capacities. Furthermore, we linked this data to other large data sets including geocoded information, such as the gridded population data from NASA’s Socioeconomic Data and Application Center (SEDAC 2018), groundwater availability data from the International Groundwater Resources Assessment Centre (IGRAC 2020), and shape-files of the administrative regions from ArcGIS, a

geographic information system (ArcGIS Hub 2016). Altogether, seven different data sets served as inputs to our evidence-based data-driven analytical models, allowing us to more realistically propose water project locations.

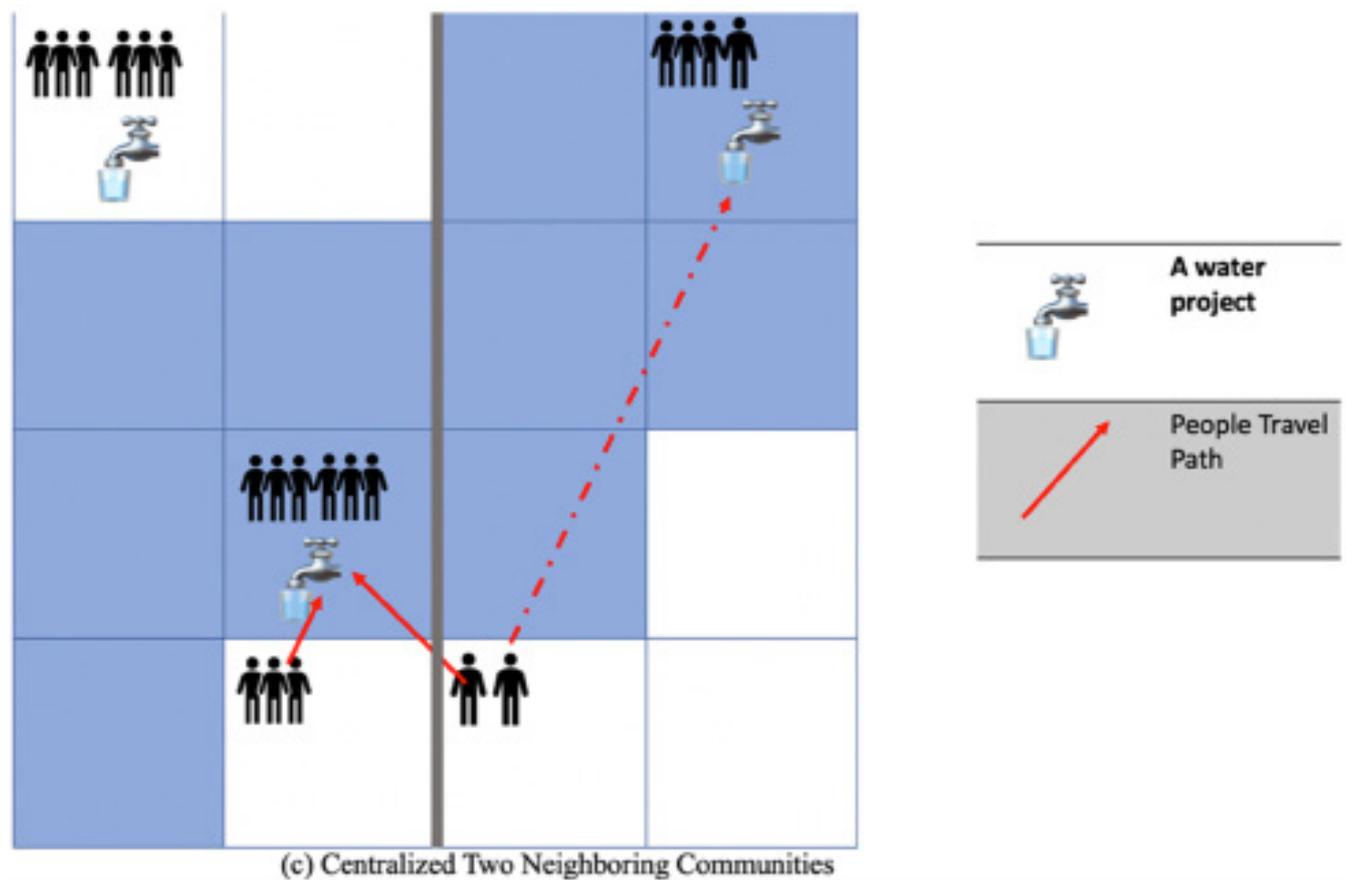
Our models are applied to, in total, 1375416 beneficiaries. With the existing water projects, 61.0% of the beneficiaries are located more than 1000 meters away from the closest water project. We find that given the current budget constraint, our optimal decentralized solution, which completely respects the current system’s structure, adds new water projects that reduce the travel distance by 68.9%, an improvement that would be difficult for the local community to achieve without our analysis because of the complexities involved in making these decisions. However, even under this optimal decentralized solution 18.4% of the beneficiaries are still located more than 1000m away from a water project, and 9.0% of the beneficiaries are in areas that would not get a water project allocation that satisfies all the constraints and is thus forced to use less water or get some of their water from potentially unsafe sources.

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We also find that it is possible to further improve the decentralized solution water accessibility level and improve equity level while staying within the budget. A small adjustment to the current system—by centralizing a pair of two neighboring communities (2-degree centralization) compared to a completely decentralized system—allows us to achieve an additional noteworthy reduction of 4.2% in travel distance beyond the decentralized solution. In this case, 1.3% more people would be within 1000 meters from a water project and 54.5% of the people without clean water in the decentralized solution would now be in areas where there is a water project. Diagram 1 shows how people in community B would not be able to travel to the closest water project (located in community A) under the current decentralized management system. Diagram 2 shows how centralizing two communities would allow those beneficiaries in B to travel less, thus reducing the overall travel distance of all the beneficiaries.



▲ Figure1



▲ Figure 2

To better understand how increasing the degree of centralization would affect these results, we also study the case of combining 3 physically adjacent areas, creating a 3-degree centralized system. We show that changing the decentralized system into a 2-degree centralized system captures nearly all of the benefits from changing a decentralized system into a 3-degree centralized system. Our proposed solution of centralizing two neighboring kebeles has received validation from the local NGO we collaborate with:

“Collaboration needs multi-sector integration. If such coordination is created by the woreda leaders and the woreda government is strong, then inter-kebele collaboration is very easy (to implement).”

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Integer Programming formulations for the Vertex Coloring Problem

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The vertex coloring problem

A coloring of the vertices of a graph $G=(V,E)$ is an assignment $c:V \rightarrow N$ of “colors” to vertices of G such that $c(i) \neq c(j)$ for each edge $ij \in E$. The classical *vertex coloring problem* (VCP) consists in finding a coloring of G minimizing the number of used colors, and it has many applications in real-life situations. A classic example of VCP arises in *frequency assignment problems* in communication networks, where a frequency has to be assigned to each antenna of the network avoiding two antennas to share the same frequency if the distance between them is smaller than a given threshold. By modeling the network as a graph in which two vertices (i.e., antennas) share an edge if the corresponding antennas are too close to each other, any coloring of this graph represents a feasible frequency assignment for the network [1]. Another classical example is the schedule of classrooms to courses (e.g., at universities) [6]. In this case, a classroom (i.e., a color) must be assigned to each course providing that no pair of courses overlapping in time is assigned to the same classroom. Many other real-world applications exist for VCP in several fields such as scheduling, register allocation, train platforming and communication networks, among others. In general, any problem assigning resources to “tasks” in which pairs of conflicting tasks cannot receive the same resource can be modeled with vertex coloring problems. There exist many variants of the vertex coloring problem, usually motivated by real restrictions. Just to name some of them: *precoloring extension*, μ -*coloring*, (γ, μ) -*coloring* and *list-coloring*, among others. An excellent review on VCP can be found in [10].

IP formulations for VCP

Integer programming (IP) has proved to be a powerful tool to solve combinatorial optimization problems and in the last 20 years it has been successfully applied to vertex coloring problems by resorting to different formulations for the classical VCP. In this article, we will briefly describe some of the most referenced formulations.



The stable set covering formulation

A stable set on a graph is a subset of pairwise non-adjacent vertices. Hence, a coloring of a graph can be seen as a partition of the vertex set into stable sets. One of the best-known IP formulations for VCP is the so-called *set covering formulation*, which uses a binary variable x_s for each maximal stable set S on the graph, to determine if S represents a color-class or not. Even when being one of the oldest formulations for VCP, the exponentially-many variables in this formulation may have discouraged its use at the beginning. However, in 1996, Mehrotra and Trick [12] presented a column generation approach to tackle this issue which allowed them to develop a robust and competitive algorithm to solve VCP.

By naming S the family of all maximal stable sets of G , and S_i those containing vertex $i \in V$, the set covering formulation for VCP is stated as:

$$\min \sum_{s \in S} x_s \quad (1)$$

$$\sum_{s \in S_i} x_s \geq 1 \quad i \in V \quad (2)$$

$$x_s \in \{0, 1\} \quad s \in S \quad (3)$$

The objective function (1) minimizes the number of used stable sets (or colors) while Constraints (2) provide that each vertex is covered by at least one of these sets. Note that a feasible solution may assign multiple colors to a vertex. In such case, any of these multiple colors may serve for the vertex. We remark that Constraints (2) could be stated as equalities, thus the solution would represent a partition instead of a covering, but to this end the set S would need to include non-maximal stable sets also, thus increasing tremendously the number of variables in the formulation. Additionally, this also complicates the column generation approach proposed in [12].

The standard formulation

The standard formulation is probably the most intuitive IP formulation for VCP. However, the first polyhedral studies on this formulation first appeared in the literature in 2002 and they were due to Coll, Marengo, Méndez-Díaz and Zabala [5]. Some years later, Méndez-Díaz and Zabala obtained the most prominent results on this formulation developing a cutting plane algorithm and a branch-and-cut approach [13, 14]. These represented the first competitive algorithms in practice for VCP.

By naming C the set of available colors (usually $C = \{1, \dots, n\}$), the formulation uses a binary variable x_{ic} for each vertex $i \in V$ and each color $c \in C$, to determine if vertex i is assigned color c or not. It also includes a variable w_c for each color $c \in C$, which states if color c is assigned to any of the vertices of the graph. With these settings, the standard formulation for VCP is stated as:

$$\min \sum_{c \in C} w_c \quad (4)$$

$$\sum_{c \in C} x_{ic} = 1 \quad i \in V \quad (5)$$

$$x_{ic} + x_{jc} \leq 1 \quad ij \in E, c \in C \quad (6)$$

$$x_{ic} \in \{0, 1\} \quad i \in V, c \in C \quad (7)$$

The objective function (4) minimizes the number of used colors while Constraints (5) provide that each vertex is receiving exactly one color. For the assignment to be a proper coloring, Constraints (6) avoid the endpoints of a given edge to receive the same color in the solution.

We shall note that the formulation, as stated above, presents a strong level of symmetry, as for any given solution there exist many other equivalent solutions obtained by the permutation of the assigned colors to each of the color-classes. This kind of symmetry is usually detrimental to solver performance.

Nevertheless, several symmetry-breaking constraints are introduced in [13, 14] succeeding in eliminating this issue.

The representatives formulation

Campêlo, Corrêa and Frota introduce in 2004 the representatives formulation for VCP [4]. Unlike the standard formulation, this model does not identify the color assigned to each vertex; it simply selects some vertices to be the representatives of their color-classes and determines which of these represent each of the remaining vertices. Note that a vertex can only represent another vertex if they are not adjacent in the graph.

By naming $\tilde{N}(i)$ the set of non-adjacent vertices of vertex $i \in V$, and $\tilde{N}[i] = \tilde{N}(i) \cup \{i\}$, the representatives formulation for VCP is stated as:

$$\min \sum_{i \in V} x_{ii} \quad (8)$$

$$\sum_{i \in \tilde{N}[j]} x_{ij} = 1 \quad j \in V \quad (9)$$

$$\sum_{j \in K} x_{ij} \leq x_{ii} \quad i \in V, \text{clique } K \subseteq \tilde{N}(i) \quad (10)$$

$$x_{ij} \in \{0, 1\} \quad i \in V, j \in \tilde{N}[i] \quad (11)$$

The objective function (8) minimizes the number of representatives (or colors) while Constraints (9) provide that each vertex is represented by exactly one of these (maybe itself). In order to obtain a proper coloring, Constraints (10) prevent a vertex $i \in V$ to represent more than one vertex in any clique (i.e., any set of pairwise adjacent vertices) in the graph. We note that for implementation purposes, it is sufficient to state Constraints (10) only for cliques of size 2 (i.e., the edges) of the graph.

Although this formulation succeeds in avoiding symmetry issues coming from colors permutation, it has other kind of symmetry as the representative of a color may be any vertex of the corresponding color-class. To eliminate this symmetry, Campêlo, Campos and Corrêa introduce in 2008, the *asymmetric representatives formulation* [3] in which a vertex i can only represent a non-adjacent vertex j if $i \leq j$, for some predefined ordering of the vertex set. With this addition, the formulation accomplishes a one-to-one correspondence between solutions and colorings of the graph and the computational performance of the solution process is significantly improved.

The orientation model

In 1998, Borndörfer, Eisenblätter, Grötschel and Martin introduce in a technical report [1] the *orientation model* for frequency assignment problems (i.e., a well-known type of VCP). Unlike other existing formulations for VCP, this model uses general integer variables instead of binary ones. A decision variable $x_i \in Z$ is used for each vertex $i \in V$ to define the color assigned to the vertex. Additionally, the formulation uses an auxiliary binary variable $y_{ij} \in \{0, 1\}$, for each edge $ij \in E$, to indicate whether $x_i < x_j$ or not. Finally, an integer variable z is used to bound the maximum color used by the solution. With these settings, and being C the set of available colors, the orientation model for VCP is stated as:

$$\min z \quad (12)$$

$$x_i - x_j \geq 1 - |C|y_{ij} \quad ij \in E, i < j \quad (13)$$

$$x_j - x_i \geq 1 - |C|(1 - y_{ij}) \quad ij \in E, i < j \quad (14)$$

$$x_i \leq z \quad i \in V \quad (15)$$

$$x_i \in \{0, \dots, |C| - 1\} \quad i \in V \quad (16)$$

$$y_{ij} \in \{0, 1\} \quad ij \in E, i < j \quad (17)$$

The objective function (12) minimizes the maximum color used (i.e., the number of used colors) as Constraints (13) provide that z is a proper bound for this number. Constraints (14) and (15) ensure that $|x_i - x_j| \geq 1$, for each edge $ij \in E$; since variable y_{ij} is binary, in any feasible solution, exactly one of the two constraints associated to ij would be non-trivial.

Unfortunately, the orientation model has not received a lot of attention in VCP literature, probably due to the fact that other formulations are usually solved faster with state-of-the-art solvers. However, it should be noted that the orientation model strongly outperforms other formulations in some specific variants of VCP such as Bandwidth Coloring and Interval Coloring problems, hence it should be firstly considered for these problems and other VCP variants of similar characteristics.

Further reading

We gave in this article a very brief survey on some IP formulations for VCP, however some other formulations are worth to be at least mentioned. One of these is the so-called *supernodal formulation* [2], which aims to modify the original graph by merging some particular nodes creating *supernodes*, and then assigning multiple colors to each node of the resulting graph. We shall remark however that when the transformed graph equals the original (i.e., when no supernodes could be created), then this formulation coincides with the standard formulation. Another IP formulation for VCP, introduced in 2009, is the *distance model* [7], which uses integer variables between pairs of vertices to determine the *difference* of the colors associated to these vertices. This formulation was further studied in [8], where a strong relation with the orientation model is shown.

Within the last years, two interesting novel formulations for VCP were introduced. The first of these, in 2014 and due to Matsui et al. [11], associates binary variables to pairs of vertices and resorts to a fractional objective function which properly counts the number of color classes in the solution. This formulation seems to show significantly good results on dense graphs. Some years after, in 2017, Jabrayilov and Mutzel [9] introduced a VCP formulation based on partial orderings which showed to be a good alternative, outperforming other formulations on sparse graphs.

As we tried to exhibit in this article, a lot of work has been dedicated to tackle VCP with different IP formulations, and the work on this path continues nowadays. Nevertheless, we can surely say that coming up with new ideas and innovative IP formulations for VCP is becoming harder and harder every time.

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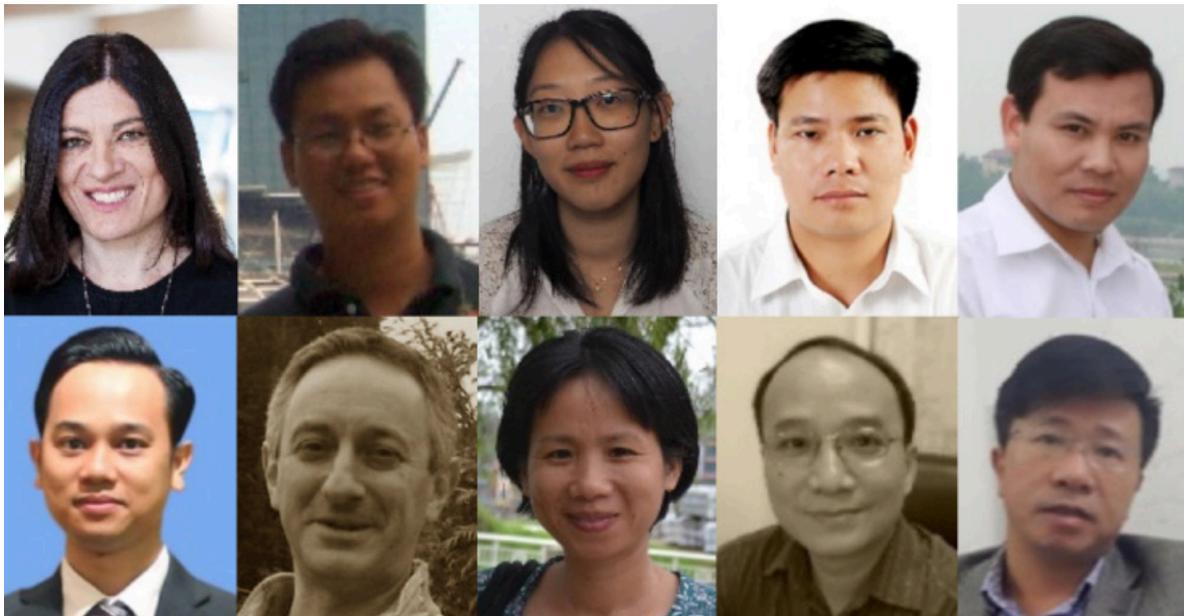
IFORS Award 2020 for OR in Development

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Optimal Investment Strategies to Minimize Flood Impact on Road Infrastructure Systems in Vietnam, GCRF-OSIRIS

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Graham Adutt - University of Kent, UK, Dang Phuong - University of Kent, UK, Chinh Ngo - Asian Management and Development Institute, Vietnam, Pham Chung - Center of Urban and Rural Transport, TDSI, Vietnam

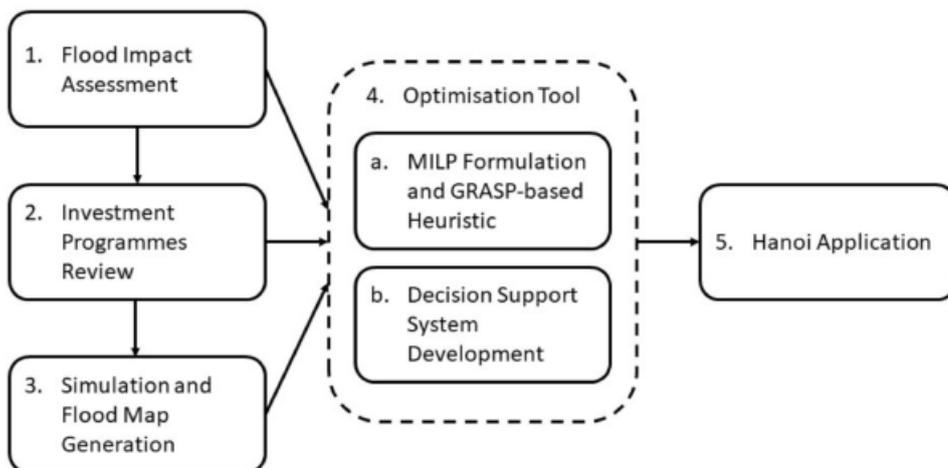


Vietnam is among the world's countries most regularly impacted by disastrous floods, mainly due to its geographical position and long exposed coastline on the South China Sea. Vietnam's National Institute of Meteorology, Hydrology and Environment (IMHEN) has recorded over 5000 deaths and 25 million people impacted by floods over the last 50 years. Vietnam's floods were once mainly a disaster for coastal and agricultural regions, but as urbanization has accelerated on the back of population growth and economic development, flooding has become a major urban challenge. The development of urban drainage systems, for example, has not kept pace with development of other urban infrastructure, and such pressures are being compounded by more erratic rainfall patterns as a result of climate change. Flooding in Vietnamese cities undermines the country's efforts to fulfil its national development plans and to achieve its targets under several Sustainable Development Goals: SDG 9 (infrastructure), SDG 11 (sustainable cities) and SDG 13 (climate action).

In early 2018, the Kent Business School at the University of Kent was awarded an 18-month Global Challenges Research Fund (GCRF) grant through the British Academy to work with Vietnamese academic and government agencies to explore how operational research (OR) methods could be used to inform urban flood mitigation planning. The project

was called "Optimal Investment Strategies to Minimize Flood Impact on Road Infrastructure Systems in Vietnam" or GCRF-OSIRIS. During the project's first few months, assessments and workshops were carried out to better understand the context and the nature of the research problem. Out of this, it became abundantly clear that Hanoi's roads are the social and economic arteries of the city and that inundation of roads caused by flooding leads to severe consequences, both in terms of lower economic productivity and reduced quality of life. Preliminary investigations also confirmed that existing flood prevention and mitigation planning was handicapped by very limited budgets and a general lack of coordination by different levels of government, from national down to local authorities. Moreover, while priorities were identified based in part on logical alignment of pre-determined city infrastructure plans, available budgets, and identified needs, rather subjective factors such as local power relations, political expediency, and personal assessment also played an outsized role. Government officials acknowledged that, as a result of Hanoi's expanding population and the increasing complexity of the city's geography and economy, new tools were urgently needed to better allocate limited financial resources for flood mitigation. Moreover, such tools needed to be objective, reliable, and consistently applied to achieve the best possible outcomes for society and the economy.

The achievement of the GCRF-OSRIS objectives required an inter-disciplinary approach integrating OR with other disciplines, including transport economics, climatology, hydrology and social science. The overall methodology comprised five interrelated components (see Figure 1).



▲ Figure 1. An inter-disciplinary approach

The core of the methodology is an optimization tool developed by the OR team of the project, in close partnership with Vietnamese academic and government agencies. Using the data and the results from the previous components, a scenario-based, multi-period, bi-objective Mixed Integer Linear Programming (MILP) model was developed to identify cost-efficient long-term mitigation investment strategies, able to reduce the impacts of future floods on the urban road network. Based on the findings of the flood impact assessment, carried out by the Asian Management and Development Institute, the minimization of infrastructure

damage and traffic congestion due to floods were chosen as the model objectives. A GRASP metaheuristic was developed to solve large-scale instances of the problem and the overall approach was embedded into a Decision Support System to enable planners and policy makers to use the optimization tool. Using a set of drainage mitigation measures provided by Vietnamese stakeholders and flood maps generated by researchers at the Vietnam Institute of Meteorology, Hydrology and Climate Change, the optimization tool was applied to generate a 20-year plan of investments, aimed at reducing flood damage and congestion in 8 central districts of Hanoi.

One of the key findings of this study is that more than half of the total reduction in congestion and damage is achieved with less than 25% of the budget, implying that some projects in the current drainage system investment and maintenance programme may not be cost-efficient for mitigating floods. The efficiency of the model and the meta-heuristic was also tested on random instances with up to 100 projects.

Following the demonstration, the Ministry of Transport representative described how important the research is for the twin problems of flooding and traffic congestion in Hanoi and advocated the need to upscale the project to the Mekong Delta, the agricultural heartland of Vietnam and home to 20% of the country's population. Overall, the project has catalyzed interest in Vietnam and in neighboring countries to develop capacity in OR to address development challenges. 🌐

JalTantra: Impacting the Practice of Rural Water Network Design in India

Nikhil Hooda ; Om Damani; Ashutosh Mahajan

Large scale projects are undertaken by governments to provide water to huge populations with a high initial capital cost as well continuous operational and maintenance costs. These projects consist of several infrastructure components like pipes, tanks, pumps, valves etc. The designers of these projects need to choose the type, size, location and configurations for each of these components. These choices not only impact the quality of service but also impact the cost of the scheme. These systems are governed by complex nonlinear hydraulic equations and have to deal with uncertainty from various sources i.e. short term and long term demand changes, quantity and quality of water supply and component failures. The ability to pay the water tariff is often limited for people in the rural areas. For large networks, invariably there are regions with worse coverage and a greater risk of failure. Any disruption of service, quickly leads to people in that region defaulting on their payments and reverting to previous unsafe local sources for their water needs. The economic stress added leads to further deterioration of the performance of the scheme affecting more and more people. This vicious cycle leads to an eventual collapse of the entire scheme. As such given the costs and complexities involved and the crucial



nature of the service being provided, these networks must be designed with great care.

The water network design problem has been studied in various forms for over 50 years. Different mathematical and algorithmic techniques ranging from deterministic ones like Linear Programming (LP), Non Linear Programming (NLP) etc. to modern metaheuristic ones like Genetic Algorithms (GA), Simulated Annealing (SA) etc. have been used over these past five decades. >>

>> The networks under consideration can have different configurations. They can be branched or looped, gravity fed or pumped. Additionally, different subset of components of the network can be considered. Branched networks are common in rural areas since the redundancy provided by looped networks is an unaffordable luxury. The piped water networks for rural schemes are typically gravity fed, since reliable electricity supply is not a given.

Maharashtra Jeevan Pradhikaran (MJP) is the government body responsible for the planning, designing and implementation of water supply schemes for the state of Maharashtra in India. It employs over 1500 engineers and over the past several decades has designed more than 11,000 rural water supply schemes. MJP when deciding to design and implement a scheme must adhere to strict government cost norms.

Existing software used by government engineers in the design of water networks are non-optimal and restrict themselves to the optimization of pipe diameters only. Other network components like tanks, pumps and valves are designed manually and heuristically. In our work we extend the problem and create a formulation that includes tanks, pumps and valves in addition to pipe diameters. This formulation is fast and optimal and is implemented in our free to use design and optimization system JalTantra, freely available at <http://www.cse.iitb.ac.in/jaltantra>.

JalTantra takes a deterministic and optimal approach to

the overall design and is developed as a free to use web application. The problem is modeled as a Mixed-Integer Linear Program. Developed in partnership with water supply engineers, JalTantra is an example of how the university can help government departments in carrying out their developmental duties. Initially developed as only a pipe diameter optimization system, with constant interaction and feedback from real world practitioners, JalTantra was iteratively extended to consider a larger subset of the network design problem. The simultaneous consideration of pipes, tanks, pumps and valves results in a complex model for network sizes of practical importance. The time taken to optimize an example 150 node network was 40 minutes and a 200 node network could not be solved within 24 hours. Several reformulations were introduced to produce a much tighter model, resulting in the two networks taking just 5 and 70 seconds respectively, prompted by the use of the COIN-OR's CBC solver in our system. JalTantra has been successfully deployed by government engineers for designing rural water networks and due to its minimum cost design, saves the government 100s of millions of Indian Rupees each year. More than 300 government engineers are already using JalTantra and over 100 more are being trained in its use every year. Hundreds of students in engineering colleges of Maharashtra are trained to design rural water networks using JalTantra every year. Besides Maharashtra, there are users not only in the states of Gujarat, Rajasthan, Madhya Pradesh, and Chhattisgarh in India, but even as far as Indonesia. 🌐

4th IFORS Global Webinar by NORAM

Karla Hoffman < khoffman@gmu.edu >

The 4th IFORS Global Webinar organized was organized by the North American Region (NORAM) of IFORS and is made up of the Canadian Operations Research Society (CORS) and the Institute of Operations Research and the Management Sciences (INFORMS). This webinar is part of a webinar series that was initiated as a mechanism to update the world community of important research during the period that, due to the coronavirus pandemic, researchers are unable to travel to international conferences to learn about the latest technological advances in Operations Research.

The 4th IFORS Global Webinar took place on February 5, 2021 with the theme of sustainability modeling and analytics. In the March 2021 issue of the IFORS Newsletter, there is an article by Elise Muller-Hooks that describes the new journal that IFORS is launching on this topic. To highlight this initiative, we chose speakers from the United States and Canada that have been doing significant research in the broad area of sustainability.

A total of 115 people attended this webinar remotely for 32 countries and five continents. The webinar will be posted on the IFORS webpages (www.ifors.org) and you are welcome to hear these informative talks. Figure 1 shows a breakdown of the attendees by IFORS region.

IFORS
Global Webinar Series

**O.R. in North America:
Sustainability and O.R.**
February 5, 2021
11:00 am Washington DC / 5:00 pm Rome

Hosts
Grazia Speranza, Italy (IFORS President)
Karla Hoffman, US (VP IFORS-North America)

**Register for this free webinar on the IFORS website:
www.ifors.org**

Invited Speakers

Elise Muller-Hooks
George Mason University
Modeling Shifts in World-wide Maritime Flows in a Changing Global Landscape and Introduction of the new IFORS journal: Sustainability Analysis and Modeling

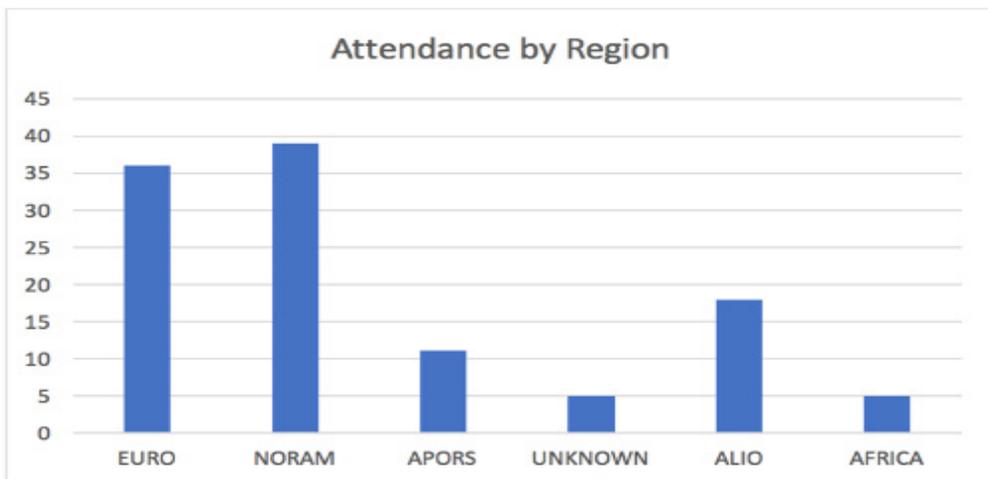
Vedat Verter
Michigan State University
Coordination in Emergency Response System Design: An Application to Hazardous Materials Transportation in Chengde City, China

Jacqueline Griffin
Northeastern University
Drug Shortages and Medical Supply Chains, Through the Lens of the UN's Sustainability Goals

Several times each year, IFORS will offer free webinars on topics of key interest to those developing and applying operational research and analytics methodologies and models.

▲ Figure 1: The 4th IFORS webinar flyer.

The webinar consisted of talks by three prominent researchers: Dr. Elise Muller-Hooks of George Mason University, Dr. Verdat Verter of Michigan State University, and Dr. Jacqueline Griffin of North Eastern University. The webinar included a lively panel discussion about the definition of sustainability and how operations research has impacted the study of resilience, risk, and sustainability.



▲ Figure 2: Attendance at the NORAM Webinar

The first of these three talks was given by **Elise Muller-Hooks**, who is the Bill and Eleanor Hazel Endowed Chair in Infrastructure Engineering at George Mason University. She serves as an advisor to the World Bank Group and has served as Program Director of the U.S. National Science Foundation (NSF) Civil Infrastructure Systems Program and lead Program Officer for the Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) solicitation. Previously, she has been on the faculties of the University of Maryland, Pennsylvania State University and Duke University. Dr. Miller-Hooks is an expert in disruption-planning and response; multi-hazard infrastructure-resilience quantification and protection; and the use of network algorithms to solve multi-modal transportation problems. She serves on multiple editorial boards, is past-president of the INFORMS' Transportation and Logistics Society, and is also past-president of the Women in OR Forum.

Dr. Miller-Hooks began her talk by first describing the goals of the new *IFORS Journal on Sustainability Modeling and Analytics* (SAM) and then provided a fascinating talk about how changes in supply routes through the Arctic could have

significant impacts globally. She explained how climatic change in the Arctic is likely to result in new opportunities for resource exploration and exportation, but is also likely to have significant global reverberations. The passage of commodities through the arctic and the resulting industrialization of this region will likely introduce both opportunities and risks. She described how she and her co-researchers constructed a global maritime distribution network that, when optimized, determines the resulting flow of goods worldwide. The hope is that the forecasts of changing maritime traffic will help to facilitate the building of greater resilience throughout that network, will inform strategies for enhancing economic growth, and will safeguard sustainable development in the Arctic.

The second speaker in this webinar was Dr **Vedat Verter**, the McConnell Endowed Chair of Business and Management at Michigan State University. Prior to this appointment, Dr. Verter spent 24 years in The Desautels Faculty of Management at McGill University, where he was a James McGill Professor. >>

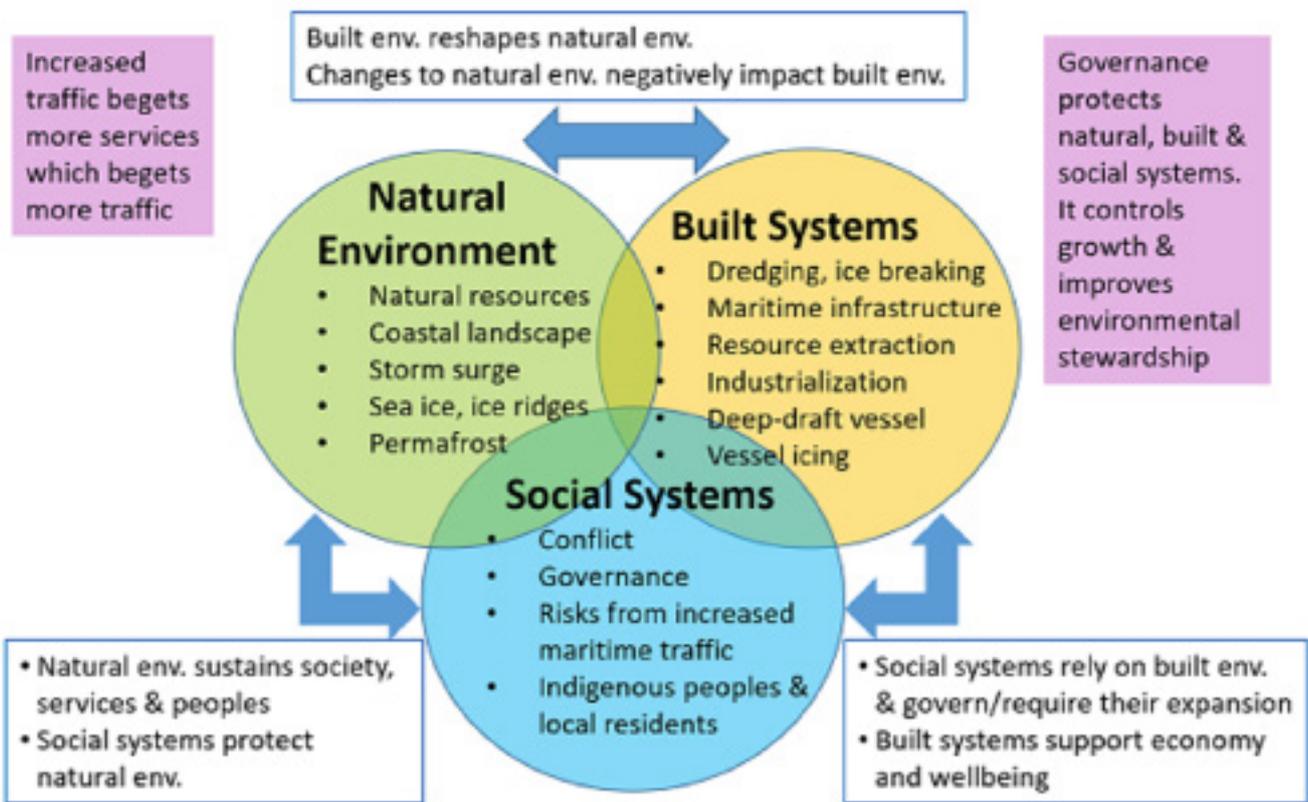
Introduction about Elise



Elise Muller-Hooks
George Mason University

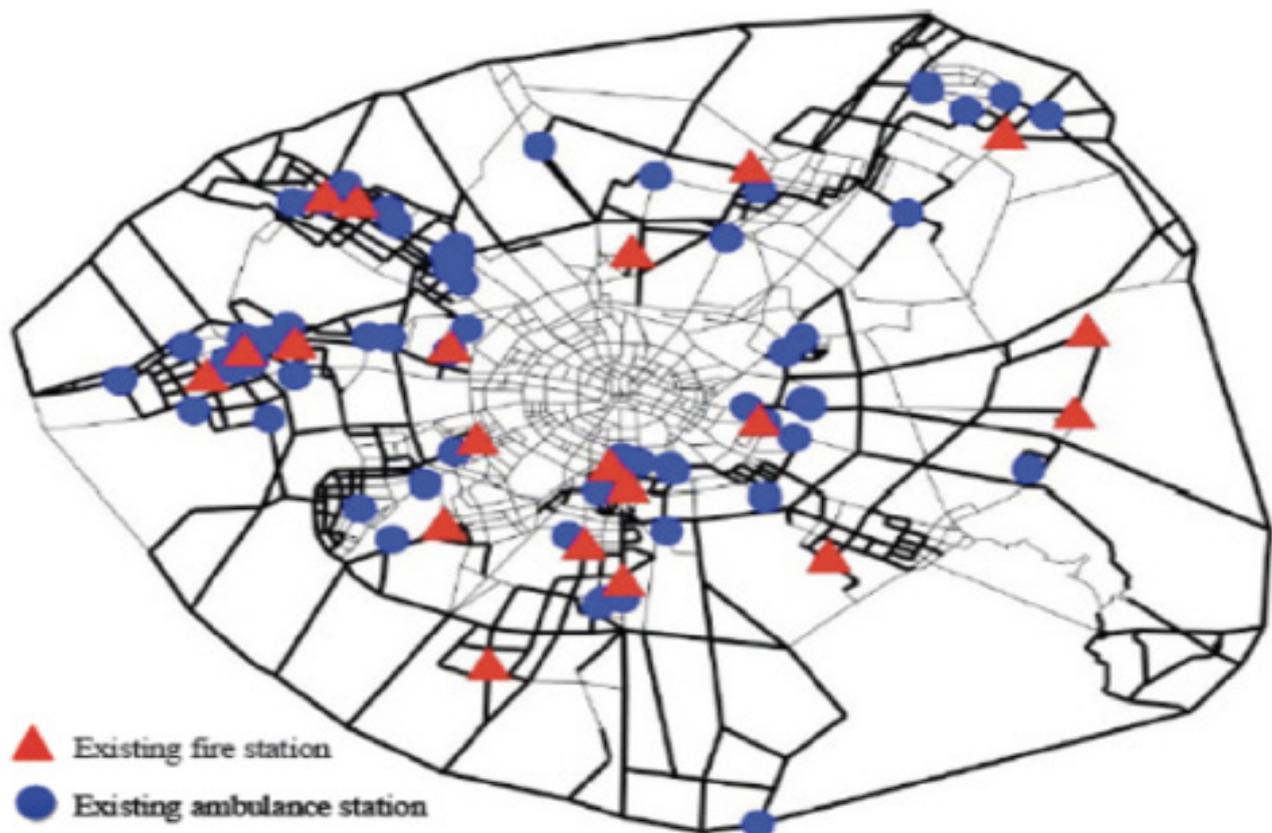
- Received her Ph.D. (1997) and M.S. (1994) degrees in Civil Engineering from the University of Texas – Austin and B.S. in Civil Engineering from Lafayette College (1992).
- The Bill and Eleanor Hazel Endowed Chair in Infrastructure Engineering at George Mason University.
- Advisor to the World Bank Group.
- Prior to Mason, she served as Program Director of the U.S. National Science Foundation (NSF) Civil Infrastructure Systems Program and lead Program Officer for the Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) solicitation (2014-16).
- Served on the faculties of the University of Maryland, Pennsylvania State University and Duke University.
- Expertise in: disruption planning and response; multi-hazard civil infrastructure resilience quantification and protection; stochastic and dynamic network algorithms; transportation systems engineering; intermodal passenger and freight transport; real-time routing; and fleet management, including paratransit, ridesharing and bikeways; and collaborative and multi-objective decision-making.

▲ Karla Hoffman introduces the first speaker



▲ Figure 3: A systems view of social, environmental and commercial interactions.

The Hazmat Roads in Chengdu City, Sichuan - China



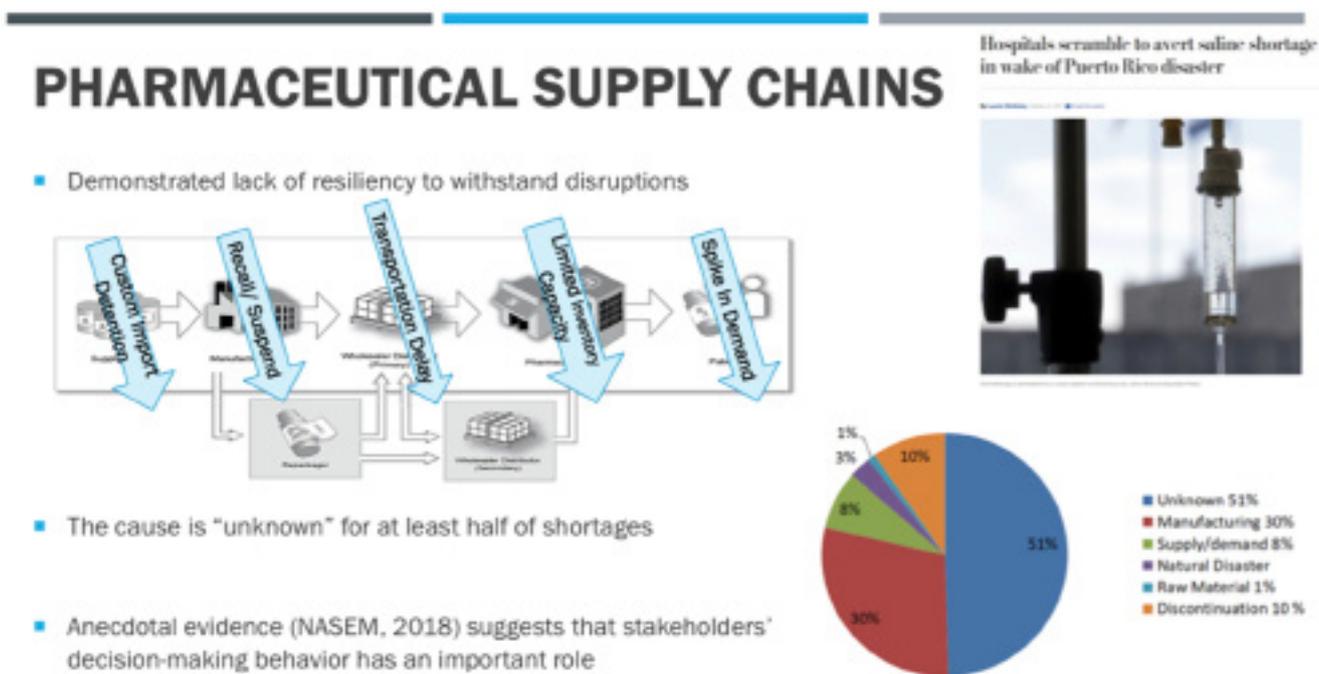
▲ Figure 4: The Hazmat Roads in Chengdu City, Sichuan - China

>> Professor Verter specializes on the application of operations research for tackling challenges in the public sector. His areas of research are service chain design, hazardous materials logistics, sustainable operations and healthcare operations management. His work in these four areas culminated into 70+ research articles in refereed journals. He was Founding Director of the NSERC CREATE Program in Healthcare Operations and Information Management, a seven-University PhD/PDF training program across Canada. Professor Verter is Editor-in-Chief of *Socio-Economic Planning Sciences*, an international journal focusing on public sector decision making. He is also among the Senior Editors of *Production and Operations Management*.

Dr. Verter's talk was titled "Coordination in Emergency Response System Design an Application to Hazardous Materials Transportation in Chengdu City, China". His talk studied the consequences of modeling emergency responses when multiple resources are required to converge on the scene, prior to certain actions being taken. Such resources can include medical technicians, emergency vehicles, fire fighters and police. He highlighted that although there is a well-established literature on designing emergency response networks for each of these resources individually, the need to model the coordination of these multiple resources is largely overlooked. Such coordination requires consideration of the response time of each resource to the emergency, and measurements of the overall impact that can occur when teams are idled until all resources arrive. Dr. Verter presented a formulation of a multiple-resource maximal covering problem that considered all resources simultaneously, and described techniques for solving these large-scale problems. He provided a case study focusing on designing the response to hazardous materials incidents in Chengdu City, China. The numerical experiments highlight the possibility of improving the current

situation by reallocating the ambulance and emergency stations to different population zones and demonstrated the measurable improvements possible by establishing new response facilities. The talk provided modeling tools that are likely to be applicable to many emergency situations and reflect the importance of such modeling when considering large-scale recovery efforts.

The third speaker in this seminar was Jacqueline Griffin who is Associate Professor of Mechanical and Industrial Engineering, and serves as the Director of Industrial Engineering and Operations Research at Northeastern University. Dr. Griffiths research focuses on the development of new models and operations research methods to address the complexities of decision making in health and humanitarian systems. In particular, she examines decision making in the presence of multiple competing objectives in real-world applications. With a focus on real-time dynamic decision making, her research includes the development of new methodologies and algorithms related to optimization, Markov decision processes, queuing systems, and stochastic programming.



▲ Figure 5: Pharmaceutical Supply Chains

The title of Dr. Griffin's talk was "Drug Shortages and Medical Supply Chains, through the lens of the UN's sustainability goals." She began by providing examples of how the medical supply breaks down whenever there is the threat of supply shortages. A simple new report can result in the hoarding of supplies where not needed thereby creating upheavals within the entire extent of that supply chain. She provides disturbing statistics about the occurrences of drug shortages that routinely occur at hospitals, pharmacies and throughout the supply chain. To model how these shortages occur, Dr. Griffin then described a game-theoretic mechanism that integrates human-in-the-loop decision-making under specific uncertainties. She measures the effects of short-term thinking and mis-communications on drug availability using simulations of the flow through the supply network. The modeling measures the value of trust between suppliers and users and concludes with some interesting observations about

how to incentivize supplies to coordinate their distributions. It also shows how partnerships among medical facilities can create more equitable distribution of supplies.

Each of these talks modeled a very specific problem and then related that problem to the overall issues relating to sustainability, risk, and the impact of human interactions within a global supply chain. The panel discussion within this webinar covered topics of interest to all operations research modelers, including: How to define the term 'sustainability' and what role operations research should play in informing decisions related to global sustainability, climate modeling and supply chain resilience. These questions led to many more questions with the discussion lasting longer than the time allotted. We thank all of the participants for their great questions and comments. 🌐

IFORS Journal: Sustainability Analytics and Modeling (SAM)

Tackling global challenges with analytics, mathematical modeling and operations research

Aims and Scope

Sustainability Analytics and Modeling publishes articles that develop and apply quantitative methods of analytics and operations research (OR) to take on global sustainability challenges. These challenges are many and broad in scope. They involve poverty, hunger, health, well-being, education, equality, water, sanitation, energy, economies, industry, infrastructuresystems, smartcommunities, consumption and production, climate, peace, and justice, among other topics, all of which are targeted by the 17 sustainable development goals (SDGs) of the United Nations (<https://www.un.org/development/desa/disabilities/envision2030.html>).

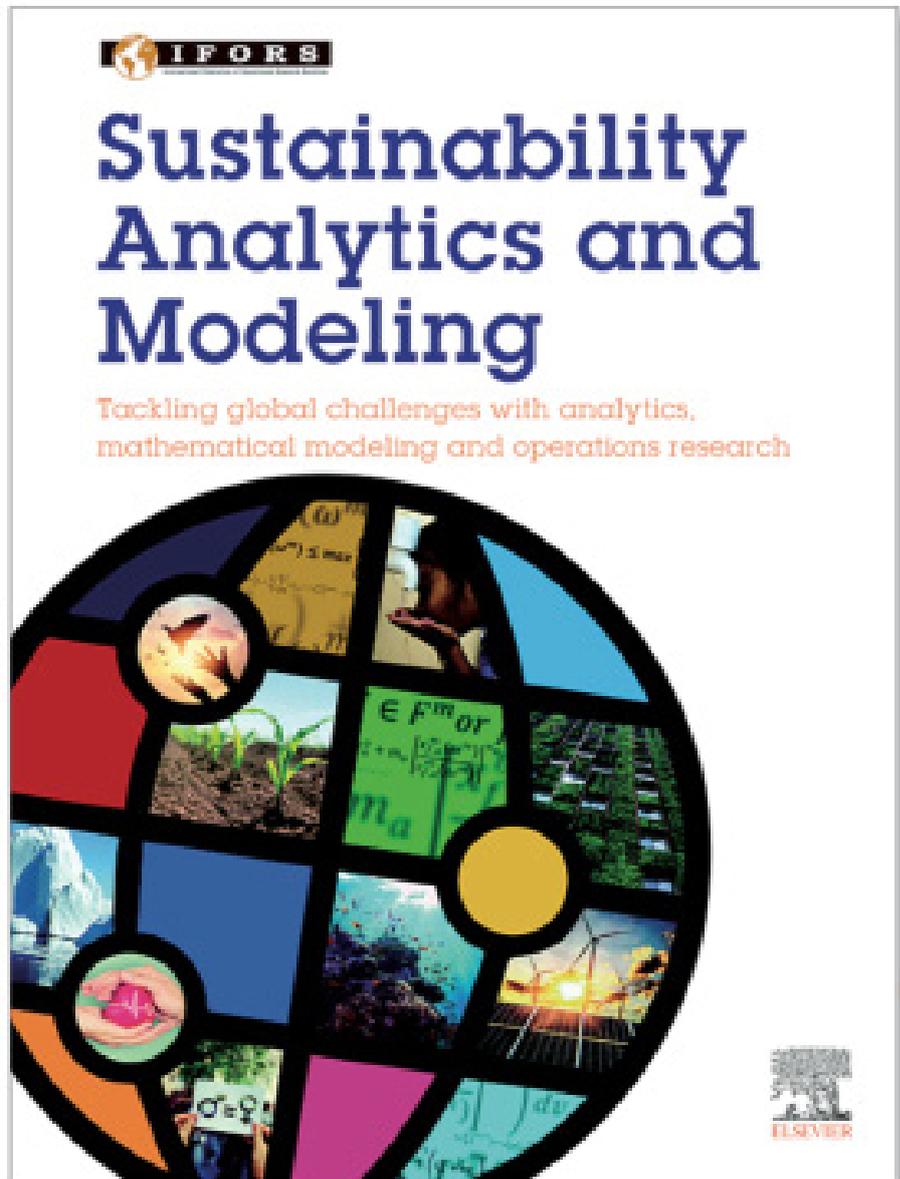
Published papers contribute through quantitative studies that create deeper understanding of the mechanisms that cause our global sustainability challenges, provide situational awareness or future predictions, uncover interconnections and their role in creating the problem, and develop potential solutions. Papers that develop policy recommendations from quantitative investigation are also encouraged.

Papers published in Sustainability Analytics and Modeling contribute through high-quality mathematical modeling, optimization, data analysis, and other analytical approaches to contending with sustainability challenges. Typical methods include (but are not restricted to): optimization (deterministic, stochastic, multi-level, dynamic, multi-criteria, multi-player), mathematical modeling, simulation, forecasting, statistical analysis, and machine learning. Case studies and numerical experiments, when possible, should be based on real world data. Interdisciplinary submissions, from researchers or practitioners, with a quantitative focus are welcome.

All papers should include a statement of the specific quantitative methods that are developed or employed and the challenge or challenges they address.

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author or research funder to cover the costs associated with publication. This ensures your article will be immediately and permanently free to access by everyone. The Article Publishing Charge for this journal is USD 1400, excluding taxes.

The Article Publishing Charge (APC) fee will be covered by The International Federation of Operational Research Societies (IFORS) for articles submitted by 31st December 2022.

For the full aims and scope, or to submit your paper, visit: journals.elsevier.com/sustainability-analytics-and-modeling 

IFORS – ITOR – Wiley Best Paper Awards

Celso Ribeiro <celso@ic.uff.br>



Wiley Online Library



The IFORS Administrative Committee approved last year the final terms of the annual **IFORS – ITOR – Wiley Best Paper Awards** for articles published in the **International Transactions in Operational Research (ITOR)**, IFORS' flagship journal.

The awards will be given annually in two categories: (1) Methodology and applications, and (2) Surveys and tutorials. The winner in each category will receive a US\$ 500 cash award prize. Winners and runner-ups in each category will receive a certificate issued by IFORS. Candidates for the awards in any given year are all papers published in an issue of ITOR in the volumes of the three preceding years. The General Editor will lead the selection process, which will be carried out by a jury formed by members of the Editorial Board, one representative of the IFORS AC and, possibly, other invited personalities. All candidate papers will be evaluated by bibliometric information (such as citations) and by their relevance, impact, and originality. The General Editor will communicate the winners and runner-ups to the Administrative Committee. The President of IFORS will make the official announcement of the Awards.

The winners and runner-ups of the **2019 IFORS – ITOR – Wiley Best Paper Awards** were announced on December 14, 2020, during the IFORS Societies Winter Meeting 2020 (online) with Presidents and Representatives of Member Societies and Regional Groupings. The following articles were nominated in each category:

1. Category: Methodology and Applications

Winner:

Célia Paquay, M. Schyns and S. Limbourg, "A mixed integer programming formulation for the three-dimensional bin packing problem deriving from an air cargo application", *International Transactions in Operational Research* 23 (2016), 187-213.

Runner-up:

Maria da Graça Costa and Maria Eugénia Captivo, "Weight distribution in container loading: a case study", *International Transactions in Operational Research* 23 (2016), 239-263.

2. Category: Surveys and Tutorials

Winner:

Mario Guajardo and Mikael Ronnqvist, "A review on cost allocation methods in collaborative transportation", *International Transactions in Operational Research* 23 (2016), 371-392.

Runner-up:

Elsa Silva, José Fernando Oliveira and Gerhard Wäscher, "The pallet loading problem: a review of solution methods and computational experiments", *International Transactions in Operational Research* 23 (2016), 147-172.

On behalf of the Editorial Board of ITOR, we extend our congratulations to all nominated authors and acknowledge your interest in submitting your work to the **International Transactions in Operational Research (ITOR)**. 🌐



BIOMA Conference Successfully Held Virtually

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Massimiliano Vasile <massimiliano.vasile@strath.ac.uk>



▲ Keynote talks by Gabriela Ochoa and Enrique Alba at BIOMA 2020.

The 9th International Conference on Bioinspired Optimisation Methods and Their Applications (BIOMA 2020, <http://utopiae.eu/bioma-2020/>) was organised on November 19-20, 2020, by the Université Libre de Bruxelles, the Von Karman Institute, the University of Strathclyde, and the Jožef Stefan Institute of Ljubljana. This edition of the conference was held jointly with UQOP, an international conference on Uncertainty Quantification and Optimisation organised by UTOPIAE, a European research and training network looking at cutting edge methods bridging optimisation and uncertainty quantification applied to aerospace systems (<http://utopiae.eu/>).

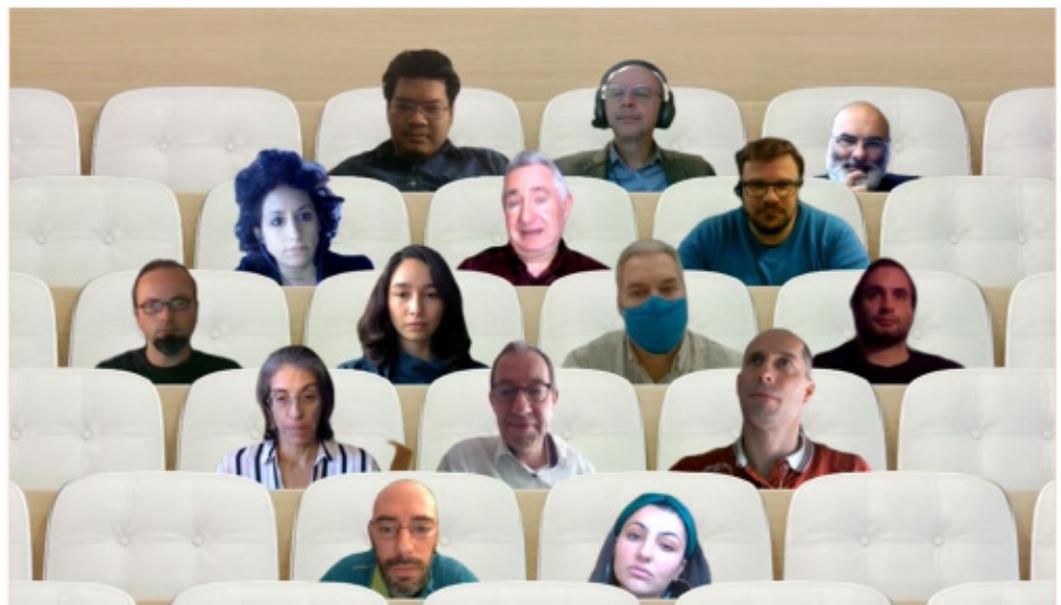
BIOMA is a key conference series specifically focusing on bioinspired optimisation methods and their applications, providing an opportunity to the global research community in bioinspired optimisation to discuss recent research results and develop new ideas and collaborations in a friendly and relaxed atmosphere.

Discussion topics included (but were not limited to): Global trajectory optimization; Multidisciplinary design for space missions; Formation and constellation design and control; Optimal control of spacecraft and rovers; Planning and scheduling for autonomous systems in space; Multi-objective optimization for space applications; Resource allocation and programmatic; Evolutionary computation for design and control; Distributed global optimization; Mission planning and control; Robust mission design under uncertainties; Uncertainty treatment in optimization; Intelligent search and optimization methods in

aerospace applications.

The BIOMA 2020 conference was attended virtually by 56 participants (including 21 post graduate students) with the following geographical distribution of attendees: Italy, 13; United Kingdom, 10; Germany, 8; Slovenia, 6; Brazil, 4; USA, 3; Spain, 2; Russia, 2; Japan, 2; Belgium, 2; France, 2; Finland, 1; Switzerland, 1.

The BIOMA 2020 program included two keynote talks: Gabriela Ochoa, University of Stirling, talking about "Recent Advances in Local Optima and Search Trajectory Networks"; and Enrique Alba, University of Málaga, talking about "Bioinspired Algorithms for Smart Cities" (<http://utopiae.eu/bioma-2020/speakers/>).



▲ BIOMA 2020: Social interaction.

Seven regular sessions took place on: Methods and Applications; Analysis of Problems and Algorithms; Swarms and Multi-player Intelligence; Applications of Evolutionary Optimization; New Methods; Multi-objective Methods and Applications; Methods for Multi-objective and Large-Scale problems.

Two discussions sessions were held at the end of each day, with the support of *Sli.do*. Among the many outcomes, the discussions pointed out that future advances are needed in theoretical studies of optimization problems and algorithm behaviour (along the lines outlined by *Gabriela Ochoa* in her keynote talk), and in the area of applications the field is moving towards addressing complex challenges (such as those addressed by *Enrique Alba* in his keynote talk).

The *BIOMA 2020 proceedings* were published in the series Lecture Notes on Computer Science (LNCS) by Springer

<https://www.springer.com/gp/book/9783030637095>.

The conference incorporated also a series of social interactions, including many informal chats during coffee and lunch breaks.

The scientific and social programmes of the *BIOMA 2020* conference would not have been possible without the support of the *UTOPIAE* project, the Jožef Stefan Institute of Ljubljana, the Université Libre de Bruxelles, the Von Karman Institute, and the Intelligent Computational Engineering Laboratory (ICELab) of the University of Strathclyde. 🌐

Latest Research Developments on Dynamic Control and Optimization: Online Discussions at DCO2021 Aveiro, Portugal

Elóisa Macedo <macedo@ua.pt>; **Tatiana Tchemisova** <tatiana@ua.pt>;
Gerhard-Wilhelm Weber <gerhard.weber@put.poznan.pl>



▲ *DCO2021*: The Opening Session with Professor Delfim Torres welcoming all participants.

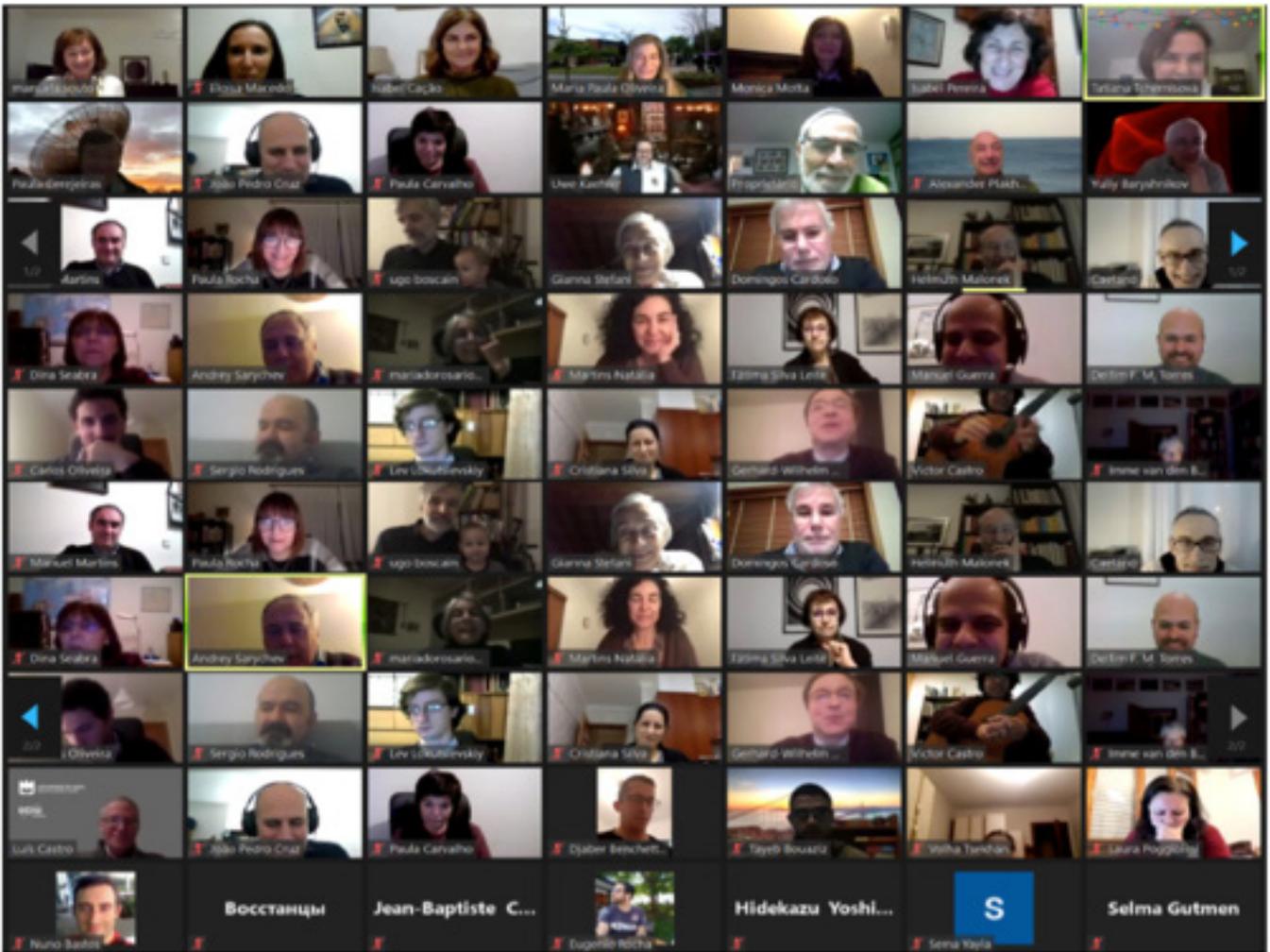
The *Dynamic Control and Optimization International Conference (DCO2021)*; cf. <https://sites.google.com/view/dco2021/dco-2021>) has been held online from 3rd-5th of February, 2021. The DCO2021 has aimed at bringing together academics and providing an environment for learning and exchanging ideas and new developments in diverse areas within the fields of dynamic control and optimization, both on theory and applications.

The conference was organized by the Department of Mathematics of the University of Aveiro (<https://www.ua.pt/pt/dmat>), the Center for Research & Development in Mathematics and Applications (CIDMA, University of Aveiro, cf. <https://cidma.ua.pt/>) and the Center for Applied Mathematics and Economics (CEMAPRE, University of Lisbon; cf. <https://cemapre.iseg.ulisboa.pt/>). The Chairs of the Organizing Committee were: *Professor Delfim F.M. Torres*, *Professor Alexander Plakhov* and *Professor Tatiana Tchemisova* from University of Aveiro. The Conference was organized with the support of *CIM - International Center of Mathematics*, and the *FLAD - Luso-American Foundation*.

The scientific event was organized as part of the celebration of

the 65th birthday of *Professor Andrey V. Sarychev*, recognized expert from the University of Florence, Italy, who taught in the University of Aveiro for various years. *Professor Sarychev* is a Full Professor at the Department of Mathematics and Informatics of the University of Florence and has been actively involved in knowledge extension activities. Since 1995, *Professor Sarychev* is a member of the editorial board of the prestigious *Journal of Dynamical and Control Systems*. The main topics of the International Conference are closely connected with the scientific interests of *Prof. Andrey V. Sarychev*, which include nonlinear dynamical control systems, control of evolution PDEs, optimal control, sub-Riemannian geometry, ordinary differential equations, calculus of variations, and propagation of acoustic waves in elastic media.

Initially planned for a friendly atmosphere on-site attendance, considering the COVID-19 pandemics context, the event was held online and the *DCO2021 Organizing Committee* gathered efforts to prepare a high-quality program divided into three main streams: Dynamic Control, Optimization, and Applications of Control and Optimization. Eleven Invited Talks were given by specialists of relevant scientific recognition from Portugal, USA, Russia, Italy and France. >>



▲ DCO2021: a snapshot of the conference participants.

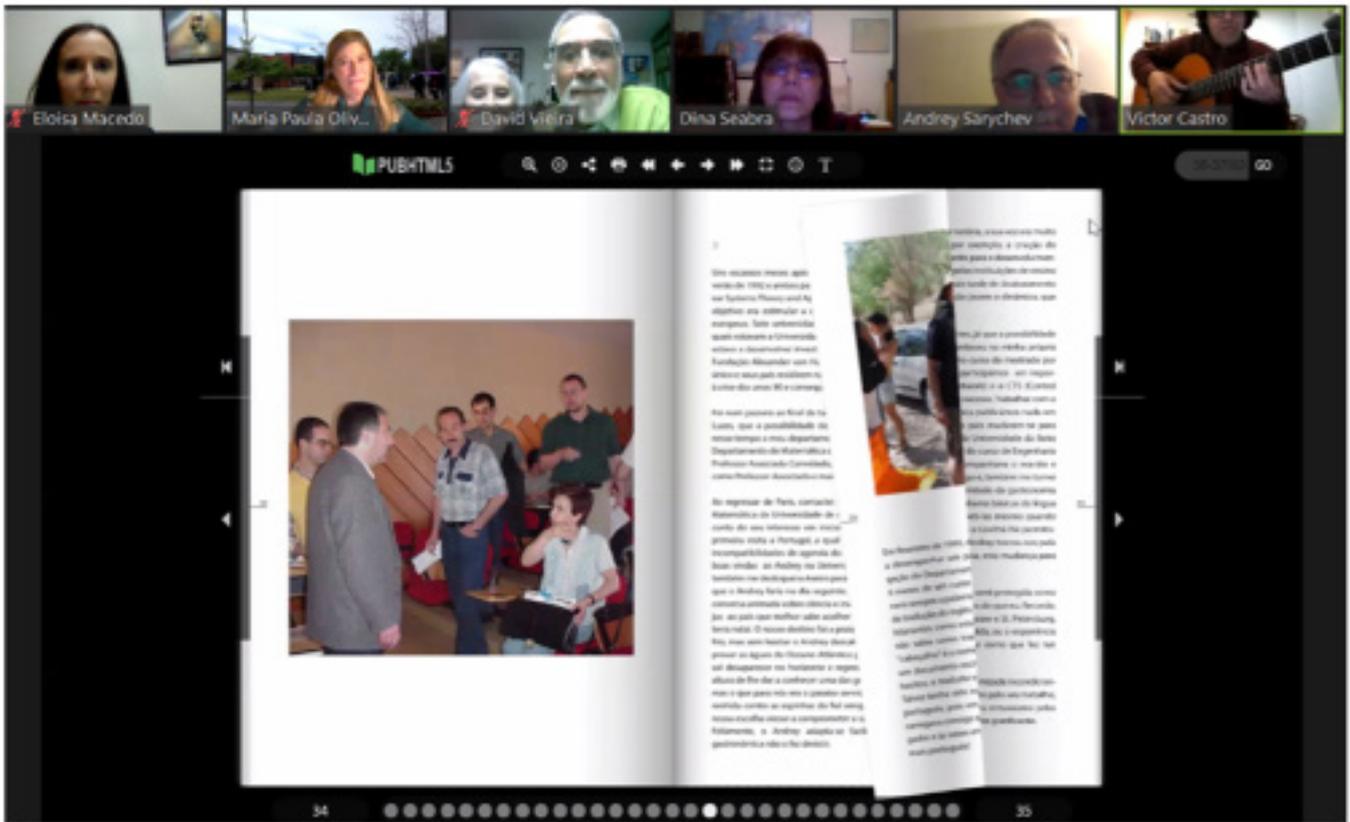
>> Thirty six contributed talks were organized in eleven parallel sessions focusing on different topics such as Dynamic systems and Geometric Control, Parametric optimal control and time scales, Differential equalities and systems, Optimal control and stabilization, Dynamic Programming and dynamical systems, Stochastic optimal control and differential games, Applications of control and optimization, Convex analysis and optimization, and Risk management, Data assimilation and Profit optimization, and others. The theoretical and practical relations with *Operational Research (OR)* played a very important role in many presentations at DCO2021 which has also become reflected, e.g., by the Special Issue “*Dynamic Control and Optimization*” of the journal *Optimization* (<https://www.tandfonline.com/toc/gopt20/current>) at the occasion of DCO2020. Moreover, the participants became informed about some of main conference highlights of this year’s OR calendar, namely, *EURO 2021* in Athens, Greece (<https://euro2021athens.com>), and *IFORS 2021* in Seoul, Korea (<http://www.ifors2020.kr/>).

The conference opened with Welcome Words by *Professor Delfim Torres*, Director of the CIDMA R&D Unit, who congratulated *Professor Sarychev* for his birthday, followed by *Professor Manuel António Martins*, Director of the Department of Mathematics, and *Professor Luís Castro*, Vice-Rector of the University of Aveiro, who shared with all conference participants that it was a privilege to have worked with *Professor Sarychev* while he was in the University of Aveiro. Then, *Professor Domingos Cardoso* took the floor to explain how important *Professor Sarychev* was for the recognition of

the Mathematics Research and Development Unit in Aveiro.

The scientific program included 11 Plenary Talks, namely: “*Control on the groups of diffeomorphisms*”, by *Professor Andrei Agrachev*, from Scuola Internazionale Superiore di Studi Avanzati, Italy; “*Obstacles to stabilization*”, by *Professor Yuliy Baryshnikov*, from University of Illinois at Urbana-Champaign, USA; “*Ensemble controllability of quantum mechanical systems*”, by *Professor Ugo Boscain*, from École Polytechnique, France; “*Optimal bacterial resource allocation*”, by *Professor Jean-Baptiste Caillaud*, from Université Côte d’Azur, France; “*Dynamics of distributed populations and its optimization*”, by *Professor Alexey Davydov*, from Vladimir State University and Moscow State University, Russia; “*Generalized convolutions, differential operators, and Lévy-like processes*”, by *Professor Manuel Guerra*, from Instituto Superior de Economia e Gestão, Portugal; “*Sub-Riemannian structures on homogeneous manifolds*”, by *Professor Fátima Silva Leite*, from University of Coimbra, Portugal; “*Necessary conditions and numerical methods for optimal control involving sweeping processes*”, by *Professor Maria do Rosário de Pinho*, from University of Porto, Portugal; “*Sufficient optimality conditions in Optimal Control*”, by *Professor Laura Poggiolini*, from University of Florence, Italy; “*Sub-Riemannian structures on Engel and Cartan groups*”, by *Professor Yuri Sachkov*, from Program Systems Institute of RAS, Pereslavl-Zalessky, Russia; and “*Elementary geometry is dead. Long live (experimental) elementary geometry!*”, by *Professor Sergei Tabachnikov*, from Pennsylvania State University, USA.

>>



▲ DCO2021: presentation of the book of messages for Professor Sarychev by Professor Paula Oliveira.

>> These sessions were scheduled by four of them at each of the first two days, and three at the final day of the conference. More than 70 participants from 19 countries of Europe, America and Asia attended the conference, among them 19 MSc. and PhD. students, and Postdocs. The presentations were very interesting covering many different perspectives and applications. Some of them became an opportunity to PhD. candidates receive feedback from experts on their research preliminary results and developments. Even in a virtual environment, the DCO2021 Organizing Committee had managed to organize a social event to all attendees. A special musical environment was created through the inspiring, tender and warm sound flow of the guitar by the hands of Mr. Victor Castro, one of the best classical guitar players in Portugal. Another special occasion was to share with Professor Andrey V. Sarychev a book dedicated to him, with several descriptions of nice memories of friends, colleagues and students that took part of Prof. Sarychev's life. It was such a pleasant moment.

behalf of many of his PhD. students, prepared a surprise for Professor Sarychev, which included sharing a book of messages from all who work closely to him during his years in Portugal: "a great mathematician and friend" (Professor Fátima Leite).

The Plenary Sessions were recorded and will be made available to the public at the conference website.



▲ DCO2021: musical event with Mr. Victor Castro.

In the Closing Session, the chairs of the DCO2021 highlighted that unfortunately, given the COVID-19 circumstance and despite these awkward times everyone is living, no in-person meeting was possible, but it was possible to provide an excellent scientific meeting that allowed for a broader participation and networking, for chatting or scheduling a time to meet virtually later on. Special words were dedicated to Professor Sarychev and all distinguished speakers. Professor Dina Seabra and Professor Paula Oliveira, on

The conference chairs are grateful to the members of the Organizing Committee for their valuable support and they also acknowledge the engagement of all the participants and speakers for creating such an outstanding environment, allowing for and fostering fruitful discussions and interesting new plans. 🌐

Presenting Your Research at E-conference in Murcia, Spain: Annual PhD Students' Conference DEcIDE Doctorate Program

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▲ Co-organizing universities of DEcIDE: UA, UMH, UM, UPCT, UNED.

For the first time as a completely online conference, the V Annual PhD Students' Conference DEcIDE Doctorate Program, Murcia, Spain, November 19-20, 2020, was organized by the University of Murcia (UM), Department of Applied Economics (<https://www.um.es/web/econ-aplicada>), in collaboration with the University Miguel Hernández of Elche (UMH): Center of Operations Research (CIO in Spanish) (<http://cio.edu.umh.es/en/>), the National Distance Education University (UNED): Department of Applied Economic and Statistics (http://portal.uned.es/portal/page?_pageid=93,671508&_dad=portal&_schema=PORTAL), the University of Alicante (UA): Department of Economics (<http://fae.ua.es/FAEX/?lang=es>), and the Technical University of Cartagena: Department of Quantitative Methods, Legal Sciences And Modern Languages (<http://metodos.upct.es/>).

The V Annual PhD Students' Conference DEcIDE Doctorate Program is an annual academic gathering that started in 2016 on Murcia, as a part of the programming of specific training activities of the DEcIDE program (<http://doctoradodecide.com/>). The DEcIDE Program an Interuniversity Doctorate program in Economics, inaugurated in the 2013-2014 academic year and verified by ANECA (the Spanish rating agency), in which doctors from the above five universities participate. This program was born from the desire of a large group of researchers to join forces, fields of specialization and academic rigor, with the purpose that Ph.D. students acquire a high qualification in the chosen line of research, preparing quality theses that give rise to publications of first level. The program consists of 9 lines of research, five of which are closely related to OR: Game theory (L4), Mathematical Economics and Social Choice (L3), Industrial Organization (L6), Time-Series Econometric (L7), Spatial Statistics (L9) (<http://doctoradodecide.com/programa/lineas-de-investigacion/>). The program has researchers whose curriculum makes them worthy of recognition as highly prestigious specialists in their respective areas. It is currently made up of more than 70 doctors from the 5 participating universities.

The main objectives of the annual DEcIDE conference have been:

- Experience exchange among doctoral students of the different branches of knowledge, with the participation of academic and students, encouraging debate and communication.
- Discussion of the current problems of doctoral students from different fields of economics.
- Dissemination of the research activity to doctoral students, members of university community, companies and society.
- Developing the ability to exhibit and disseminate research results carried out in the doctoral thesis.
- Promoting creative abilities of study and research among PhD students.
- Highlighting the value of Doctoral degree in access to the labor market.

The conference comprehends two different tracks: (1)



▲ Logo of DEcIDE

Seminarios novel, aimed for presentations of 1st and 2nd year students, (2) *Jornadas doctorado*, aimed for presentations of 3rd and subsequent years. The organizing committee may re-assign any proposal on the basis how developed is the submitted research. Students on their third year in the programme are especially encouraged to attend the conference, but any student enrolled in it should attend (it is recommended by their compulsory list of activities for the program).

Discrete Optimization Talks (DOTs), One Year Later

Aleksandr M. Kazachkov <akazachkov@ufl.edu>; Elias B. Khalil <khalil@mie.utoronto.ca>



▲ Snapshot of DOTs 2020 speakers.

How did DOTs start? In March 2020, many academics and researchers worldwide began to conduct their activities from home to reduce the spread of COVID-19. All of a sudden, casual hallway conversations with colleagues about recent papers and results were no longer possible. Similarly, conferences and university seminars were cancelled in droves.

In this context, we started to plan DOTs, as a way for researchers in the field of discrete optimization to remain connected. We decided that each session of our virtual seminar series would consist of two live half-hour talks, including time for speakers to answer questions, followed by a social component.

As a first step, in early April 2020, we created a large contact list of possible invitees from a variety of countries, institutions, and research areas within discrete optimization (across theoretical, computational, and applied interests), and off went the first round of emails to potential speakers. We were positively surprised that our colleagues shared our enthusiasm for the mission of DOTs, many of them quickly accepting our invitations to speak: it was on!

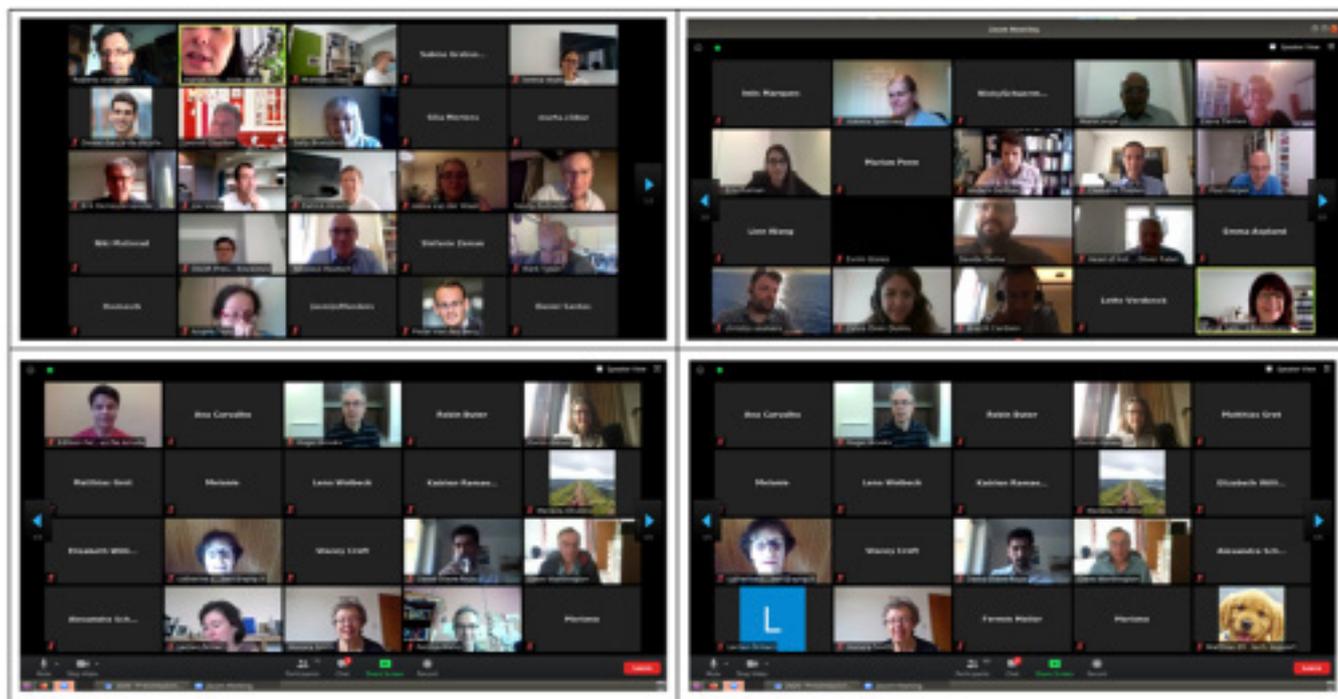
To spread the word in the Operational Research (OR) and

Computer Science (CS) research communities, we created a website, posted announcements on relevant mailing lists, and tweeted under the hashtags #DiscreteOptTalks and #DiscreteOptimizationTalks. Importantly, we relied on the support of our colleagues at the *Canada Excellence Research Chair* in Real-Time Decision-Making at Polytechnique Montreal (CERC-DS4DM), where we were both postdoctoral researchers at the time. Following the initial advertising campaign, the DOTs mailing list garnered a few hundred registrations before the *first DOT of April 21, 2020*.

A distinguishing feature of the DOTs format is the social component. DOTs was not the first virtual seminar in OR/CS, and we had been attending quite a few excellent ones since March 2020. However, most of those seminars lacked the casual aspect of in-person conferences or after-seminar hallway/podium discussions. To address this, we invited attendees to stick around and chat in breakout rooms with the speakers. Usually, tens of attendees stay, whether to ask questions or just to socialize, by catching up over a coffee or tea with colleagues around the world, perhaps compensating slightly for the isolating circumstances everyone has faced.

e-ORAHS 2020 Conference: Hosted in Vienna, Austria, With Online Participants Worldwide - revisited

Roberto Aringhieri <roberto.aringhieri@unito.it>; **Melanie Reuter-Oppermann** <oppermann@is.tu-darmstadt.de>



▲ Zoom screenshot taken during the opening session of e-ORAHS (upper left: Roberto Aringhieri, Marion Rauner, Matthias Eller, Lorena Reyes, Daniel Garcia de Vicuna, Leonid Churilov, Sally Brailsford, Erik Demeulemeester, Joe Viana, Patrick Hirsch, Alexa van der Waall, Sandy Rutherford, Raimund Kovacevic, Nikolaus Hautsch, Mark Tuson, Angela Testi, Pieter van den Berg; upper right: Izabela Spernaes, Mario Jorge, Elena Tanfani, Erin Roman, Anders Gullhav, Clemens Thielen, Paul Harper, Davide Duma, Oliver Fabel, Christos Vasilakis, Zehra Önen Dumlu, Brecht Cardoen, Margit Sommersguter-Reichmann; lower left and right: Edilson Fernandes de Arruda, Roger Brooks, Evrim Günes, Mariana Oliveira, Catherine Crenn-Hebert, David Olave-Rojas, Dave Worthington, Lerzan Örmeci, Honora Smith, Fermin Mallor).

The *EURO Working Group (EWG) ORAHs* (<http://orahs.di.unito.it>) provides a network for researchers involved in the application of systematic and quantitative analysis to support planning and management in the health services sector. The *EWG* organises an annual meeting, which is open to anyone with a quantitative background and those who have interest in the subject area. In 2020, the annual meeting took place in July, from Monday 27 to Friday 31.

The organisation of the 46th annual *ORAHs* meeting was assigned to *Marion Rauner* (University of Vienna) during the business meeting that closed the 44th *ORAHs* in Oslo in 2018. The local organising committee was composed by *Patrick Hirsch* (University of Natural Resources and Life Sciences, Vienna, Austria) and *Margit Sommersguter-Reichmann* (University of Graz, Austria). On the September 2020 issue, a report by the local organisers was presented. The present one is to offer the perspective of the *EWG* in these challenging times.

As for many other *EWGs*, the pandemic due to the spread of the COVID-19 poses a new challenge to the conference, that is to postpone it or to go online. After a discussion among the members of the board and the local organisers committee, the decision to move to an online version of the *ORAHs* meeting was taken around mid-April 2020. After careful consideration

of the advantages and disadvantages of the different online platforms, the local organising committee decided to use the ZOOM platform as a virtual venue. The *ORAHs 2020 e-conference (e-ORAHs)* took place virtually from July 27 to 31 at the University of Vienna (<https://orahs2020.univie.ac.at>).

The scientific program can be summarised by the following numbers: 145 participants from 23 (not only EU) countries presenting 96 papers and 10 posters. A special mention should be made for the two keynotes and the other special sessions. On Monday 27, *Peter Zweifel* gave a talk on "Preference Measurement in Health Using Experiments" while, on Tuesday 28, *Greg Zaric* gave a talk on "Incentives and Coordination in Healthcare". After *Zaric's* keynote, a round table on "Challenges in Health Care Prevention" took place with *Sally Brailsford*, *Margaret L. Brandeau*, *Alexandra Schosser*, and *Bernhard Schwarz*. On Wednesday 29, the "Covid-19 Policy Modelling" special session took place chaired by *Alexander Rutherford*. The session was composed of three talks: (1) "Discrete Event Simulation Model to support decision-making concerning COVID-19 patients' admissions in hospitals and Intensive Care Units", (2) "A Queue Network Model of Ventilator Access during the COVID-19 Epidemic", and (3) "Optimising the daily swab test collection to identify new cases of Covid-19".

Last but not least, the long awaited poster session took place on Wednesday 29, during which 10 posters were presented. In accordance with the rules of the Gallivan Award, five of them competed for the final victory. The award committee (*Roberto Aringhieri, Sally Brailsford, Michael Carter*) decided unanimously to assign the Gallivan Award to *Erin Roman* who presented the poster “*Variability in hospital treatment costs: A time-driven activity-based costing approach for early stage invasive breast cancer patients*”.

An informal survey confirmed the pleasure of attending the conference anyway. However, the hope is not to repeat an online conference since the informal aspects of attending the ORAHS conference (dinners, friendships, discussions, ...) is almost lost, despite the big efforts of the organisers.

Finally, we want to recall that this ORAHS was the debut of the new EWG coordinators *Inês Marques* and *Roberto Aringhieri* (<http://orahs.di.unito.it/chairman.html>), whose main objective is to try to innovate the EWG activities, while keeping the traditional family atmosphere that reigns in each ORAHS meeting. The opening session was devoted to illustrate the meaning of “ORAHS family” and to introduce the topics that were then discussed during the EWG business meeting. During the opening session, the whole ORAHS family expressed deep condolences for the recent passing of *Tuğba Çayırılı* and *David Bensley*. The business meeting opened with a competition for those who felt the highest temperature (the July 31, 2020, was quite hot in many countries). The discussion, which lasted more than two hours, revolved around the theme of how to organise the next ORAHS conferences and the EWG activities during the pandemic. 🌐

Global Development in the 5th Industrial Revolution: GDFC 2020 South Africa – Online – and EWG ORD

Nina Kajiji <nina@nkd-group.com>; **Gordon H. Dash** <ghdash@uri.edu>; **Gerhard-Wilhelm Weber** <gerhard.weber@put.poznan.pl>

The 4th Industrial revolution (4IR) created a proliferation of AI-based technologies, block-chains, new terms (e.g., coined the term *IoT*), and “smart” machines. In total, the argument was made that these technological advances are societal necessities for human wellbeing. But, unplanned for was the creation of a much larger global economic divide. Under 4IR, profit drove the firm’s objective function. Consequently and subsequently, supply chains were developed to maximize monetary benefits to corporations. As corporate entities created and curated specialized databases and models motivated by the need to maximize profits, the masses found it challenging to access these databases to solve indigenous problems.

This disparity became even more apparent as the world experienced the historic pandemic known today as



COVID-19. Almost instantly, global economic development and restoring sovereign economic equity became a primary focus of world governments. This commitment filtered down to corporations and academic researchers alike. These groups are actively incorporating the U.N.’s sustainable development goals (SDG) in their product and research and development efforts. As just one example, SOLVE, an initiative of the Massachusetts Institute of Technology (MIT), seeks input to design the 2021 Solve Global Challenges. Further, at the 2020 Davos Summit, the theme was “*Blockchain + A.I. + Humans = Magic!*” And, on January 26, 2021, the European Commission launched its “Green Consumption Pledge.”



▲ Impressions from *Global Development Finance Conference* series. Left to Right: *Dina Potgieter* (Executive Manager, GDF), *Dr. Gordon Dash* (Co-ordinator, EWG-ORD), *Dr. Nina Kajiji* (Co-ordinator, EWG-ORD), *Professor Nicholas Biekpe* (President, *Africagrowth* Institute and Chair, GDF). (Photo taken in 2019, before global COVID-19 outbreak.)

In this report we shall particularly address the *Global Development Finance Conference 2020* which took place virtually at *November 18-19, 2020* (cf. <https://www.globalcidef.com/event/2020-global-development-finance-conference/>), as an element in the entire congress series and in relation with our EWG-ORD.

Indeed, the *EURO Working Group on Operational Research for Development* (EWG-ORD) has long embraced the evolving global focus to the fifth generation industrial revolution (5IR). The 5IR focus is shifting industrial platforms to include sustainability at all levels. >>

>>The shift was in clear evidence at the 2020 annual Workshop meeting of EWG-ORD. Taking center stage and consistently explored at the *EWG-ORD Workshop* are topics on climate change, disaster relief, and women's health. The presentations included extensive theoretical and applied research using macro and microfinance models, AI tools like neural networks, and complexity theory. Data science methods were also in full display, including the use of tools such as SVM, MARS, Lasso, data envelopment analysis, and more. Seeking a broader recognition of the *EWG-ORD* mission, the coordinators have participated in the *Global Development Finance Conference (GDFC)* over the past few years. The *GDFC* is one of the premier economic development conferences with global participation. Sponsored annually by The Chartered Institute of Development Finance and Africagrowth Institute, the *GDFC 2020* conference was, like many professional gatherings, impacted by the COVID-19 pandemic. Given global travel restrictions, the conference was held virtually. The presentation by Professors Dash and Kajiji, bond expert Vonella, and Ph.D. student Wilcox, focused on network linkages between the spillovers and spillbacks of U.S. municipal bond markets to the South African government bond market (cf. <http://bit.ly/GDF2020-Presentation>). In addition to examining the volatility spillovers from five U.S. state-level data, the volatility spillover from precious metals and the material impact of COVID-19 were studied. Our study found significant spillover effects from both the U.S. government bond market and the South African bond market contribute to the formation of daily bond returns across the five states under study. Four of the five states experienced a negative contribution to daily bond returns due to COVID-19. One of the takeaways from the conference was identifying doctoral-level students who made a direct appeal to seek *EWG-ORD* assistance to advance their research methodologies using artificial neural networks and big data. A Ph.D. student from the University of Durban is now actively engaged using our research-based toolset.



▲ Impressions from *Global Development Finance Conference* series: attendance. (Photo taken in 2019, before global COVID-19 outbreak.)

In keeping with the theme of EURO 2021, Athens, Greece, and *EWG-ORD's* own mission, the annual *EWG-ORD Workshop* will feature the harnessing of both deep and shallow learning methods, big data, nonlinear goal programming, and more for improving the wellbeing of global societies. We will be planning in-person sessions and virtual posters and presentations. These virtual sessions are necessitated due to COVID-19 vaccination and travel restrictions, affecting participant travel in July 2021. For additional information relating to the workshop or how you can get involved, please send an email to info@ewgord.org.

Regarding next conferences by the Africagrowth Institute we refer to http://www.africagrowth.com/event_conf.htm. Especially, together with the African Finance Association, the Chartered Institute of Development Finance, the Development Finance Centre (University of Cape Town), and other African Universities and financial, accounting, banking, and research institutions, it co-organizes the *17th Annual African Finance Association* on May 11-12, 2021. 🌐

Game Theory and Management in Saint Petersburg and Online: The 14th International Conference “Game Theory and Management” (GTM 2020)

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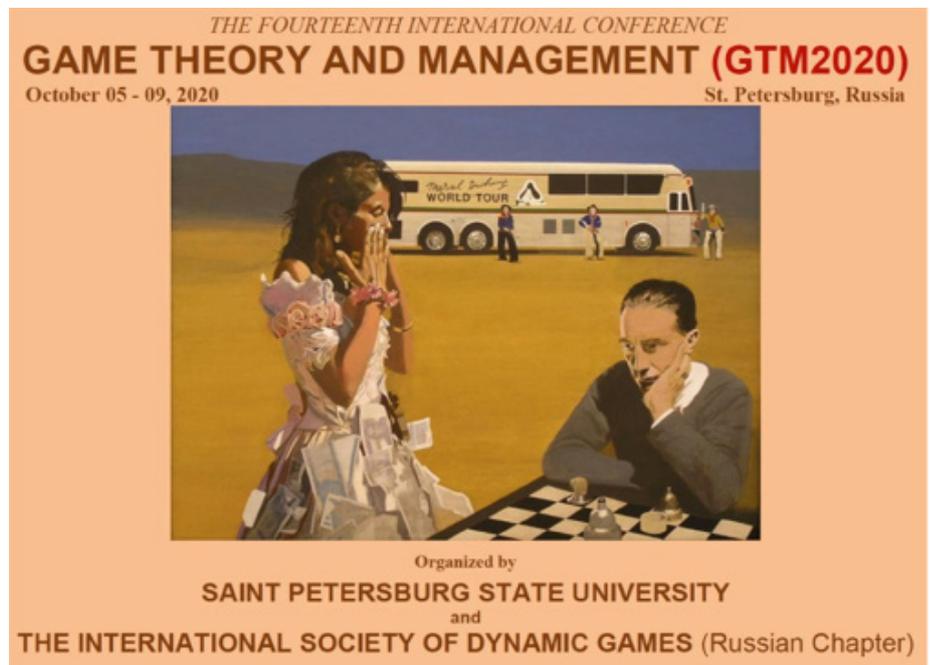
On October 5-9, 2020, the 14th International Conference “*Game Theory and Management*” (*GTM 2020*) was celebrated at Saint Petersburg State University (<https://english.spbu.ru/>), Russia, in online format. The conference was organized with the support of *Saint Petersburg State University* and *The International Society of Dynamic Games* (Russian Chapter).

This is the 14th international conference in the series “*Game Theory and Management*” held at Saint Petersburg State University since 2007. And it is the unique annual international conference on game theory and their applications in management in Russia. The uniqueness of the conference lies in the fact that both specialists in game theory, operational research and theory of dynamic games participate in the

conference, and it is supported by both the *Game Theory Society* and the *International Society of Dynamic Games*.

The main goal of the conference is to exchange the ideas in the field of game theory and its applications in various areas of management and operational research. The game theory in operations research applications is a basis of the study of organizations and decision making of individuals, as well as an important tool to describe network formation including formation of communities in social networks. Game theory helps to analyze the information and find the optimal or equilibrium behavior of organizations or individuals operating available information which can be limited.

The *GTM 2020* conference was traditionally organized under the guidance of a permanent international Program Committee chaired by Prof. Leon Petrosyan and Prof. Nikolay Zenkevich. Based on the decision of international program committee in 2020, the topics of the 14th International conference "GTM 2020" included dynamic, differential, evolutionary, stochastic, network, adaptive and cooperative games, operational research as well as game theory applications in the areas of management: strategic and international management, industrial organization, marketing, operations and supply chain management, public administration, financial management, energy and natural resources management, environmental management problems.

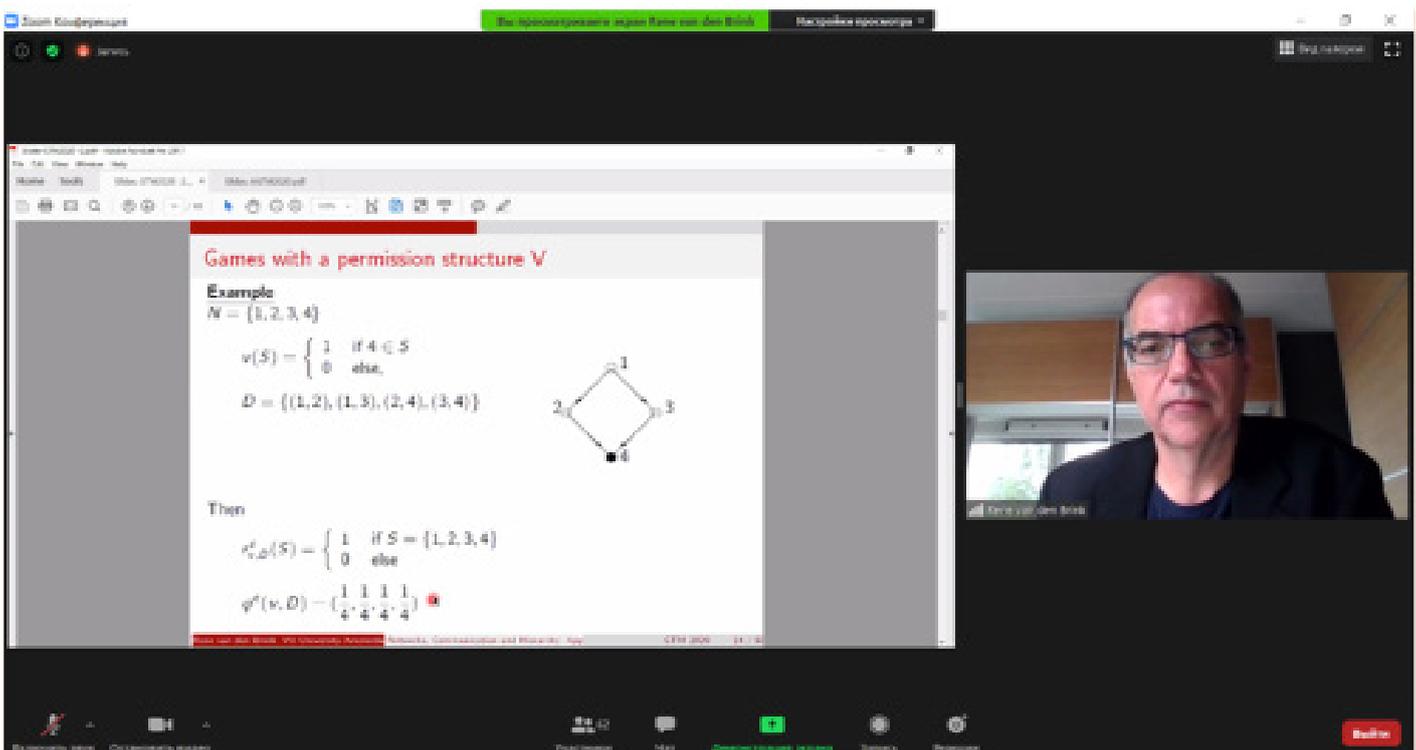


▲ A poster of the 14th International Conference "Game Theory and Management".

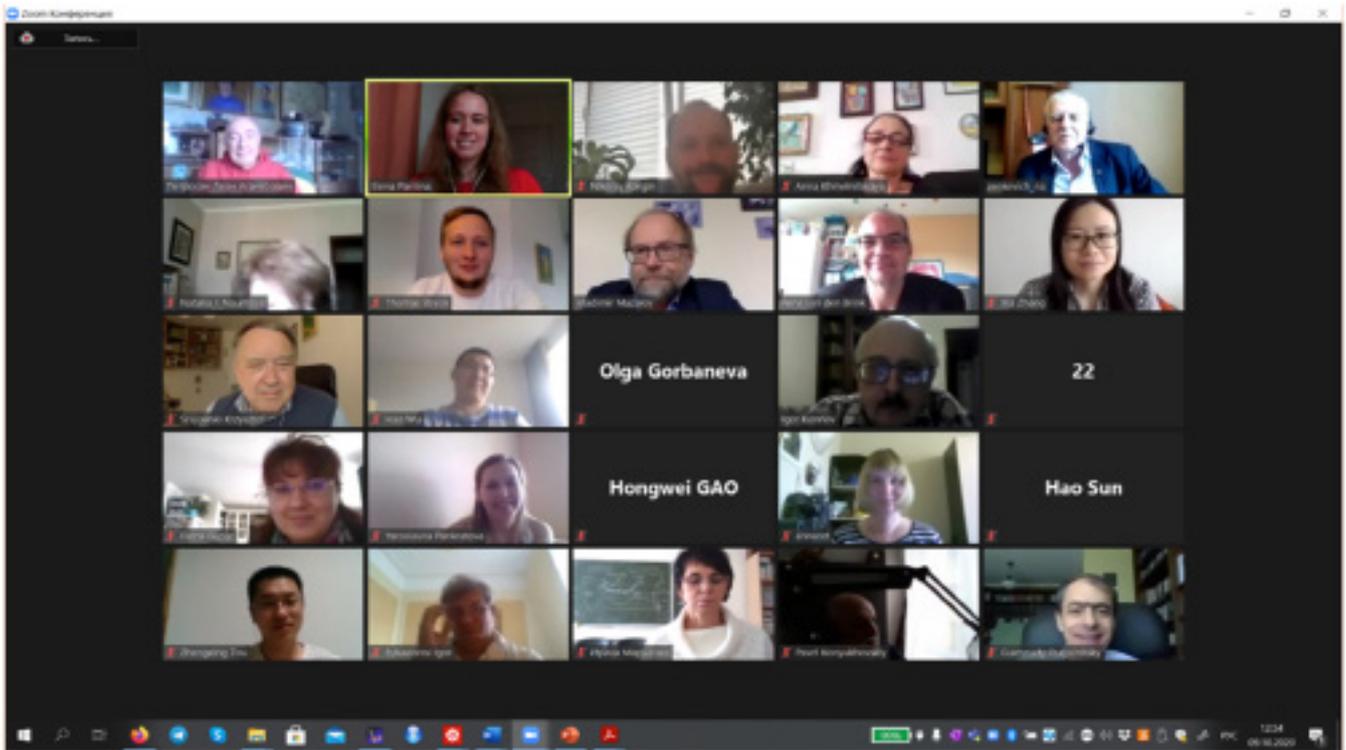
Four experts in the field of game theory and its applications in management sciences were invited to *GTM 2020* as plenary speakers. They made the following presentations: "Networks, Communication and Hierarchy: Applications to Cooperative Game", Professor Rene van den Brink, Vrije Universiteit Amsterdam, the Netherlands; "Spatial Effects and Strategic Behavior in Transboundary Pollution Dynamic Games", Professor Javier de Frutos, University of Valladolid, Spain; "Numerical Computations with Infinities and Infinitesimals: Methodology and Applications", Professor Yaroslav Sergeyev, University of Calabria, Italy; Lobachevsky State University, Russia; "Conflict and Cooperation in Marketing Channels: A Game-Theoretic Perspective", and Professor Sihem Taboubi, HEC Montréal, Canada.

In total, 94 reports of 164 authors from 24 countries (Argentina, Australia, Brazil, Canada, Czech Republic, China, Great Britain, France, Germany, Hungary, India, Iran, Italy, Japan, Luxembourg, Moldova, Mongolia, Netherlands, Romania, South Korea, Spain, Ukraine, USA, and Uzbekistan) and 12 regions of Russian Federation were submitted. Finally, 90 researchers representing 52 scientific organizations participated. In total, 83 section talks (some in co-authorship) and 4 plenary talks were made. The number of registered participants was 128.

The participants from Russian Federation represented 13 cities: St. Petersburg, Moscow, Petrozavodsk, Nizhny Novgorod, Yekaterinburg, Saratov, Novosibirsk, Samara, Irkutsk, Kazan, Izhevsk, Vladimir, Vladivostok.



▲ A snapshot of the plenary lecture by Prof. Rene van den Brink.



▲ A snapshot of the conference participants.

In addition to plenary sessions, 15 parallel sessions were organized in the following areas: Game theory and applications to management (5 sessions), Dynamic games and applications (4 sessions), Network games, Collaboration in supply chains and social networks, Cooperation, allocation and negotiations, Game theory and economic applications, Numerical methods of decision making, Game theory problems, Multicriteria games.

The proceeding of the conference will be published in

2021. Further details about “14th International Conference Game Theory and Management (GTM-2020)” are available on the official conference’s website <https://gsom.spbu.ru/en/research/conferences/gtm2020/>

At the closing session, the 15th international conference “Game Theory and Management 2021” was announced. It will be held at Saint Petersburg State University on June, 23-25. Further details on GTM 2021 can be found on the official website <https://gsom.spbu.ru/en/research/conferences/gtm2021/>. 

The First OR/Data Science Virtual Conference in Latin America - Presented by Galileo University in Collaboration with INFORMS

Jorge Samayoa <jorge@galileo.edu>

This virtual conference “Advances in Data Science & OR Virtual Conference” was held on September 22-24, 2020, and hosted more than 700 delegates from 26 different countries (for a survey, please cf. the first figure).

After I finished my Ph.D. at Purdue University, I went back to my country, Guatemala. Among other activities, I was re-hired by Galileo University to chair the operations research program – a small program with a handful of students and some faculty members. In order to increase the popularity of the area in the university, I launched a few initiatives with the objective of gaining ownership of *Operational Research*; INFORMS played an important role!

I signed up all my students to INFORMS and we started organizing more OR related activities. After improving the marketing strategy, service and hiring more faculty, we started growing significantly. In two years, we went from a handful of students to 60 and becoming one of the most popular master’s programs in the college of engineering.



A year later the president of the university and I thought that having an institute dedicated to OR and related areas could help us to continue this growth, and the *Operations Research Institute (IIO, in Spanish)* was born. This became a platform for launching programs in Data Science and Business Intelligence, going from 60 to more than 160 students nowadays – all *INFORMS* members.

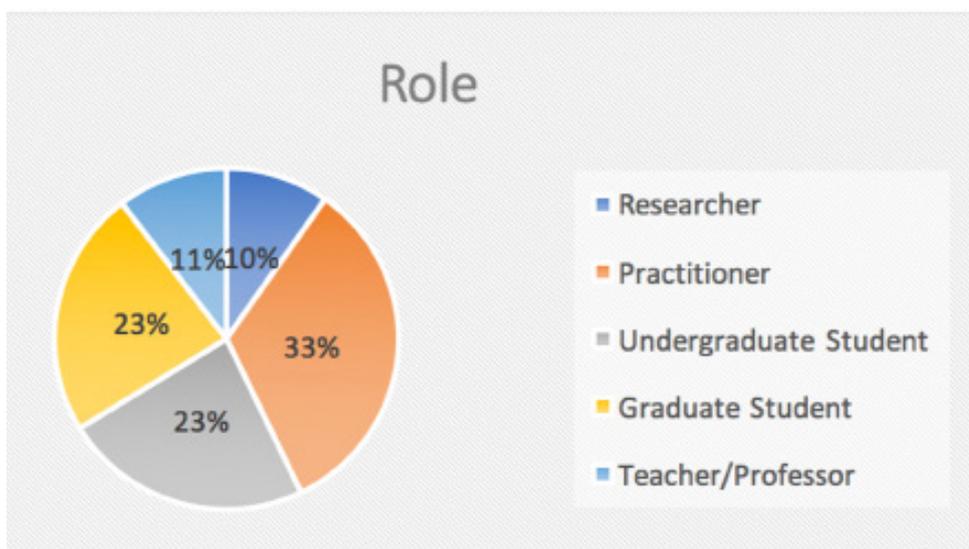
Because of this growth on the *INFORMS* membership from Guatemala, I was contacted by *Sue Merchant*, VP of international activities of *INFORMS*. She asked me to become part of *INFORMS' International Activities Committee (IAC)*. In this venue, I presented the initiative of organizing a series of small conferences in countries where we have members but attending mayor conferences could be complicated and offered Guatemala to run the pilot. Fortunately, I had the support of the IAC and the board authorized it.

Originally, we (the *IAC*) thought we should have a rather small conference (100-125 delegates) in the campus of Galileo University, but the pandemic came out; we had to switch to virtual. This brought an opportunity to increase the impact in the region.



▲ *Advances in Data Science & OR Virtual Conference*: participating countries.

Before and after the conference we conducted a survey in order to study the impact of the conference. We found that 90% of the registered delegates had never attended an *INFORMS / OR* conference in the past. On average, 96% were either very satisfied or satisfied with all the activities of the conference, the rest were between neutral and dissatisfied. 99% would recommend this type of conference, and 98% would consider attending an *INFORMS* conference in the future. The professional role of the delegates can be found on our second figure.



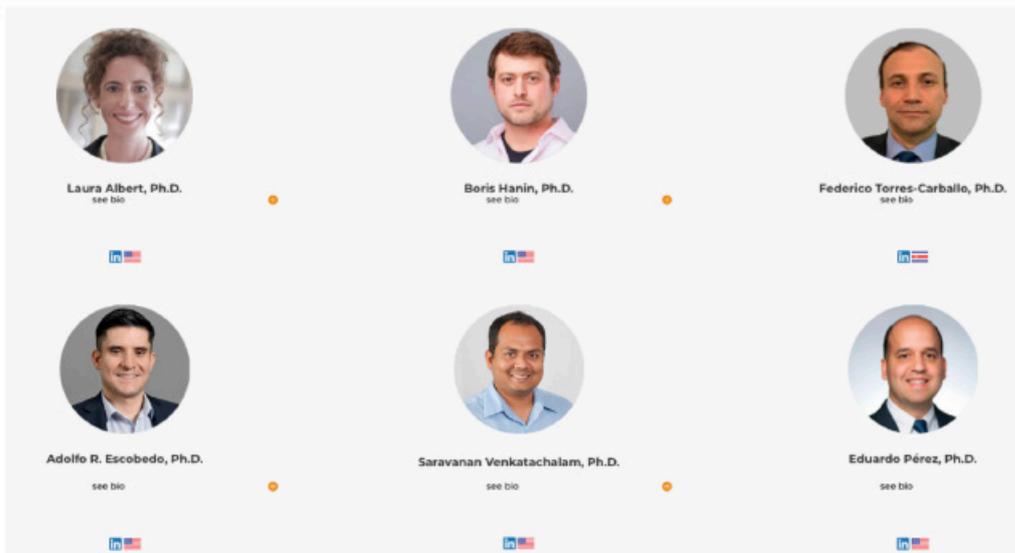
▲ *Advances in Data Science & OR Virtual Conference*: role of the participating delegates.

I put together a team of great professionals in the university, and had all the support from the university board, the *IAC* and *INFORMS*, thus we were able to organize this event. We had 3 international keynotes, 2 workshops, 12 technical talks, 1 poster competition and a networking event, spanned in a three-day experience.

The conference was organized with 10% of the original budget we had estimated for the in-site conference and had 600% more delegates registered than the expected. We had three sponsors, making the event free for all delegates – I can guarantee that these delegates spent less than what they would in the in-site event.

I would like to thank *Sue Merchant* and all the *IAC*, *Universidad Galileo*, *INFORMS* and our sponsors for all their support. Also, I want to extend a special thanks to the organizing committee *Preng Biba*, *José Ramirez*, *Marco To*, *Alberth Alvarado*, *Miguel Morales*, *Roberto Portillo*, *Marco Tulio Gomez*, *José Josué* and *Juan Carlos Pozuelos*, for all the effort put into this - we had a blast!

International Speakers



▲ *Advances in Data Science & OR Virtual Conference: our international speakers. To learn more about the speakers please follow this link.*



Advances in Data Science & OR Virtual Conference.

WHAT INFORMS OFFERS MEMBERS :

- **International conferences** (at reduced fees)
(eg Business Analytics and the Annual Meeting – virtual this year)
- **Certified Analytics Professional (CAP) qualification**
- **Website packed with useful information** www.informs.org
-Training courses, on-line tutorials, videos, webinars, case studies
-Resources for teachers.....etc
- **19 World class journals and magazines including:**
Applied Analytics; Decision Analysis; Transportation Science; Manufacturing and Service Operations Management; Operations Research; Transactions on Education; Management Science; Strategy Science; Stochastic Systems; Analytics magazine; OR/MS Today; and many others



▲ *INFORMS: co-host at Advances in Data Science & OR Virtual Conference; with Sue Merchant (LinkedIn) and Jorge Samayoa (LinkedIn).*

This was a fantastic experience, with a lot of learning. We, as IAC, hope to continue to replicate this event in other countries and help more professionals and scholars be part of an OR communities. I would encourage other societies to organize this type of events, and feel free to contact me if I can be of any help!

For more information about the conference, please visit here:

<https://www.galileo.edu/page/en/virtual-congress-advances-in-data-science-and-operations-research/>

For more information about our programs, please visit here: <https://www.galileo.edu/iio/>

ICCESEN 2020 Antalya Online - Migport, Migration Portal and COVID-19's Impact on Digitalization

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Selma Gütmen <selmagutmen@gmail.com>; **Gerhard-Wilhelm Weber** <gerhard.weber@put.poznan.pl>

Following the tradition of the previous six years, *ICCESEN 2020 - 7th International Conference on Computational and Experimental Science and Engineering*, October 21-25, 2020, was conducted as "online" due to COVID-19 and very successfully again (<https://www.iccesen.org>). Under the leadership of Conference Chair, *Prof. Iskender Akkurt* from Süleyman Demirel University, several universities of Turkey initialized and co-organized "ICCESEN". These conferences are hosting registered participants from all over the world, around 500-700 attendees with about 1000 papers, in beautiful Kemer, Antalya, Turkey. This conference series offers to Middle East and North Africa academics a unique chance to gather with international scholars, to show their newest findings and develop scientific collaborations. Scientists, designers and engineers, from applied mathematics, *OR-MS*, industrial engineering and technology, computer engineering and natural science, business and economics, education and healthcare share their findings and give oral presentations. The conference series connects people with their backgrounds from various science, high-tech, and *OR* branches. Interdisciplinary works disclose potentials of scientific enrichment between *OR* and aerospace technology, radiology and medicine, electrical engineering and neuroscience, finance and economics, optimization applications and social sciences. If ever he could not attend in person, *Willi* became substituted by a friend, or he took part electronically. He collaborates with *OR* in Turkey and maintains contacts between the "old and new" Turkish friends and conferences.



▲ Youth, Social Entrepreneurship & Sustainable Development Workshop, Rutgers University, ZOOM platform, 2020.



▲ Gerhard-Wilhelm Weber's speech at ZOOM platform of ICCESEN 2020.

In the year 2020, the whole conference had to take place *online* because of the pandemic COVID-19. As in the past, *OR*, its subjects and its community, served as a "secret weapon" of *ICCESEN 2020's* success. Like in all of the six previous *ICCESEN* editions, *Willi* was an Invited Speaker and, in the 2020 congress, referred on "*The Arts: Supported by Data Analytics, Deep Learning and OR: Human Creativity and the Art of Painting*" from a scientific, an artistic and an economic viewpoint, an interdisciplinary and a novel *OR* perspective. His coauthors have been *Melvin Selim Atay* (METU, Ankara, Turkey) and *Dr. Suryati Sitepu* (HKBP Nommensen University, Medan, Indonesia). *Willi* was a member of the Scientific Committee for *ICCESEN 2020*. The participants of *ICCESEN 2020* were informed about the spirit of our *EURO* and *IFORS* conferences, and our nearest congresses, especially *IFORS 2021* in Seoul, Korea, August 22-27, 2021 (<http://www.ifors2020.kr/>), and *EURO 2021* in Athens, Greece, July 11-14, 2021 (<https://euro2021athens.com>).

The year 2020 has been a challenging year for academia that many international events, conferences and programs have been canceled. Despite face-to-face events canceled, the online shift created a new opportunity with digital conferences, workshops and events. Online conferences connected more people from all around the world than before. *Berat Kjamili* and *Gerhard-Wilhelm Weber* started a sympathy- and award-winning startup, *Migport* (www.migport.com), which connected refugees online. *Migport* as a startup was entirely online even before the pandemic. In late 2017, *Willi* moved to Poland from Turkey. *Berat* still resides in Ankara, Turkey. However, they continued writing reports, papers and chapters, and working on the startup online. The story of *Migport* connecting people online for the social good can be applied to the pandemic.

Hence, *Migport* organized and participated in the biggest hackathons ever organized with European Commission, *Coronathon Turkey*, and *Migathon*, which connected around 30,000 people worldwide to find solutions to the social and environmental problems caused by the Coronavirus. *Migport* also took an active role in the “*Youth, Social Entrepreneurship and Sustainable Development*” workshop, run by Rutgers University, funded by Hollings Center for International Dialogue, its Turkish chapter being coordinated by *Migport*. The workshop connected 40 young social entrepreneurs from Turkey, Iraq and Pakistan with each other and top



▲ In the ZOOM platform of ICCESEN 2020; some speakers and organizers: Prof. G.-W. Weber, moderator Dr. Feride Kulalı (Üsküdar University, Istanbul, Turkey), Chair Prof. Iskender Akkurt, Prof. Madjid Fathi (University of Siegen, Germany) and Prof. Zuhail Er (Istanbul Technical University, Turkey).

social entrepreneurship ecosystem players of the best. The program aims to start the next global social ventures, which include international teams with the same purpose to solve societal problems we have. The YSESD core team include YSESD Director and PI, Dr. Eric Davis from Rutgers University, Dr. Yass Alkafaji from the American University of Sharjah, Dr. Abid Ali, Data Science Program Faculty, Northwestern University, Evanston, IL, and Mr. Berat Kjamilli, *migport.com* – Refugee Knowledge Sharing Platform, Istanbul, Turkey.

We recall that one and a half year ago, *Migport* also delivered a keynote speech at ICCESEN 2019 – 6th International Conference on Computational and Experimental Science and Engineering, Kemer, Antalya, Turkey, October 23-27, 2019 (cf. <http://www.iccesen.org/>, link: “Previous ICCESENs”). ICCESEN conferences have strongly contributed to *Migport* in terms of encouragement and for establishing further interdisciplinary connections from OR, high-tech and other sectors. *Migport* has brought the experience of high-tech and social impact into the entrepreneurship and startup world. Last but not least, *Migport’s* experience of ICCESEN can be explained as a merge of social and high-tech impacts. 🌍



▲ Youth, Social Entrepreneurship & Sustainable Development Workshop, Rutgers University, ZOOM platform, 2020.

The International Conference of Production Research: ICPR - Americas 2020. Held Virtually and Successfully - A Participating Scholar's Perspective

Ibrahim Kucukkoc <ikucukkoc@balikesir.edu.tr>

ICPR-Americas 2020 was held virtually during December 9-11, 2020 [1]. After a careful peer-reviewing and selection process, around 260 presentations from many different countries, not only from the Americas but also Europe, Asia, Africa and Australia have been made in addition to five enlightening plenary talks.

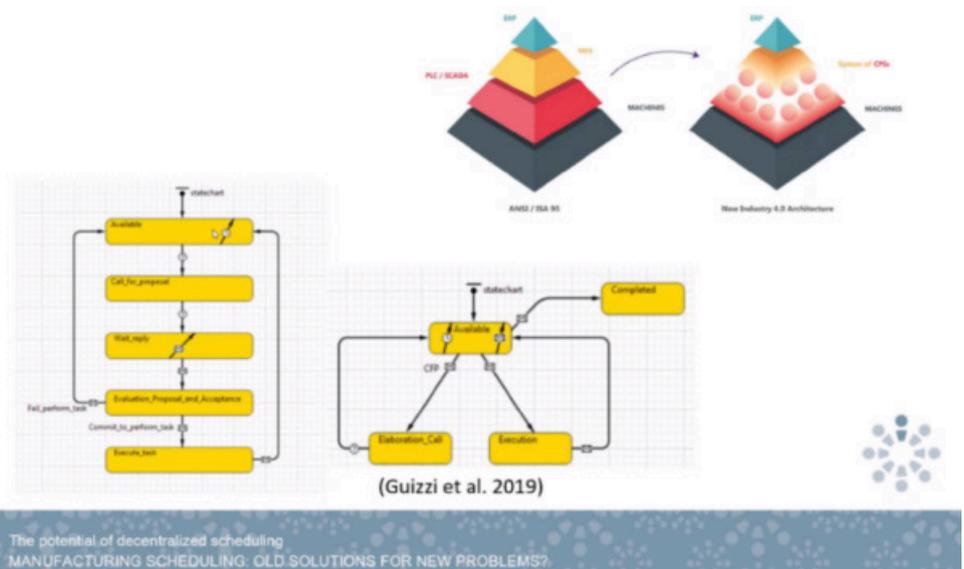
Although the conference was originally scheduled to be held at the campus of *Universidad Nacional del Sur* in *Bahia Blanca* (Argentina), it was reorganized in a purely virtual form based on the decision by *Daniel Rossit* (General Conference Chair) and *Fernando Tohmé* (Scientific Chair) due to COVID-19 pandemic.

I have come across to the conference call through an IFORS announcement [2] and submitted two papers with my colleagues (*Qiang Li* and *David Z. Zhang* both from University of Exeter, UK and *Zixiang Li* from Wuhan University of Science and Technology, China). The papers were accepted after a revision based on constructive comments from anonymous reviewers.

The Opening Ceremony and the First Day

Following the opening ceremony chaired by *Luis Quezada* (President of IFPR), *Jose Framinan* (University of Seville, Spain) delivered a plenary talk titled "*Manufacturing Scheduling: Old Solutions for New Problems?*" [3]. After a brief introduction on recent disruptive changes in the manufacturing process/technologies (such as additive

The potential of decentralized scheduling



manufacturing), *Jose Framinan* discussed "whether these changes may be addressed by simply extending the existing scheduling theory by e.g. devising new scheduling models and/or new solution procedures, or whether they require a profound rethinking of the field by incorporating new approaches".

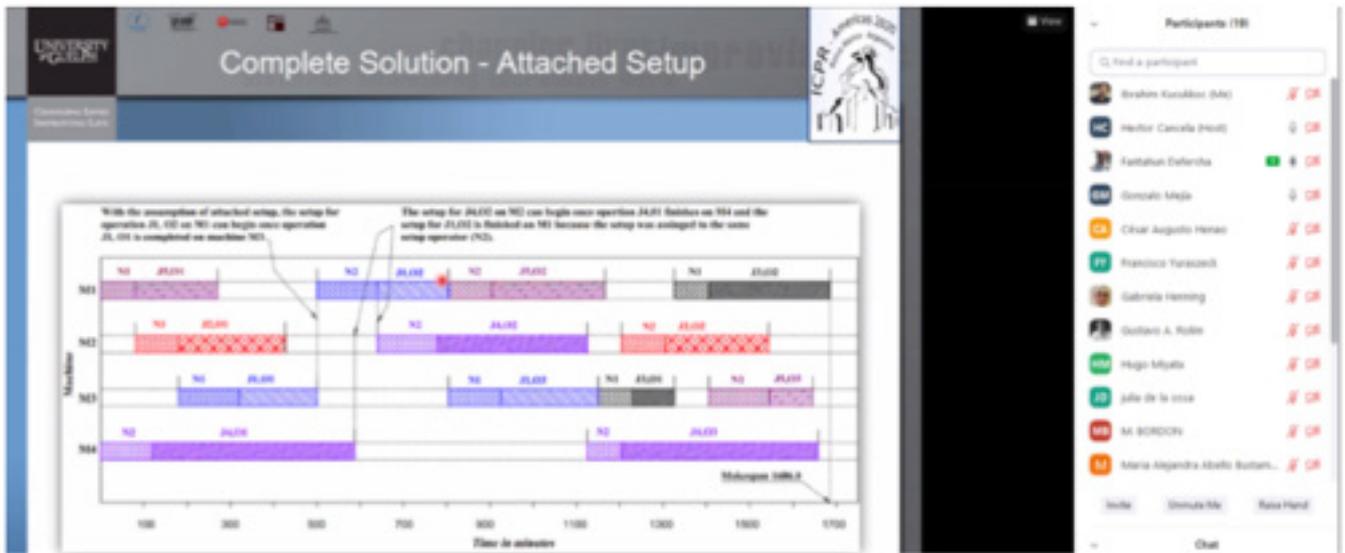
Several special [4] and general sessions (each had about 4-5 presentations) have been organised usually in six parallel sessions. The special sessions included recent hot and emerging topics, e.g., *Production Planning and Industry 4.0*, *Machine Learning and Big Data in Industrial Processes*, *Sustainable Production and Reverse Logistics*, and *Mechatronics for Advanced Manufacturing* among others.

Participants were allowed 20 minutes presentation (including 5 min Q&A) in English, Spanish or Portuguese.

Another plenary talk in the first day of the conference was delivered from *Gonzalo Mejía* (Universidad de La Sabana, Colombia) on "*Perspectives and Trends of Industry 4.0 in Latin America*". He first introduced the current topics and technologies then addressed new trends and perspectives of Industry 4.0 in Latin America. A special focus on production systems, urban transportation and supply chain was given and potential areas of application and new research topics were examined.



▲ Plenary speakers *Francesco Pilati* (upper left) and *Dmitry Ivanov* (below), and the General Conference Chair *Daniel Rossit* at ICPR-Americas 2020.



▲ Another interesting presentation titled “A Genetic Algorithm for Flexible Job Shop Scheduling Problem with Scarce Cross Trained Setup Operators” by Fantahun Defersha at ICPR-Americas 2020.

Two Plenaries followed by a Full Programme in the Second Day

The second day has begun with two plenary talks from Francesco Pilati (University of Trento, Italy) and Dmitry Ivanov (Berlin School of Economics and Law, Germany). Francesco Pilati presented “hardware/software architectures aimed at the human body digitalization and analysis during the execution of manufacturing/assembly tasks within common industrial workstations” in his talk entitled “Digitalization of Manual Production and Assembly Processes for Smart Factories of the Future”. This was followed by the talk entitled “Ripple Effect in Supply Chain Networks: History, New Insights from the COVID-19 Pandemic, and Future Perspectives” by Dmitry Ivanov in which “a viable supply chain model and debate about concepts of digital twins, structure dynamics control, intertwined supply networks, and reconfigurable supply chains” were presented.

These were followed by interesting presentations, including

“Modelling the Dynamics of a Smart Factory” by Marisa Sanchez (Universidad Nacional del Sur, Argentina). Another interesting presentation was made by Fantahun Defersha (University of Guelph, Canada) on dual-resource constrained flexible job shop scheduling problem, entitled “A Genetic Algorithm for Flexible Job Shop Scheduling Problem with Scarce Cross Trained Setup Operators”.

Our presentations titled “2D Nesting and Scheduling in Metal Additive Manufacturing” and “Dynamic Order Acceptance and Scheduling Approach for On-demand Production with Additive Manufacturing by Considering Idle Costs” were also scheduled and presented on the second day. Both papers focus on the scheduling issues in cutting edge additive manufacturing technology from different aspects. We appreciate the great feedback on possible extensions of our research from the audience (which will certainly help when preparing extended versions for the post-conference publications).



ICPR - Americas 2020
The International Conference of Production Research
Bahía Blanca, Argentina, December 9-11, 2020

2D Nesting and Scheduling in Metal Additive Manufacturing

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▲ Our first paper presented at ICPR-Americas 2020.



▲ Our second paper presented at *ICPR-Americas 2020*.

The Last Day and the Awards Ceremony

The third (and also the last) day of the conference included a plenary talk and award & closing ceremony after a full conference programme (started at 8:30 in local time as usual). *Sri Talluri* (Michigan State University, USA) discussed supply chain strategies and practices that have contributed to the disruptions we are currently facing amid COVID-19 in his plenary speech entitled *"Managing Macro Level Supply Chain Disruptions: Lessons from COVID-19"*. The presentation *"A Benders Decomposition Approach for an Integrated Bin Allocation and Vehicle Routing Problem in Municipal Waste Management"* (by *Arthur Mahéo, Diego Gabriel Rossit and Philip Kilby*) received the Best Paper Award. The *Best Young Researcher's Paper Award* went to *Juan Antonio Cedillo-Campos* (Tecnológico de Monterrey, Mexico) with the presentation entitled *"A production planning MILP optimization model for a manufacturing company"*.

While a physical event would be much more beneficiary in many aspects, no doubt that the chairs and the organisation committee did their best to make the conference great success. The programme committee was very successful to group talks considering the language of the presentation as well as the topic itself. Now it is time for the authors to prepare extended manuscripts for the post-conference publications in reputed indexed journals [5].

The *26th ICPR conference* will be held in Taiwan in 2021 again in virtually. The conference website [6] is already live and the submissions due very soon (be quick!).

Hope to see you there!

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On the author. *Ibrahim Kucukkok* is an associate professor at Balikesir University, Turkey. He obtained his PhD degree from the University of Exeter, UK in 2015. 🌐

▲ The *26th ICPR* event is planned to be held virtually in Taiwan in 2021 as indicated during the Closing Ceremony at *ICPR-Americas 2020*.

Summer School in Australia Attended by the Curious from all Over the World - IEEE Canberra

AI 2020

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Artificial Intelligence (AI) enables breakthroughs in a myriad of areas, from health to finances, from electronics to robotics, and from small-scale to world-encompassing – and some of them are in close collaboration with *Operational Research (OR)*. AI technology is being driven by rapid advances in machine learning as well as mathematical methods, and this summer school on AI has showcased international research as well as world-leading domestic expertise. It has provided an educational platform for innovative, interdisciplinary research associated with the computational concepts underlying intelligent systems.

To bring AI to the broader technical and non-technical audience, we have organized this summer school under the title of the *IEEE Canberra Artificial Intelligence Summer School* (December 4-7, 2020, <http://canberraai.net/caiss2020/>), cordially inviting everybody around the world to participate -- for free! We have secured high-caliber Australian and international AI experts, who have shared their passion for both Artificial Intelligence (AI) and education. The primary targets of this Summer School have been undergraduate students and early career academics that are hungry for learning about

University of Nottingham
UK · CHINA · MALAYSIA

Penguin watch competitions

Increasingly an important area of data collection and research is citizen science. Intervals can help to efficiently gather rich data.

Many important citizen science projects involve keeping count of animal populations – including penguins.

We have a short competition where you can have a go at this – best estimates win 100 AUD (probably as a voucher)! (Randomly adjudicated if exact draw).

<https://decsys.azurewebsites.net/survey/1ezv>

▲ *IEEE Canberra AI 2020*: Competition organized by *Christian Wagner* (University of Nottingham).

AI and lifting their skills in the field, and it has been organized in broad tutorial and hands-on session's format. The Summer School was sponsored by the *IEEE Computational Intelligence Society (IEEE CIS)*.

Leading up to the event, we have received over 200 registrations from over 30 countries. Of these, approximately 30% were from PhD students, 20% coursework students, 15% postdocs and early-career researchers, 15% other academics, and the remaining ones ranged from teachers to professionals from industry. To keep our attendees up-to-date, and to enable communication among them, we set up a Discord channel, where over 170 of them have joined.

During the event, we have used ZOOM and its "breakout session" feature, which allowed us to quickly set up group discussions of 5-8 participants. Whenever possible, each breakout room had an organizer, a presenter or a volunteer coordinating the discussions when needed.

Zoom Meeting

Recording... View

Participants (28)

Hirad Assimi

Markus Wagner

Pascal Kerschke

Anja Jankovic

federicopigazzi

Raphael Patrick Fra

Ales Zamuda

Ali Rida I

Lennart Merlin Schäper...

WWU Münster

WIS & STAT

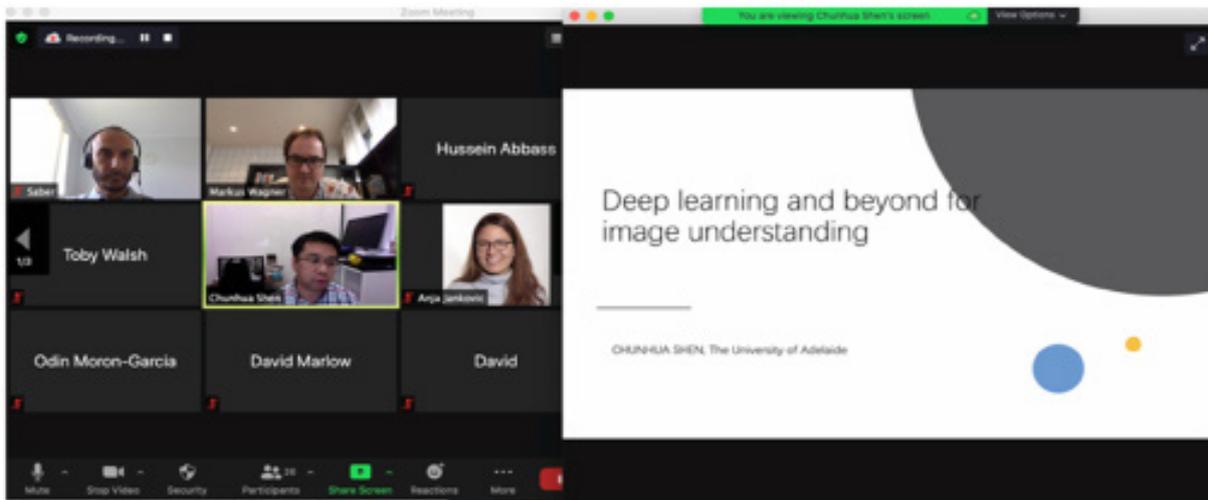
Fundamentals, Benefits and Perspectives of Automated Algorithm Selection

Pascal Kerschke
University of Münster, Germany

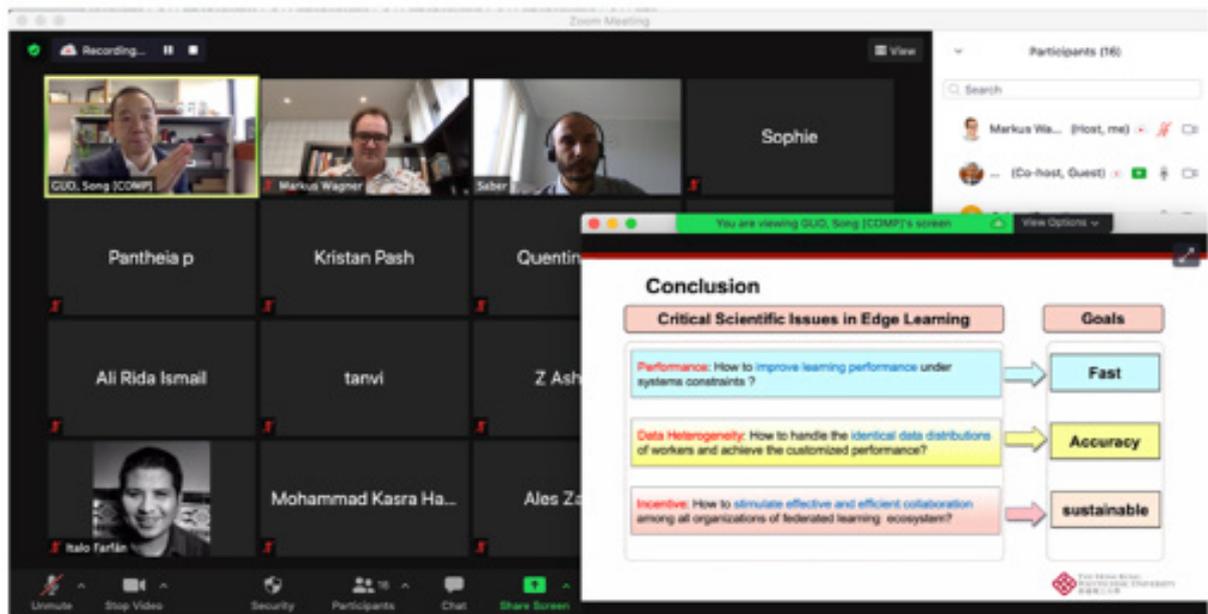
Presenter: 80th Ontario Artificial Intelligence Summer School (2020)
At New York 19 Street
December 14, 2020

▲ *IEEE Canberra AI 2020*: *Pascal Kerschke* (University of Münster) during his weekend session

While we had initially intended to "engineer" the audience of these breakout sessions to maximize diversity - i.e., to balance the expertise across the groups - this would not have been easily possible due to the unexpectedly large number of registrations. >>



▲ IEEE Canberra AI 2020: Chunhua Shen (University of Adelaide) kicking off his session.



▲ IEEE Canberra AI 2020: Song Guo (Hong Kong Polytechnic University) wrapping up his session on edge learning.

>> As a positive side-effect, however, this has meant that a random allocation would (to a large extent) average out the effects automatically. From what we have observed, good discussions have been going on, with attendees using their cameras and thus meeting people independent of their location.

To briefly explain the “Canberra” in the summer school’s title: it has been co-located with the *Canberra Artificial Intelligence week* (<http://canberraai.net>), which has encompassed a number of events, including the *IEEE Symposium Series on Computational Intelligence (IEEE SSCI 2020)*, the *33rd Australasian Joint Conference on Artificial Intelligence (AI2020)*, the *18th Australasian Data Mining Conference (AusDM’20)*, *Women in Artificial Intelligence (WAI2020)*, and many more. The intention had been to organize the summer school as a traditional one, i.e., face-to-face - however, we had to go fully online due to the pandemic. While we simply could not offer the same level of immersion and direct networking, the positives are plentiful: we have had both attendees and speakers participate who could otherwise not have come to Canberra, and the cost of organizing the event has been minimal, as has been its CO2 footprint.

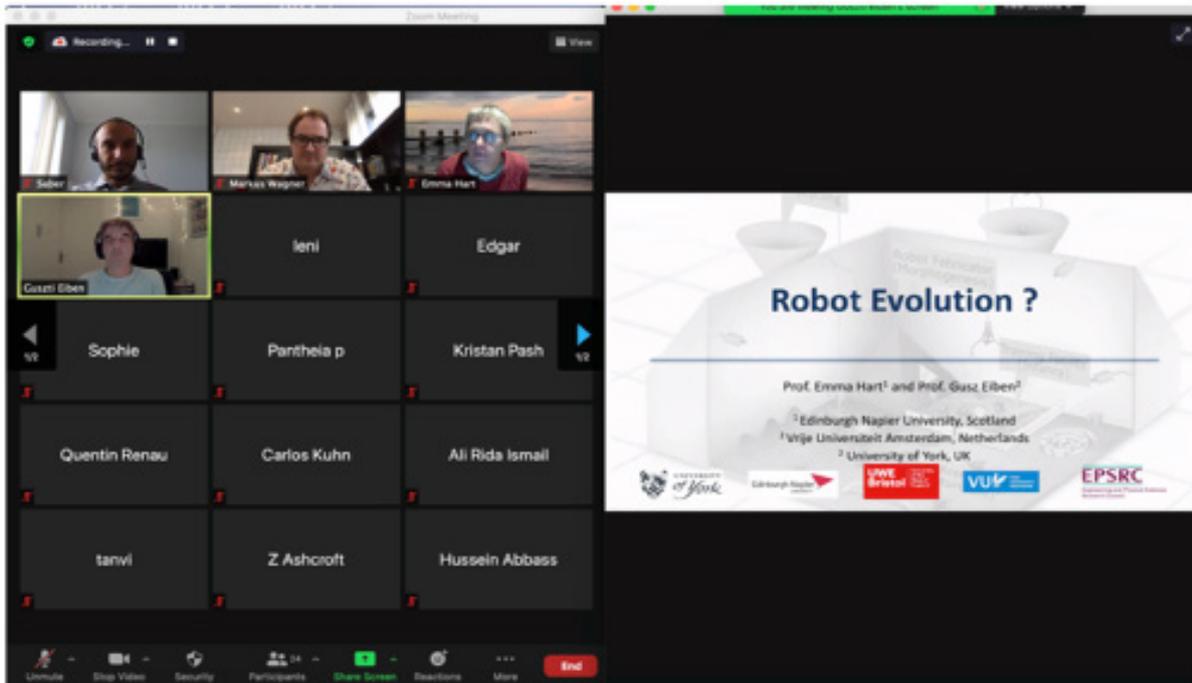
Based on the local time of Canberra (Australia), we have run

the summer school as four sessions named either “AI for lunch”, “AI for dinner” or “AI from dusk till dawn”.

On December 4, we had “AI for dinner”: following the welcome by the organizers, *Christian Wagner* (University of Nottingham) and his team kicked it off with “*Capturing and Handling of Uncertainty at Source - using intervals rather than numbers in AI*”. Besides the academic content, this included a live competition where participants had to estimate the number of penguins in pictures, and the winner has been awarded AUD 100.

On the weekend, with “AI from dusk till dawn”, *Yaochu Jin* (University of Surrey, UK) told us about advances in “*Data-driven evolutionary optimization: From complex engineering design to deep neural architecture search*”, before *Pascal Kerschke* (University of Münster, Germany) focused on “*Fundamentals, Benefits and Perspectives of Automated Algorithm Selection*”.

On December 7, during “AI for lunch”, four Australian researchers captivated the audience. First, *Haris Aziz* and *Toby Walsh* (University of New South Wales, Australia) taught on “*Game theory and market design*”, and then *Chunhua Shen* and *Qi Wu* (University of Adelaide, Australia) on “*Vision-and-Language: the next generation of AI*”.



▲ *IEEE Canberra AI 2020*: start of the session held by *Emma Hart* (Edinburgh Napier University) and *Gusz Eiben* (Vrije Universiteit Amsterdam).

In the last session on December 7, again termed “*AI for dinner*”, *Song Guo* (Hong Kong Polytechnic University) first presented on “*Edge Learning for Distributed Big Data Analytics: Theory, Algorithm and System Design*”, before we concluded the summer school with *Emma Hart* (Edinburgh Napier University, UK) and *Gusz Eiben* (Vrije Universiteit Amsterdam, the Netherlands) “*Artificial Evolution of Robotic Ecosystems*”.

This online summer school has shown that modern technology based on machine learning as well as mathematics can bring us engaging summer schools despite travel bans. While many

of the established academics might be longing to see each other again in person, new teaching and interaction concepts open up academic events to audiences who could otherwise not participate, may it be due to health, political, or financial reasons. We are looking forward to seeing what the future will enable us to do - in the ever-growing fields of *AI* and *OR*, and in particular at their intersection.

Lastly, we would like to thank thank *Jiangjun Tang* and *Raul Zapata* for looking after the website, as well as *Yuanheng Zhu* and the *IEEE CIS* for making this summer school possible. 🌐

Innovation for Systems Information and Decision - The 2nd Meeting: Virtual Conference from Brazil



Prof. Dr. Danielle Morais (Recife, Brasil):
Program Chair of *INSID-2020*.

The *INSID* meeting is an event linked to the *INCT-INSID* (<http://insid.org.br>), which is a Brazilian project with a cooperative inter-institutional scientific network through international extensions for developing advanced research and applications on decision making and aiding (including multicriteria and multiobjective methods - *MCDM-A*, and group decision and negotiation - *GDN*). The *INCT-INSID* is led by *Prof. Adiel Teixeira de Almeida* from Universidade Federal de Pernambuco and has more than 10 international partners (<http://insid.org.br/>



Prof. Dr. Pascale Zaraté (Toulouse, France):
Member of scientific committee *INSID-2020*.

international-associate-partners/).

The *INSID* is an annual *International Conference on INnovation for Systems Information and Decision*. This meeting provides a forum for those working in developing advanced research and applications on decision making and aiding (including multicriteria and multiobjective methods - *MCDM-A*, and group decision and negotiation - *GDN*) since 2008, under the acronym *SIDS*.

The first *INSID* was held in 2019 in Natal, Rio Grande do Norte, Brazil. The second *INSID* has been at the Federal University of Pernambuco in Recife, Pernambuco, Brazil, from December 2-4, 2020. Due to the current situation of COVID-19, the *INSID 2020* happened virtually.

The *INSID 2020* presented long papers in proceedings published at Lectures Notes in Business Processing (LNBIP), Springer (*INSID 2020* was the first volume of proceedings in LNBIP Series). Short papers, extended abstracts and abstracts published in local proceeding. For *INSID 2020*, 8 long papers, 14 short papers, 31 extended abstracts and 29 abstracts have been presented during the conference.

Before the conference, the participants were asked to create a 15 minutes video of their presentation. The videos were broadcast for the participants according to the schedule of the event, and after each presentation, the participants had 5 minutes for live discussion. The program assigned a chair/co-chair for each session, which briefly introduced the session and requested to the technical support to broadcast the video. At the end of each presentation, the participants activated camera and microphone (in *google meet* platform) and discuss



INSID Innovation for Systems Information and Decision meeting about the paper.

INSID 2020 provided a stimulating environment for the dissemination of state-of-the-art and knowledge about *INnovation for Systems, Information and Decision* and allowed discussions among participants, exchanging ideas and critical comments.

A new *INSID* event will be organized next year hopefully in real life, in Recife/Brazil from December 1-4, 2021 (see the call for papers at <http://insid.events/insid2021/>). We hope that these events series could initiate new collaborations among all participants. 🌐

Promoting OR in Nigeria: IORMS 2020 Virtual Conference - “Overcoming Impacts of COVID-19”

Olabode S. Adewoye <adewoye2012@gmail.com>; **Olugbenga A. Oso** <gbengaoso@yahoo.com>



▲ *IORMS 2020* Guest Speakers (from left to right): Prof. Adedeji Badiru, USA, Dr. Paula Carroll, Ireland, and Prof. Christopher Thron, USA.

The *Institute of Operational Research and Management Science (IORMS)*, a registered professional institute to promote, develop, and regulate the education and practice of Operational Research in Nigeria held its *3rd Annual International Conference* on November 17-19, 2020 (www.iorms.org.ng). The 1st and 2nd International Conferences took place in March 2018 at Akwa Ibom State University, Nigeria (www.aksu.edu.ng) and in July 2019 at Mountain Top University (MTU), Ogun State, Nigeria (www.mtu.edu.ng), respectively.

The *2020 IORMS conference* with the theme “*Overcoming Impacts of COVID-19 Pandemic: An Operational Research*

Optimization Approach” was held as a virtual event due to the restrictions imposed in view of the COVID-19 pandemic. The event kicked off at exactly 12 noon on Tuesday, November 17, with the opening announcement by the anchor of the conference, *Dr. Olabode Adewoye*. Immediately after the first activity, *Olugbenga Oso*, the Chairman of the Local Organizing Committee in his opening remarks, stated that the virtual conference intends to educate, inspire and expose participants to various tools of OR in tackling COVID-19. This ushered in the *IORMS* President and Chairman of Governing Council to declare the event open.



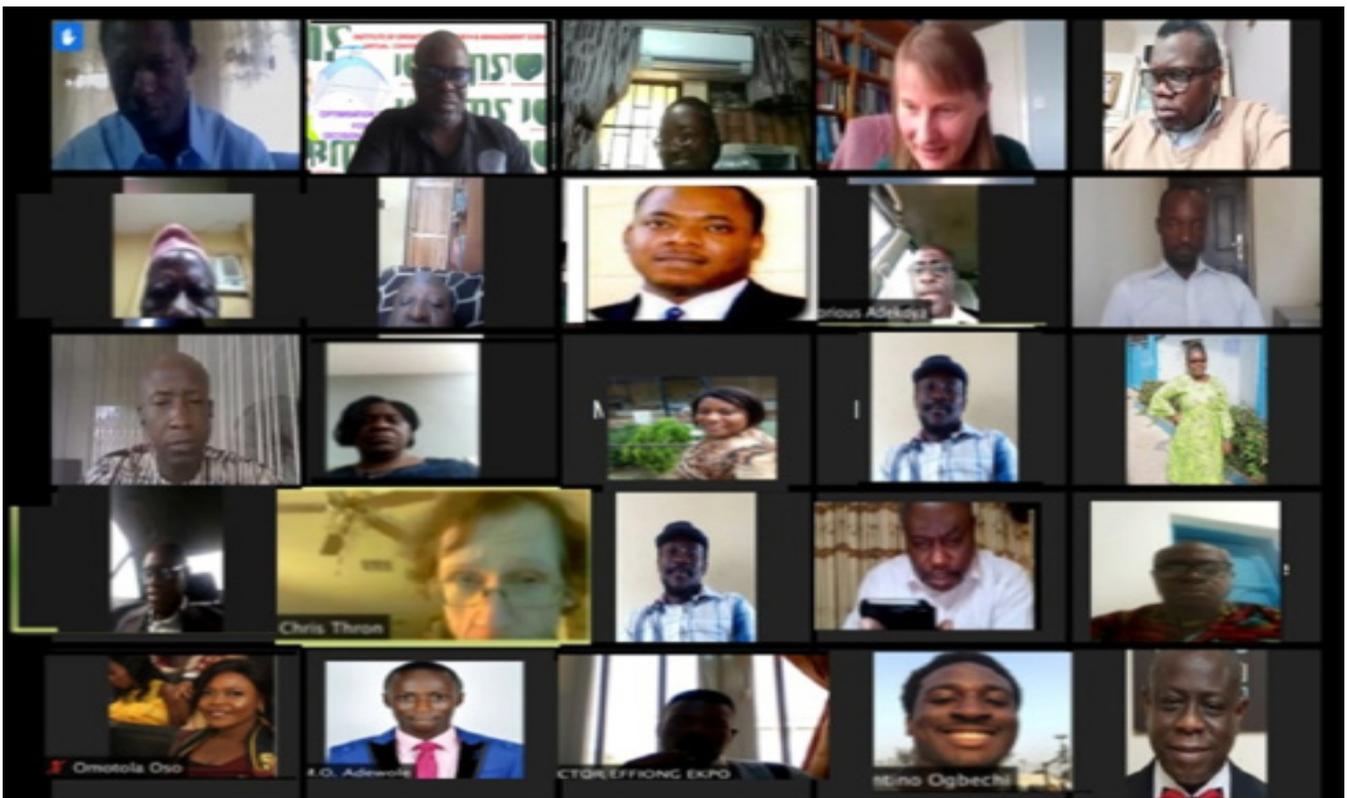
▲ IORMS Officers (from left to right): Dr. Olabode Adewoye, General Secretary, Prof. Dr. Rasheed Ojikutu, President, and Olugbenga Oso, LOC Chair.

The IORMS President, Prof. Dr. Rasheed Ojikutu gave an encouraging opening address mentioning that “Humanity has faced serious and dangerous challenges since the supposed emergence of “corona” virus in Wuhan, China, in February 2019. From that corner of the world the epidemic has transformed into a global pandemic with immense effects and with such rapidity that has left humanity with its mouth agape - but covered. Meanwhile, the Vice-Chancellor of the University of Lagos, Prof. Dr. Toyin Ogundipe, the Chief Host, also talked on the Conference Theme as it relates to what he termed “The New Normal”. In addition, Prof. Dr. Folasade Ogunsola, the Deputy Vice-Chancellor (DVC) University of Lagos, who is also a member of COVID-19 Crusader for Lagos State Government delivered her goodwill address.

There was a total of nine paper presentations including the papers presented by three Guest Speakers: Prof. Dr. Adedeji Badiru, Dean of Engineering and Management of the Air Force Institute of Technology, Ohio, USA, whose paper was on “Operational Research Methods and Tools for Online Education Amidst COVID 19 Pandemic”, Dr. Paula Carol, University College Dublin (Chair of EURO WISDOM Forum) who discussed on

“Sustainability Modelling and Optimisation Contribution to Affordable and Clean Energy”, and Prof. Dr. Christopher Thron of Texas A&M University, USA, who spoke about “Optimal Management of COVID-19 using a Combination of Distancing & Testing Strategy”. The virtual conference was attended by more than 50 local and international participants.

Plenary and parallel sessions took place during the next two days and each session had a Chairman and Guest speaker. Other papers were on “Predictive Modelling of COVID-19 Pandemic Evolution in Nigeria” by E. Agunloye, “COVID-19: Imperative for E-Service Quality Improvement in Business Organizations” by Ighomereho O. Salome, “Application of Queueing models for evaluation of effectiveness of the automatic disinfectant booths in Federal Polytechnic Ilaro” by O. Ogunsanwo, “Predictive Modelling of COVID-19 pandemic evolution in Nigeria” by E. Agunloye, and “A Comparative Analysis of the Shortest Path Algorithm for COVID-19 Activities & Distribution of Palliatives items” by Abraham Tamber. The paper presenters are scholars from different universities and educational institutions in Nigeria.



▲ Impressions during the celebrated IORMS 2020 Virtual Conference.

Prof. Dr. Rasheed Ojikutu, IORMS President, Dr. Olabode Adewoye, General Secretary of IORMS, Prof. Dr. F. O. Ogunwolu, University of Lagos, Dr. I. Etukudo, Governing Council, IORMS, Prof. Dr. O. S. Asaolu, 1st Vice President of IORMS, and Okesola Moses, IORMS Registrar, chaired the different sessions.

Another highlight of the conference was the virtual induction of new members, conducted by the Registrar of the Institute, Okesola Moses. Those inducted were: *Olugbenga Ayoola Oso* as Fellow; *Ighomedreho O. Salome (Ph.D)*, *Ofuani, Barbara Aiwanehi (Ph.D)*, *Adebola Glorious Adekoya*, *Abraham Jighjigh Tamber*, *Victor Effiong Ekpo*, *Kingsley Mordi*, *Okoh Godwin Luke*, *Adewusi Adewale*, *Edu Semiu Olatunde* as Full Members, *Ogbechi Daniel Chinaedum Ayodele* as Associate member; while *Ogbechi Valentino Olisemeka* and *Ogbechi Naomi Boluwatife* were inducted as Student Members.

The Vote of Thanks was given by *Dr. Olumuyiwa S. Asaolu* who also closed the conference at about 3:00pm. The *Annual General Meeting* for all members started immediately after the Closing program. 🌐



▲ Some participants at IORMS Conference 2019.



▲ MTU staff and IORMS executives in 2019.



▲ Section of participants at IORMS Conference 2019.

ICPR–Americas 2020 Survived the Year of the pandemic

Fernando Tohmé <ftohme@criba.edu.ar>; Daniel Rossit <daniel.rossit@uns.edu.ar>

The series of *ICPR–Americas* conferences constitute the *Latin–American chapter* of the *International Conferences of Production Research* organized by IFPR (International Foundation of Production Research). The main goal of these conferences is the promotion of exchanges among specialists on production systems and processes, aimed at creating goods and services. These encounters have been repeated for almost two decades in the *ICPR–Americas* meetings and for more than fifty years in the *World ICPR* conferences (Velasco & Mejía 2019).

This year the Tenth *ICPR–Americas* Conference was held during December 9–11, for the first time, in Argentina, even if 2020 was a difficult year dominated by the impacts of the COVID-19 pandemics. One of the effects of the pandemics was the disruption of normal academic activities like this conference. Several rounds of reformulation of dates and formats were needed to reach the point of running *ICPR–Americas* virtually at the end of 2020. This was only possible thanks to the work and support of all the organizing committee, the Universidad Nacional del Sur, in particular the Departments of Engineering and Mathematics, as well as the help of the Board of *ICPR–Americas* and *IFPR*.

The inaugural talk was given by *Dr. Luis Quezada*, of Universidad de Santiago de Chile, president of *IFPR*. *Dr. Quezada* referred to the history of the *ICPR–Americas* conferences as well as of its parent institution, *IFPR*, giving a warm reception to all the participants. *ICPR–Americas 2020* featured five highly prestigious invited speakers, who were so kind as to collaborate with this conference. The first invited participation was that of *Dr. Jose Framiñán* of Universidad de Sevilla (Spain) on “*Manufacturing Scheduling: Old Solutions for New Problems?*”. *Dr. Framiñán* presented a deep and innovative overview of the scheduling problems that emerged in manufacturing processes in the last decade, focusing not only on the last research results but also on the remaining open problems. Another invited talk was given by *Dr. Gonzalo Mejía Delgadillo* of Universidad de la Sabana (Colombia), on “*Perspectives and trends of Industry 4.0 in Latin America*”. *Dr. Mejía Delgadillo* reviewed the degree in which Industry 4.0 technologies have been incorporated in Latin–America, pointing out that supply chains in the food production may become empowered by them.

Another interesting presentation was on “*Digitalization of manual production and assembly processes for smart factories of the future*” in charge of *Dr. Francesco Pilati* of Università di Trento (Italy), who analyzed the impact of new technologies on production systems that depend heavily on manual



operations and the design of new automatization tools to replicate those activities, in order to redesign those workplaces to make them more ergonomically efficient. Finally we had two internationally prestigious talks referring to how to address disruptions to *supply chains*, the first one given by *Dr. Dmitry Ivanov* of Berlin School of Economics and Law (Germany) on “*Ripple Effect in Supply Chain Networks: History, New Insights from the COVID-19 Pandemic, and Future Perspectives*”. *Dr. Ivanov* focused on events of high negative impact on supply chains as well as on strategies to mitigate them. The other invited presentation on the subject was given by *Dr. Srinivas Talluri* of Michigan State University (USA) on “*Managing Macro Level Supply Chain Disruptions: Lessons from COVID-19*”. In his talk, *Dr. Talluri* analyzed the impact of events like the current *lockdowns* on supply chains, as well as ways of rebalancing those networks to ensure their survival.

An event run in parallel to *ICPR–Americas 2020* was an Industry Symposium, coordinated between the academic committee of the conference and representatives of the local industry of the Bahía Blanca region. The papers presented at the Symposium discussed real cases and problems of concrete industrial sectors. Those 17 contributions corresponded to experiences of Argentinean and foreign companies, and almost all of them were presented by representatives of those firms. Interesting and useful exchanges between academics and private sector representatives took place in the sessions of the Symposium, highlighting the value of these mixed events.

The conference itself featured 15 sessions on different particular aspects of production research as well as a general session on the classical topics of *ICPR–Americas*. More than 270 papers were presented, authored by more than 1000 contributors of 3 continents, with a large majority of them from the Americas. >>



▲ Here we are! Conference banner of *ICPR–Americas 2020*, successfully conducted!

Stock and flow diagrams

Accepted orders = $\min(\text{New_Orders}, \text{MaxAcceptedOrders})$

Shop floor production = $\min(\text{Available capacity A} + \text{Available capacity B}, \text{Capacity utilization}, \text{Forecast orders to produce})$

Shop floor production A = $\min(\text{Available capacity A}, \text{Shop floor production})$

Shop floor production B = $\begin{cases} \min(\text{Available capacity B}, \text{Shop floor production} - \text{Available capacity A}), & \text{for } (\text{Shop floor production} > \text{Available capacity A}) \\ 0, & \text{otherwise} \end{cases}$

Backlog(t) = $\text{Backlog}(t-dt) + (\text{Accepted orders} - \text{Rate of fulfilled orders}) * dt$

Marisa Sanchez

▲ ICPR-Americas 2020: Lecture of Dr. Marisa Sanchez (Universidad Nacional del Sur, Argentina) cherished by the participants.

MICHIGAN STATE UNIVERSITY | Broad College of Business

Managing Macro-Level Supply Chain Disruptions: Lessons From COVID-19

Sri Talluri, Ph.D.
Hoagland-Metzler Endowed Professor
Eli Broad Graduate School of Management
Michigan State University

Keynote ICPR Americas 2020
12/11/2020

Fernando Tohme
Daniel Rosak
Srinivas Talluri

▲ ICPR-Americas 2020: Keynote Lecture by Dr. Srinivas Talluri (Michigan State University).



▲ Some of the invited scientists at ICPR-Americas 2020:
Prof. D. Ivanov. Prof. J.M. Framiñán. Prof. F. Pilati. Prof. G. Mejía Delgadillo. Prof. S. Talluri.

>> We have ensured a special issue for selected papers in *Springer's Communications in Computer and Information Science* as well as issues for extended versions in *Annals of Operations Research*, *Production Journal*, *Mathematical Biosciences and Engineering*, *IET Collaborative Intelligent Manufacturing*, *Journal of Food Processing and Preservation*, and *International Journal of Integrated Supply Management*. Some specially chosen papers will also be published in *International Journal of Production Research*.

Finally, let us say that even if *ICPR-Americas 2020*, due to its virtual form, did not facilitate the usual person-to-person

exchanges of academic meetings, the meeting preserved the continuity of *ICPR-Americas* in such a challenging year. This provided a forum for young researchers to present their investigations and allowing them to advance their agendas even in the face of lockdowns and travel restrictions, sharing and discussing their results with colleagues of other parts of the world.

Reference:

Velasco, N. M., & Mejía, G. (2019). Consolidating a research community on production research and logistics in Latin America. *Academia Revista Latinoamericana de Administración*. 🌐

Virtual INFORMS Annual Meeting Successfully Celebrated

Ariela Sofer <asofer@gmu.edu>; Michael C. Fu <mfu@umd.edu>

This article is a modified version of an article by the Virtual 2020 INFORMS Annual Meeting co-chairs Michael Fu and Ariela Sofer, printed in the October issue of the INFORMS member magazine *OR/MS Today* and is reprinted with permission from INFORMS.

From Nov. 7-13, 2020, the inaugural *Virtual INFORMS Annual Meeting* [1] featured more than 4,000 synchronous and asynchronous presentations from OR and analytics professionals across the globe.

With five full meeting days featuring live and on-demand presentations each day, the *2020 Annual Meeting* provided a unique virtual experience allowing participants to interact with the content they wanted, whenever and wherever they wanted to access it. Highlights included:

- o A meeting schedule that provided attendees the opportunity to create a meeting experience to fit their schedule, with a combination of live and recorded presentations, chat sessions, poster sessions, *TutORials*, technology tutorials, engaging networking opportunities and more.
- o Unique opportunities to connect and interact with presenters and other meeting participants to build lasting relationships.



Ashley Kilgore, Communications Manager at INFORMS (<https://www.linkedin.com/in/ashley-kilgore-90a46863/>).

- o Interactive virtual meeting guides [2] to help attendees navigate and enhance their meeting experience.
- o A robust and comprehensive lineup of live plenary and keynote speakers.
- o Two additional full days of content.

The meeting program included presentations with real-time Q&A opportunities that remain available for download, along with thousands of other on-demand sessions, until Feb. 15, 2021. This win-win format not only allowed participants to view talks they otherwise would not have been able to attend, but also allowed participants to present their ideas to a wider audience and gave attendees greater opportunities for exposure.

The technical program consisted of an exciting array of presentations. The cutting-edge plenary sessions addressed such topics as elections, polling and gerrymandering, data challenges for the 2020 U.S. Census, and COVID-19 modeling and policy.

The opening plenary presented by *Sheldon Jacobson* (Omega



▲ Logo of Virtual 2020 INFORMS Annual Meeting.

Rho Distinguished Lecturer), University of Illinois at Urbana-Champaign, titled *“Operations Research and Public Policy: Making a Difference”*, shared the history of gerrymandering and its impact, and how algorithmic redistricting can be used to create fair and balanced district maps.

A panel discussion moderated by *Anne Robinson*, Kinaxis, and consisting of *Julie Swann*, North Carolina State University; *Retsef Levi*, MIT; *Nicoleta Serban*, Georgia Tech; and *Nicholas Reich*, University of Massachusetts, Amherst, was titled *“Forecasting Models for the COVID-19 Pandemic”*. The panelists, all experts in COVID-19 models, explored the different models that have been used, how these models and their results have been communicated, and opportunities for additional COVID-19 work in the *OR/MS/analytics space*.

Nancy Potok, former deputy Director and COO of the US Census Bureau presented *“The Future of Federal Statistics and the Role of the Chief Statistician”* during which she discussed her time at the Census Bureau, the modernization efforts that propelled the 2020 U.S. Census and other recent modernizations to the federal statistical system, and what changes we can expect in years to come.

In his plenary, *“AI is the Right Term for Our INFORMS Profession”*, *Michael Watson*, cofounder of Opex Analytics, took a bold stance when he discussed embracing artificial intelligence as an umbrella term for operations research and analytics.

The keynote speakers covered state-of-the-art advancements in a broad range of timely topics, including social distancing models, disaster relief, supply chains, machine learning, simulation for big data, quantum computing, artificial intelligence and more.



2020 is a very complicated year

COVID-19

Nationwide social justice movement

Presidential election year



▲ Keynote presentation by Linda Burtch (Burtch Works) at Virtual 2020 INFORMS Annual Meeting.

The **Keynote Presentations** included:

Matteo Fischetti (IFORS Distinguished Lecturer), University of Padua, “Mathematical Optimization for Social Distancing”; Peter W. Glynn (Philip McCord Morse Lecturer), Stanford University, “Statistics, Stochastics, and Service Operations”; Elad Hazan, Princeton University, “Optimization for Machine Learning: Insights and Challenges”; Guru Pundoor, American Eagle Outfitters, “Evolution of Retail Supply Chains – Practitioner’s Perspective”; Simon Lee, Waitr Inc., “What We Wish Application Engineers Knew About Analytics”; Maria Mayorga, North Carolina State University, “From Patient to Population: Integrating Personalized Medicine and Public Health”; Yianni Gamvros, QC Ware, “Quantum Computing and Optimization”; Linda Burtch, Burtch Works, “The New Normal? COVID-19’s Impact on the Analytics Landscape & Developing Trends”; Barry Nelson, Northwestern University and Lancaster University, “Rebooting Simulation for Big Data, Big Computing, and Big Consequences”; David Simchi-Levi, MIT, “Statistical Learning in Operations: The Interplay between Online and Offline Learning”; Richard Tapia, Rice University, “Underrepresentation in STEM: A Danger to the Health of the Nation”; Franz Edelman Award winner Intel, “Intel Realizes \$25 Billion by Applying Advanced Analytics from Product Architecture Design through Supply Chain Planning”; UPS George D. Smith Prize winner Queen’s University, “Building a

World-class Analytics Ecosystem”.

For additional coverage of each of the plenary and keynote presentations, visit the *INFORMS* member magazine online, *OR/MS Today*, at pubsonline.informs.org/magazine/orms-today/news. This year’s *TutORials* covered a wide spectrum of topics, such as analytics-based issues of diversity, algorithmic bias, healthcare analytics, public education, entrepreneurship, wine analytics, and more. A new highlight of the conference was a specialized cluster of practice-curated sessions.

Pre-Meeting Events

In accordance with previous year’s Annual Meetings, *INFORMS* continued to offer specialized opportunities leading up to the conference such as the *INFORMS Combined Colloquia* [3] and *INFORMS Workshop on Data Mining & Decision Analytics*.

The *Virtual 2020 INFORMS Combined Colloquia* [3] was held November 7 and was designed to provide attendees with technical material, career experiences from senior and junior *OR/MS* professionals and an environment for networking. The three colloquia included: the *Teaching Effectiveness Colloquium*, *Doctoral Student Colloquium* and *New Faculty Colloquium*.

A Sample System

Setting: Hospital System

Level Description
Environmental: shift schedules that impact providers, shared hospital resources, external factors
Organizational: patient’s level of care, care team, unit level resources, current practice patterns
Interpersonal: people patient may come in contact with during visit and supporting family
Individual: Individual patient health, history, treatment

▲ Keynote presentation by Maria Mayorga (North Carolina State University) at Virtual 2020 INFORMS Annual Meeting.

Initial conditions (specifically 1963) matter

Tocher (1963) *The Art of Simulation*, English University Press

- Manufacturing applications
- Queueing without exponential distributions

Conway (1963) "Some tactical problems in digital simulation," *Management Science*

- OR/MS research is *analysis methodology*

GPSS and the limits of memory (early 1960's)

- Process-oriented simulation modeling (**A**)
- Long-run averages estimated "on the fly"

Northwestern ENGINEERING 4

INFORMS 2020

▲ Keynote presentation by *Barry Nelson* (Northwestern and Lancaster Universities) at *Virtual 2020 INFORMS Annual Meeting*.

Why is the research question so challenging?

▶ Three key challenges for reducing contextual bandits to offline regression

1. Computational difficulties
2. Statistical difficulties associated with confidence bounds
3. Statistical difficulties associated with analyzing dependent actions

▲ Keynote presentation by *David Simchi-Levi* (MIT) at *Virtual 2020 INFORMS Annual Meeting*

The *Virtual 2020 Teaching Effectiveness Colloquium* was designed to address the needs of graduate students about to enter the academic job market, as well as faculty looking to stay abreast of the "best practices" regarding *OR/MS/analytics* pedagogy. The colloquium featured a wide variety of speakers from business and engineering schools who addressed different aspects of incorporating and assessing effective teaching techniques into any undergraduate or graduate curriculum.

The *Virtual 2020 Doctoral Student Colloquium* was intended for doctoral students who need guidance deciding between a career as an academic or a practitioner. It included sessions dedicated to examining both career options and choosing between the two. It also addressed topics like navigating the job hunt, dealing with work-life balance issues, and suggestions concerning job market preparation and positioning. It was organized with current doctoral students 2-3 years from graduation in mind; however, students in their final year of a doctoral program were also welcome to attend.

The *Virtual 2020 New Faculty Colloquium* was expressly tailored to meet the needs of academics at the beginning of their careers. It gave faculty in their first two years insight into successfully navigating the tenure process, including how to build and maintain a research program, advise students, balance research, teaching and service, write successful proposals and more.

INFORMS Workshop on Data Mining & Decision Analytics

The *Data Mining Section of INFORMS* organized the *15th INFORMS Workshop on Data Mining & Decision Analytics*, held November 7 [4]. The workshop provided the opportunity for participants to share their recent research work with peers from data mining, decision analytics and artificial intelligence.

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2. <http://meetings2.informs.org/wordpress/annual2020/guides/>.
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4. <http://meetings2.informs.org/wordpress/annual2020/data-mining-workshop/>.

On the authors. *Ariela Sofer* is interim Divisional Dean for Engineering of the Volgenau School of Engineering at George Mason University. She is the *general co-chair* of the *2020 INFORMS Annual Meeting*. *Michael C. Fu* holds the Smith Chair of Management Science in the Robert H. Smith School of Business, University of Maryland, College Park. He is the *general co-chair* of the *2020 INFORMS Annual Meeting*.

In addition to *INFORMS* and the authors, we thank dear **Ashley Kilgore** for communication and help to make this reprint possible. *Gerhard-Wilhelm Weber* 🌐

Bringing together International Logistics and SCM Specialists: Successful 7th LSCM 2020 Tehran - Online

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▲ LSCM 2020: logos of the conference and its organizers.

Kharazmi University in Iran hold the *Seventh International Conference on Logistics and Supply Chain Management* virtually in six different panels on December 23-24, 2020 with the collaboration of *Iran Logistics Society* (<https://ocs.springer.com/ocs/home/LSCM2019> and <https://www.ifors.org/7th-international-conference-on-logistics-and-supply-chain-management-lscm-2020/>). It provided an enjoyable

from 18 different countries.

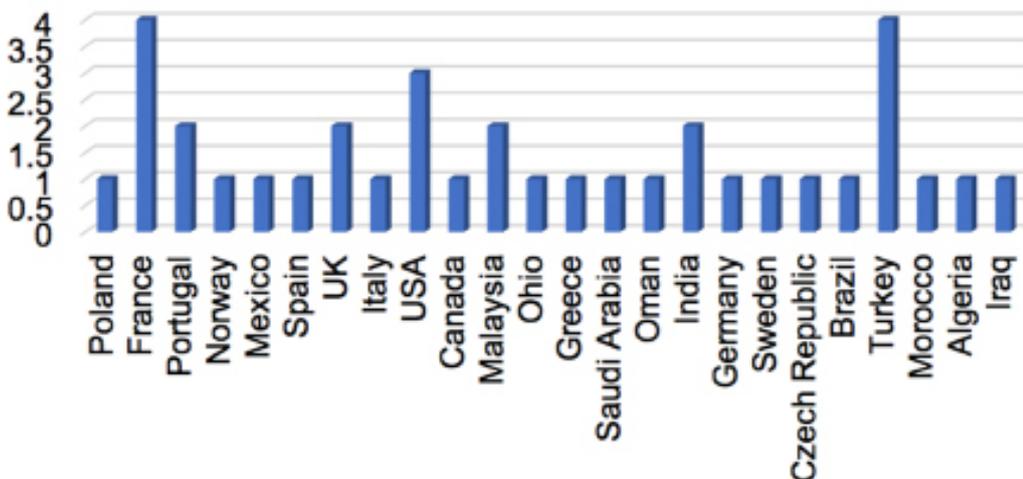
The prominent keynote speakers, *Prof. Maria Grazia Speranza* (the President of *IFORS*), *Prof. Gerhard-Wilhelm Weber* (EURO Conference Advisor), *Prof. Rubén Ruiz García* (Editor-in-Chief *Operations Research Perspectives*), *Prof. Leopoldo Eduardo cardenas-Barron* (Tecnológico de Monterrey) and



▲ LSCM 2020: Conference Chairman and Scientific Managers

and energetic knowledge transferring atmosphere for its participants (as several feedbacks revealed), since the conference team members were working hard in a friendly environment. The conference included participation of more than 37 countries, international scientific committee members from 24 countries, reviewers from 16 countries and submission of papers from more than 60 internationally affiliated authors

Dr. Jai Acharya (Principal Consultant of *IMMC*), presented academic as well as practical speeches which attracted the attentions of both graduate students and practitioners. The topics discussed include “*Contribution to Sustainability of Research in Transportation and Logistics*”, “*Research and Its Implementation: Human Skills and Resource Management*”, and “*Sciences Education in Digital Era*”, “*Rumor Propagation Model: OR and Mathematics*”, “*Metaheuristics for Flow Shop Scheduling: Just Do Simple Local Search*”, “*Writing Good Papers*”, “*Inventory Model with Price and Time Sensitive Demand Considering Nonlinear Holding Cost and Shortages*”, “*The Conference.... The Paper*”, “*Application of Innovative Technology and Blue Economy in Maritime Transport, Logistics & SupplyChain Management System*”, etc.



▲ LSCM 2020: International Scientific Committee members from 24 countries



▲ The well-known Keynote Speakers of LSCM 2020

There were also a variety of speeches about “E-Government”, “intelligent case study in LSCM: Gamification approach”, “three pillars of industrialization”, “LSCM in Industry 4.0”, “intelligent logistics”, “risk management in supply chain” and “research experiences and achievements in OR & industrial engineering”.

Some interesting competitions were planned, involving “PhD. Award Competition” (managed by Prof. Reza Tavakkoli-Moghaddam and Dr. Maryam Ameli), “3-Minute Defense” (managed by Dr. Reza Yousefi Zenouz) and “Book Award Competition” (managed by Dr. Mir Saman Pishvaei). “Supply Chain in Covid-19” workshop was another important event in this conference which was conducted by Indian researchers.

It is worth noting that the selected English papers of the conference will get published in Springer’s CCIS book series. CCIS is abstracted/indexed in Scopus, SCImago, El-Compendex, DBLP, Google Scholar, Mathematical Reviews, and etc. CCIS volumes are also submitted for inclusion in ISI Proceedings.

LSCM2020 attracted the attention of students and professionals internationally. The covering subjects included, but not limited to, “uncertainty in supply chain”, “green and sustainable supply chain”, “pricing in supply chain”, “expert systems in supply chain”, “information technology in supply chain”, “crisis supply chain”, “transportation and distribution in supply chain”, “value creation in supply chain”, etc.

The conference team members, including Dr. Roya Soltani (International Committee Manager), Ms. Leila Chehrghani (International Relationship Manager), Dr. Mohammad Vahid Sebt (Conference Executive Manager), Dr. Hamed Davari Ardakani (Scientific Committee coordination Manager), Mr. Hiva Selki (Website Manager) and Seyedeh Banafshe Moghtadaei

(Communication Manager), worked really hard in cooperation with other members on this event to prepare attractive scientific programs such as sharing and discussing theoretical and practical knowledge and hold LSCM as reach and successful as possible.

The participation and perseverance of this passionate team made a completely friendly and enjoyable atmosphere. Having different competitions and the efforts of the organizing team to bring together international students and professors led to extensive interactions on the latest global issues related to logistics and supply chain management, such as a COVID-19 panel, and made the conference even more interesting and fruitful. The numerous requests of international professors to speak at the conference excited us and redoubled the efforts of the LSCM 2020 team to improve the quality of the conference.

The successful and great organization of this conference and the numerous positive feedbacks received from the participants have given additional energy to our team and have encouraged us to hold future conferences. 🌐



▲ The LSCM 2020 Team (from left to right): Dr. Ali Azimi Vaghar, Dr. Mohammad Vahid Sebt, Ms. Leila Chehrghani, Ms. Sara Fatemi, Dr. Soheila Mirzaei, Dr. Roya Soltani, Dr. Zohreh Molamohamadi, Ms. Mahsa Haezi, Dr. Hamed Davari Ardakani, Prof. Abolfazl Mirzazadeh, Ms. Shabnam Izadi, Ms. Mona Ashtari; (on the screen, from top left to the bottom right): Mr. Seyed Hassan Tayyar, Ms. Elham Akbarian, Ms. Elnaz Karami Avarzaman, Ms. Zahra Pourfarash, Ms. Elmira Ebrahimi, Ms. Banafshe Moghtadaei).

Bridging OR with Social Sciences and Humanities through Operationalization - MSBC 2019 successfully celebrated in Vilnius

Leonidas Sakalauskas <leonidas.sakalauskas@mif.vu.lt>

On behalf of the Organizing Committee, I was pleased to welcome the participants of the International and *EURO Mini Conference "Modeling and Simulation of Social-Behavioural Phenomena in Creative Societies" (MSBC-2019)* that was held in Vilnius, Lithuania, September 18-20, 2019.

MSBC-2019 encouraged and facilitated interdisciplinary communication, emphasising those areas that present the newest results having potential for simulation and modelling of social-behavioural phenomena in creative societies as well as practical applications through analysis of the relevant data. Moreover, the use of recent advances in different fields was promoted, such as new social capital models, cultural behaviour modeling, concepts and models of creative societies, agent-based social simulation, computational social science, and artificial society modeling.

The *MSBC-2019* conference launched an open panel for the effective dialogue among researchers and practitioners interested in the integration of operations research science and social science and humanities. Recently, there has been an increasing number of challenges related to processes that are taking place because of interactions between people or their communities. In general, society creates a plethora of social behavioural phenomena, such as the conduct of voters during elections, the behaviour of the crowd during a terrorist attack, people's behaviour during pandemics, institutions' social capital development processes, the behaviour of social network users, etc., whose knowledge of mechanisms is essential for building a stable and efficient future society that will be creative (*Florida, 2020*). The aforementioned phenomena and others alike could be explored through operationalisation via the application of *OR* for modelling and simulation of complex social-behavioural phenomena (*Habermas, 1984*).

The scientific programme of *MSBC-2019* consisted of invited lectures and contributed sessions. The invited lectures were



▲ Prof. Dorien DeTombe (Amsterdam University),
Chair of the *MSBC-2019* Programme Committee.

delivered by well-known scientists who put the special emphasis on those areas that most contribute to the appreciation of modeling and simulation of social-behavioural phenomena in creative societies. These lectures became valuable tutorials for many young promising researchers who took an active part in the conference.

The following Invited Lectures were delivered at *MSBC-2019*: "*Co-Creating for Cultural Commons: Scenarios for Cross-Sectoral Collaboration*" by Marianne Ping Huang (University of Aarhus, Denmark), "*Computational Modelling and Data Analytics for the Study of Historic Cities*" by Georgios Artopoulos (University of Cyprus), "*Modeling Deviant Cyber Behaviors: Bots, Trolls, and Information Operations*" by Nitin Agarwal (University of Arkansas at Little Rock, USA), "*Smart Culture in Smart Cities – Impact Perspectives and the Case Study Smartsquare*" by Jens Bley (University of Hamburg, Germany), "*Sociocognitive Aspects in Learning and Teaching*" by Ismo Kopponen (University of Helsinki, Finland), "*Spillovers, or what Is Culture Good for*" by Martynas Petrikas (Vilnius University, Lithuania).

Dissemination of knowledge discovered in *MSBC-2019* was considered as a very important task. The Programme Committee after thorough reviewing by an international board of reviewers selected 10 papers for publication in *Springer Proceedings* in series "*Communications in Computer and Information Science*" (*CCIS*) (published before the conference and delivered at it). The Programme Committee also selected papers which were submitted for publication in the special issue called "*Societal Complexity and Behavioral Simulation*" of the top-rated *Central European Journal of Operations Research (CEJOR)*.



▲ Prof. Nitin Agarwal (University of Arkansas at Little Rock), Keynote Speaker at *MSBC-2019*.



▲ Prof. Marianne Ping Huang (Aarhus University),
Keynote Speaker at MSBC-2019.

The conference programme also included social activities such as Welcome Reception, Conference Dinner, and Bus Tour to the Open-Air Museum of the Centre of Europe and Trakai Castle, which allowed the participants to get to know each other and to gain experience about Lithuanian culture and history and, in addition, to enjoy the Lithuanian cuisine and hospitality.

On behalf of participants and organisers, I express our gratitude to *Vilnius University, Lithuanian Research Council, EURO, EWG on Ethics and OR, LitORS* and other partner

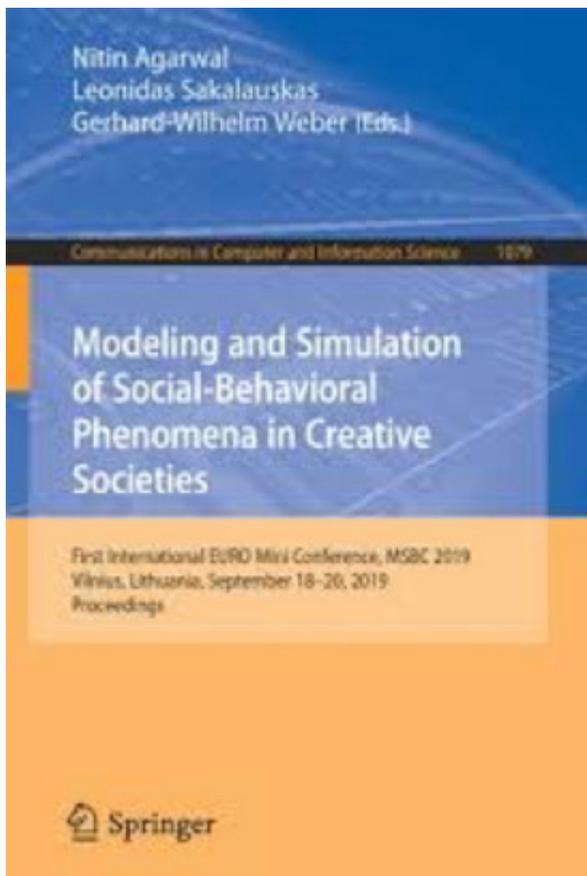
institutions that sponsored *MSBC-2019* and helped arrange it. I really appreciate the Organizing and Scientific Programme Committees for their superb job in organizing *MSBC-2019*.

The *MSBC-2019* conference took place with great enthusiasm of participants, who have decided to organise bi-annual international conferences on its subject. The next conference *MSBC-2021* will be held in Vilnius, Lithuania, September 22-24, 2021 (<http://www.msbc2021.vgtu.lt>). Preliminary, *MSBC-2023* is planned to be organized in Russia.

I look forward to seeing you in forthcoming *MSBC* conferences!



▲ Prof. Leonidas Sakalauskas (Vilnius University),
Chair of the MSBC-2019 Organizing Committee.



▲ Springer CCIS Proceedings of MSBC-2019.

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Exploring International Logistics and Supply Chain Management: LSCM 2020 Tehran – Online – a participating scholar’s perspective

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**7th International Conference on
Logistics and Supply Chain Management**
23-24 December 2020
www.Lscm2019.com

Business uncertainties expect organizations to evolve for creating opportunities and proactive responses and one way to sharpen and evolve is through congregations of intellectuals and business corporates at various national and international interactive platforms. Over a longer period, business and academic research conferences have become a common and popular medium of studying and networking, offering multiple opportunities for participants to learn and engage in well informed discussions. *Kharazmi University* (<http://www.khu.ac.ir>) of Tehran, Iran, in association with *Iran Logistics Society* provides interactive stages of learning and engagements to all the participants.

The conference was initially planned for a formal physical presence of all the participants, however, due to pandemic, its format was converted into virtual mode. Keeping the spirit of the event alive, the organizers managed to “pull the show through” a massive online presence of participants and dignitaries.

The *Kharazmi University* organized their *7th International Conference on Logistics and Supply Chain Management (LSCM 2020)* (<https://www.ifors.org/7th-international-conference-on-logistics-and-supply-chain-management-lscm-2020/>) on December 23-24, 2020, using a virtual platform. The conference was co-organized by the *Iran Logistics Society* which remains actively engaged in the formation of specialized logistics committees for creating a significant platform for industry and government interfaces and alliances. This society also encourages the development of cultural and scientific relations at national and international levels among research scholars and industry experts. *Prof. Dr. A. Mirzazadeh* (<https://www.linkedin.com/in/a-mirzazadeh-48459936/>), as scientific committee manager, organized this fantastic event with the cooperation of more than 1100 scientists, academicians, practitioners, students, and other participants.

The conference was endorsed by prominent social media platforms like LinkedIn and its media sponsor included ConferenceAlert.com, among others. The University of Maryland, The University of Manchester, Karlsruhe Institute of Technology, SIEMENS, Center for European Studies were among many of its scientific sponsors.

It became enriched by the contributions of the Scientific

Committee which consisted of international professors from 24 countries and included prominent names like *Prof. Dr. Alexandre Dolgui* (<https://www.imt-atlantique.fr/en/courses-study/career-portraits/alexandre-dolgui>), *Prof. Dr. Gerhard-Wilhelm Weber* (https://www.researchgate.net/profile/Gerhard_Wilhelm_Weber), *Prof. Dr. Ruben Ruiz* (<http://www.upv.es/ficha-personal/rucarga1>), *Prof. Dr. Turan Poksoy* (www.arsiv.ktun.edu.tr) AND *Dr. Sadia Samar Ali* (<https://scholar.google.co.in/citations?user=bgD0eIQAAAAJ&hl=en>), and many more. National participants included *Prof. Dr. Mir Mahdi Seyed Esfahani*, *Prof. Dr. Reza Tavakkoli Moghadam* and many other well-known names. Valuable insights were shared by Keynote Speakers like *Prof. Dr. Maria Grazia Speranza* (the President of IFORS, <https://www.ifors.org/officers-page/>), *Prof. Dr. G.-W. Weber*, *Prof. Dr. Ruben Ruiz Garcia*, *Dr. Jai Acharya*, and *Prof. Dr. Leopoldo Eduardo Cardenas-Barron*.

Overall, the conference witnessed participation of more than 50 distinguished faculty members and over 200 research scholars presented their papers in English or Persian language, spanning over multiple parallel sessions.



▲ Scientific Committee Manager of LSCM 2020:
A. Mirzazadeh, Kharazmi University, Tehran, Iran.

Keynote Speakers :



Prof. Maria
Grazia Speranza
President of IFORS
University of Brescia, Italy



Prof. Gerhard
Wilhelm Weber
EURO Conference Advisor
IFORS Developing
Countries Online Resources,
Poznan University of Technology, Poland



Prof. Rubén
Ruiz García
Polytechnic University
of Valencia, Spain



Dr. Jai
Acharya
Principal Consultant
(IMMC), Singapore



Prof. Leopoldo
Edoardo
Cárdenas-Barrón
Instituto Tecnológico de
Estudios Superiores
de Monterrey, México

▲ Keynote Speakers at LSCM 2020.

As the main objectives of this virtual meet were to provide a platform for information dissemination, exchange of ideas, experience, research findings, theoretical and practical achievements and recent trends in logistics industry and related academic research. The conference team members,



▲ Sadia Samar Ali chairing the session from Jeddah, Saudi Arabia.

including: *Dr. Zohreh Molamohamadi* (Scientific Committee Co-Manager), *Dr. Roya Soltani* (International Committee Manager), *Ms. Leila Chehrghani* (International Relationship Manager), *Dr. Mohammad Vahid Sebt* (Conference Executive Manager), *Dr. Hamed Davari Ardakani* (Scientific Committee coordination Manager), *Mr. Hiva Selki* (Website Manager) and *Seyedeh Banafshe Moghtadaei* (Communication Manager), worked really hard in cooperation with other members on this event to prepare an attractive scientific program for a best combination of theoretical and practical knowledge dissemination through LSCM for a maximum reach. Interesting topics related to supply chains and logistics decision making were discussed during sessions of Prof. Sadia Samar Ali and some highlighted papers were based on "Route optimizations", "Strategies for carbon efficiency in manufacturing", "Heuristic approximation approach for transportation location problem and sub-Arc location", "Managing hard time window in supply chains", "Big data cost analytics-energy supply versus demand", "Comparison of Wolf colony optimization" and "Review of logistics performance via Logistics performance Index Review". Additionally, these sessions meant to offer participants new ways of thinking,

solutions and best practices for coping with unforeseeable situations, and to allow them to become better informed, more creative, and efficient problem solvers for handling current disruptions in today's supply chains.

The conference received immense support, appreciation, and participation in a two-day multiple-session format, as expressed in the closing address by the organizers.

The conference enriched the participants' practice by offering them a unique online learning platform along with an opportunity of publication their work in reputed international journals. Selected papers in English and Persian language were sent for publications in international journals like *International Journal of Supply and Operation Management (IJSOM)*, *Amirkabir International Journal of Modeling, Identification, Simulation and Control (AIJ-MISC)*, and *Journal of Industrial Engineering and Management Studies*. It is worth noting that the selected English papers of the conference will get published in Springer's CCIS book series. CCIS is abstracted/indexed in Scopus, SCImago, EI-Compendex, DBLP, Google Scholar, Mathematical Reviews, and etc. CCIS volumes are also submitted for inclusion into ISI Proceedings. Along with this the conference also offered "The First PhD Thesis Award of 2020" to participants from various backgrounds of Industrial Engineering, Management, Economics, Computer Engineering, Manufacturing and Production Engineering, Financial Sciences, etc. The winners were selected based on theoretical creativity and innovation-relevant content, structure and rigorous theoretical foundations, and applicability and practicability of the presented work.

This conference and the earlier ones in the conference series have proven to be a great success in establishing the university's position and encouraging participant's learning, progress and growth. Real-life "stories" on challenges faced, on struggles managed and on success achieved shared by leading experts and dignitaries have provided motivation and inspiration to attendees for out-of-the-box solutions to even unexpected problems. 🌐



▲ A selection of the distinguished scholars of LSCM 2020.

Retail Analytics and its Pathway to Actionable Insights – Meeting of EURO Working Group Retail Operations - Online

Alexander Hübner <alexander.huebner@tum.de>;
Robert Rooderkerk <rooderkerk@rsm.nl>

The *EURO Working Group on Retail Operations* has been founded in 2015 by *Heinrich Kuhn* (KU Eichstätt-Ingolstadt, Germany), *Pedro Amorim* (FEU Porto, Portugal) and *Alexander Hübner* (TU Munich, Germany). The purpose of this working group is to advance the development and application of quantitative methods in the field of Retail Operations. Retail Operations emerged as a substantial and important area of research in recent years. There are several drivers of this development. Retailing is a large and growing sector of the economy in most countries, both developing and developed. For the better part of the past 50 years, the retail industry has not only been a significant contributor to the economy but also a leader in the design and development of advanced operational concepts. A recent example is the growth of omni-channel retailing, which combines online retailing with bricks-and-mortar retailing. It has changed how traditional brick-and-mortar retailers like Wal-Mart or Macy's operate their store channels, as well as how pure-play online retailers like Amazon or Alibaba operate their online channels. Retailing is a dynamic sector in which changes in markets, firms, and products occur rapidly. Recent research in retailing has discovered new applications, contexts, and theory, which promise a fertile ground for OR researchers for many years to come.

The working group expanded to more than 100 members nowadays. Annual meetings took place at Castle Beilngries (Germany, 2016, organized by *Heinrich Kuhn*), Porto (Portugal, 2017, organized by *Pedro Amorim*), Eindhoven (Netherlands, 2018, organized by *Jan Fransoo*) and Mallorca (Spain, 2019, organized by *Victor Martínez de Albéniz*). The annual meeting 2020 was planned to be hosted by Koç University, Istanbul (Turkey), but had to be postponed due to the pandemic. The latest meeting of the EWG took place in an online format and was hosted by *Alexander Hübner*, Full Professor of Supply and Value Chain Management at Technical University of Munich. More than 60 participants joined the meeting on November 27th, 2020. *Robert Rooderkerk*, Associate Professor of Operations

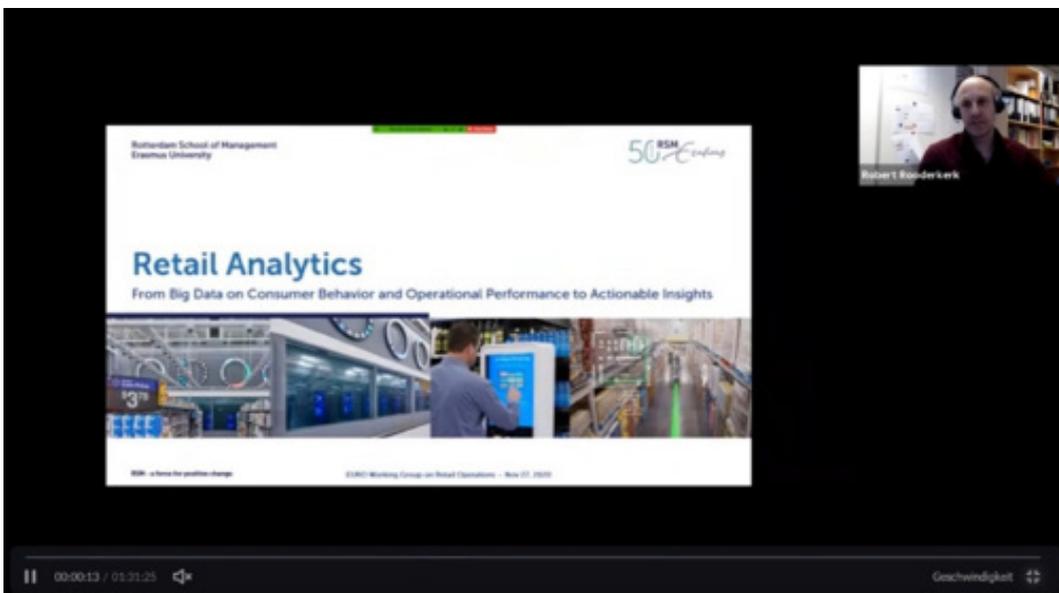


▲ Organizer and Keynote speaker of meeting by EWG Retail Operations:

Management at Rotterdam School of Management, Erasmus University, The Netherlands, delivered the Keynote Speech for the meeting.

In his presentation on *“Retail Analytics: From Big Data on Consumer Behavior and Operational Performance to Actionable Insights”*. *Robert* discussed how the introduction of new technologies in the retail value chain leads to an abundance of new data sources. These so-called *Big Data* allow for better measurement of consumer behavior and operational performance. *Robert* explained that the degree, to which the use of these Big Data will also deliver improved insights for retail operations, depends on the successful adoption of advanced analytics. These big data retail analytics are the focus of his study, which is joint work with *Nicole DeHoratius* (University of Chicago, USA) and *Andrés Musalem* (University of Chile).

The goal of *Robert* and his co-authors is to summarize the developments in practice (*“the evolution of analytics”*) and contrast these to the state of academic research. To this end, they have been employing advanced analytics (e.g., text analytics and bibliometrics) alongside more traditional methods (e.g., interviews). The study will ultimately provide academics with a clear roadmap for future research on retail operations. It considers how exciting new challenges come with the availability of new data sources and what analytics needs (will) exist in practice.

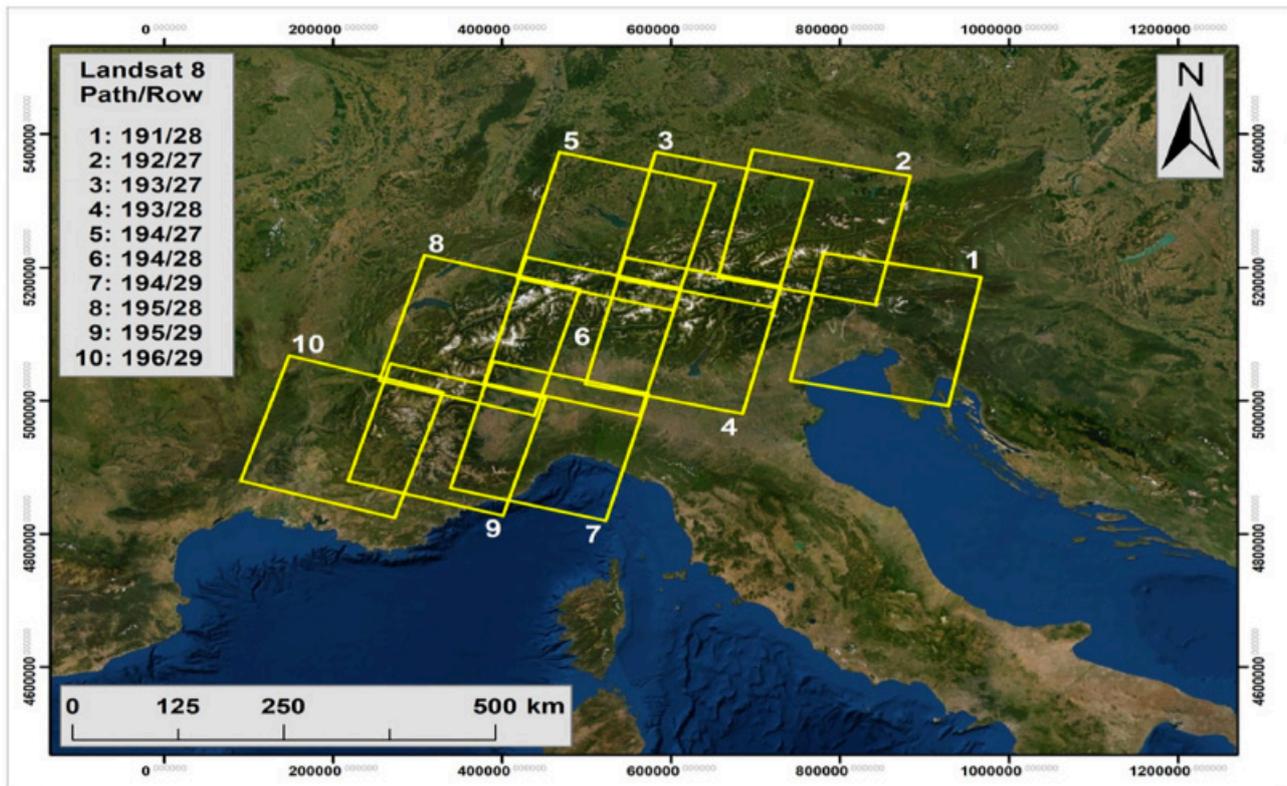


▲ Keynote talk of *Robert Rooderkerk* at online meeting of EWG Retail Operations.



EGU2020 General Assembly in AI City - Online: OR-ML in Processing Satellite Big Data, Retrieving Snow Products for Water Management

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▲ EGU2020: Locations of Landsat 8 tiles over European Alps.

The EGU General Assembly held on May 4-8, 2020, in the online format Sharing Geoscience Online was an exciting experiment in response to the COVID-19 pandemic and a great success throughout the entire week. 18,036 abstracts formed the program with 701 scientific sessions, 11,380 presentation materials accompanied the abstracts and received 6,297 comments so far (to be continued until May 31). A remarkable number of 26,219 individual chat users (combination device + browser) joined our 721 live text chats and posted 200,400 messages. Based on the combination of IP addresses and email addresses used for chat registration, we identified 22,376 individuals from 134 countries. Furthermore, virtual live sessions, Union Symposia, Great Debates, Townhall Meetings, and Short Courses were successfully held, and several networking events gave our community members a unique chance of meeting online and sharing their researches and ideas (<https://www.egu2020.eu>).

In the Dedicated Session GI4.6: *"Progresses and gaps on monitoring of snow and its components at the local-, regional to global scale and its applications to support weather, hydrological and climate science, as well as monitoring of natural hazards"* (<https://meetingorganizer.copernicus.org/EGU2020/displays/37552>), the implementation of OR (Operational Research) and ML (Machine Learning) methods to generate better hydrological and weather forecast models were also discussed in detail. Our presentation in this session addressed

the implementation of ML algorithms to extract fractional snow cover information from satellite data. Snow is an important physical element of the Earth's surface and it has various distinctive features that make the continuous monitoring of its spatial and temporal extent highly significant for fundamental environmental studies. Regarding climatology, snow cover has a direct impact on the energy exchange process between the Earth and its atmosphere, since: (i) it reflects considerable amount of incoming solar radiation due to its high albedo in the visible and the near-infrared regions, and (ii) it prevents the release of heat from the Earth's surface during winter by acting as an insulator with poor heat conducting characteristic [1]. Snow also plays an important role in hydrology of the world's mountainous regions as well as mid- to high-latitude alpine environments. The spatial extent of snow has been declared as an essential climate variable. Thus, accurate modeling of snow cover is crucial for the better prediction of snow water equivalent and, consequently, for the success of general circulation and weather forecasting models as well as climate change and hydrological studies [2]. Remote Sensing (RS) has been offering a powerful alternative for consistent monitoring of snow cover extent with timely and multispectral data acquired by various kinds of coarse and medium spatial resolution instruments since the mid-60s, when the first operational snow mapping was done by National Oceanic and Atmospheric Administration (NOAA) [1]

The *Moderate Resolution Imaging Spectroradiometer* (MODIS) sensor on board to Terra satellite of NASA provides daily global snow cover data with its MOD10A1 product at 500 m spatial resolution [3]. This short report summarizes the initial results of our efforts to develop an alternative methodology to improve or refine the current MOD10A1 FSC product by using *Artificial Neural Networks* (ANNs), *Multivariate Adaptive Regression Splines* (MARS), *Random Forests* (RFs) and *Support Vector Machines* (SVMs) algorithms.

Recent technological improvements in all kinds of measurement devices (MODIS, in our case) create a gigantic and continuously growing supply of information (“big data”) to analyze. This situation forces us, *OR-Analytics* and earth scientists, to position the *ML* issues within the areas of *Data Science* and *RS*. As pointed out in Liang [4], data acquired by remote sensing are often employed in environmental parameter monitoring based on physical models. Although the formation process from environmental parameters to *RS* observations can be realized by the use of “stiff” model formulas who have their scientific origins in the natural sciences, especially in physics, these “traditional formula-based” approaches heavily depend on a priori knowledge on the model parameters. However, this knowledge on the model parameters suffers from by two basic facts which put a certain limitation on the accuracy of environmental remote sensing: *i)* the highly complex nature of the physical processes, and *ii)* the spatial and temporal variations on these model parameters [5]. As a result, based on the theories from *Inverse Problems and Statistical Learning*, many forms of “model-free” (i.e., “data-driven”) *ML* algorithms have been developed and successfully implemented in various science and engineering disciplines to analyze “earth big data”; as in the case of this study, which indeed aims to achieve two tasks simultaneously: 1) to mark important points that should be taken into account when building models by these *ML* algorithms, and 2) to illustrate and test whether better FSC estimates can be achieved from “MODIS data” by employing these *ML* methods.

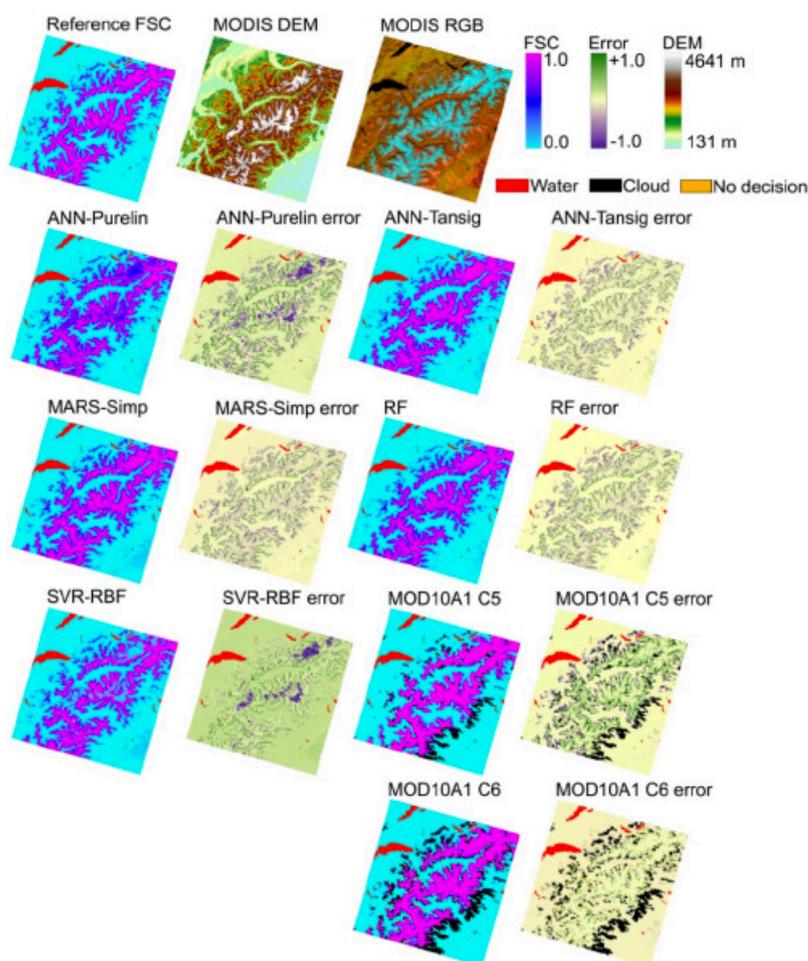
The results indicate that the proposed machine learning algorithms can have a significant contribution to the FSC mapping accuracy of MODIS since they can be trained and tested by using the same training data with a little effort on the reconfiguration of the model tuning parameters. The RF FSC model trained with full set of predictors showed high correlation (~0.93) with the reference dataset and it produced the lowest RMSE values (~0.13) on all individual test datasets over the study region. In terms of the simplicity in model tuning and the time spent during model training, MARS and RFs algorithms are better alternatives than ANNs and SVMs [6].

These novel and powerful results became appreciated a lot during the days of *EGU2020*, and further research has been encouraged. Actually, in our *OR* community, notably at IAM of METU, Ankara (Turkey), we have developed new versions of MARS and SVMs, shortly called as CMARS, Robust MARS, Robust CMARS, CGPLM, Robust CGPLM or IKL.

They already show a high promise for the topics of this study and the *EGU* conference series, and their important real-world applications of *OR* for humanity. This has also been demonstrated at a number of our events organized by *EURO* and *IFORS*, and at our *IFORS Developing Countries Online Resources* (https://ifors.org/developing_countries/index.php/Main_Page).

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▲ EGU2020: re-constructed satellite images by ML-based FSC models on a test scene.

SIMANTAP - Online: International Conference “SIMANTAP 11th” Solemnly celebrated in Siantar, Indonesia

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

SIMANTAP 11th 2020 was an international and national conference for sharing knowledge and research in Mathematics, and its applications provided a platform for teachers, researchers and practitioners from both academia as well as industry to meet and share the cutting-edge development of mathematics, and educational mathematics-based research.

The conference took place at *Universitas HKBP Nommensen Convention Center*, Siantar near Medan, North Sumatra, Indonesia. It was collaboration between *Universitas HKBP Nommensen (UHN)-Siantar* and *IndoMS SUMUT-ACEH*, Indonesia, on November 28-29, 2020. Due to the COVID-19 pandemic, the conference was mainly held online using ZOOM. This event was the 11th conference in this novel conference series. The topic of the conference was dedicated to a motto from *Operational Research*: “*Mathematics to Enhance the Quality of Human Lives*”, which is of a vast importance worldwide, especially, for an emerging nation like Indonesia with its 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 *Operational Research* knowledge about innovation in



▲ Mentor and mastermind of SIMANTAP 11 th 2020 and of OR in Indonesia: Prof. Dr. Herman Mawengkang (USU Medan).

SEMILAR NASIONAL MATEMATIKA DAN TERAPAN (SiManTap) ke-11 2020
http://simantap11.uhn.p.ac.id

TEMA : Mathematics to Enhance the Quality of Human Lives

NARASUMBER :

- Prof. Sri Wahyuni, Universitas Gajah Mada, Indonesia
- Prof. Dr. Sri Mawengkang, Universitas Sumatera Utara, Medan, Indonesia
- Dr. Swasono Raharjo, SPd, MSi, Universitas Negeri Malang, Indonesia
- Prof. Dr. Hotman Simbolon, Universitas HKBP Nommensen, Siantar, Indonesia
- Prof. Dr. Ismail Husein, Universitas Islam Negeri Sumatera Utara, Medan, Indonesia
- Dr. Ismail Husein, Universitas Islam Negeri Sumatera Utara, Medan, Indonesia
- Prof. Dr. Sri Mawengkang, Universitas Sumatera Utara, Medan, Indonesia
- Dr. Hotman Simbolon, Universitas HKBP Nommensen, Siantar, Indonesia
- Dr. Ismail Husein, Universitas Islam Negeri Sumatera Utara, Medan, Indonesia

TOPIC SEMINAR : Pure Mathematics, Statistics, Mathematics Computation, Mathematic Education, Information System

TANGGAL PENTING
JADWAL : 28-29 NOVEMBER 2020
PENDAFTARAN PESERTA : 28/11/2020 s.d. 30/11/2020
PENDAFTARAN PEMAKALAH : 29/11/2020 s.d. 30/11/2020

BAYAR PERBAYA
MAHASISWA : Rp. 150.000
GURU : Rp. 200.000
BAYAR PEMAKALAH
MAHASISWA : Rp. 250.000
GURU : Rp. 400.000

Contact Person
Juli Andri Sari Sihaga, M.Pd. (08195227002)
Siantar Simamora, M.Pd. (082197503451)
Joeli Purba, M.Pd. (08127004662)

Sumantri Projo-Negoro Louis, M.Pd.Hq. 08176087240

Lokasi Pelaksanaan
Aula Universitas HKBP Nommensen Pematangsiantar Jl. Sangnauluh No. 4 Pematangsiantar.

PEMBAYARAN BNI
TRANSFER MELALUI REKENING BNI : 1109711116 a/n Suprapto Manurung & Sumantri Sihembing

▲ Welcome to *SIMANTAP 11th 2020*, beautiful Siantar, North Sumatra, Indonesia

applied mathematics, statistics and mathematics education. This congress was especially used as a scientific stage for accommodating exchange between young researchers who mostly originated from Indonesia in the areas of applied mathematics. 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 reputable worldwide. Indeed, at *SIMANTAP 2020 OR* as well as mathematics applied as our valuable relay to the real life with all of its industrial and economic, environmental and social, developmental and educational challenges, and as a precious chance for the young generation to get further involved within modern scientific research and the international *OR* community.

A majority of the presentations by the main speakers and parallel speakers put their focus onto *OR*, applied mathematics, management, *OR* education, 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.

There were eight keynote speakers of the conference. These were the local leaders and representatives *Prof. Dr. Sri Wahyuni* (Universitas Gajah Mada, Yogyakarta, Indonesia), *Prof. Dr. Herman Mawengkang* (Universitas Sumatera Utara, Medan, Indonesia), *Dr. Swasono Raharjo*, SPd, MSi (Universitas Negeri Malang, Indonesia), *Dr. Hotman Simbolon* (Universitas HKBP Nommensen, Pematang Siantar, Indonesia), *Dr. Ismail Husein* (Universitas Islam Negeri Sumatera Utara, Medan, Indonesia) and the international guests >>

>> Prof. Dr. Rhonda Farragher (The University of Queensland, Brisbane, Australia): “Thinking Mathematically - Teaching Students, Teaching Ourselves”, Dr. Burcu Gürbüz (Institute of Mathematics, Johannes Gutenberg University Mainz, Germany): “Numerical Investigations of Mathematical Models in Biology”, and Prof. Dr. Gerhard-Wilhelm Weber (Poznan University of Technology, Poland, and METU, Ankara, Turkey): “Sentiment for Investment ... When Stochastic Dynamics and Behavior in Economics come together”.

During the conference the latter one, Willi, invited to the next conference highlights of EURO 2021 in Athens, Greece (<https://euro2021athens.com>), and IFORS 2021 in Seoul, Korea (<http://www.ifors2020.kr/>). A triggering and driving force among the co-organizing institutions has been University of Sumatera



▲ Impression from SIMANTAP 11th 2020, online site: with moderator Mungkap M Siahaan.



▲ Professor Herman Mawengkang’s 75-Years birthday celebration at SIMANTAP 11th 2020.

Utara, leading university in Sumatra Island, Indonesia, notably by its Department of Mathematics. The friends there successfully organized and conducted 5 conferences called *InteriOR*, “The International Conference on Operational Research”. This series is held and very much enjoyed 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 11th 2020 in lovely Siantar, also known as Pematangsiantar, pearl of Sumatra near to world-famous Lake Toba, the 75th birthday of “Professor Herman” was cheerfully and solemnly celebrated in the great friendship which is so characteristic for our Indonesian and international OR families.



▲ SIMANTAP 11th 2020: Opening Session with Jubilee Editor-in-Chief Professor Herman Mawengkang, organizers and friends. From left to right: Dr. Suryati Sitepu, Dr. Mardiningasih, Dr. Syahril Efendi, Prof. Herman Mawengkang, Suprpto Manurung, MSC (Chairman of SIMANTAP 11th conference), Prof. Dr. Tulus and Dr. Jumaria Sirait.

As the Editor-in-Chief and the Conference Host, Prof. Dr. Herman Mawengkang, extends his deepest appreciation to all local organizers, the team around the Conference Chair, Mr. Suprpto Manurung, who worked very hard and showed a great care and warmth, to all the keynote speakers, participants and all the many friends from near and far. Without their commitment, this symposium would not have become such a great success. Eventually, we wish you all a robust health and a big success in the next years. We from Sumatra Island hope to see you at SIMANTAP 12th 2021! 🌐

XVI Summer School in Discrete Mathematics: From Valparaiso to Gather.town

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Iván Rapaport <rapaport@dim.uchile.cl>; **Victor Verdugo** <victor.verdugo@uoh.cl>;
José Verschae <jverschae@uc.cl>

The *Summer School on Discrete Mathematics* has taken place every year since 2006 at the *Institute of Complex Systems* in Valparaíso, Chile. It has been a cornerstone event in the Chilean community related to Discrete Mathematics, bringing together

students and researchers of Combinatorics, Computer Science, Graph Theory, Algorithmic Game Theory, Optimization, Operational Research, and related areas. Every year it receives about 40 advanced undergraduate and graduate students from Chile and Latin American, and more recently from other parts of the world. Being an event with

a long tradition, we can feel the impact that the school had in creating an Algorithms and Combinatorics community in Chile. Just as an example, many of the current organizers participated in the school as undergraduate students and were attracted to the area; now we are part of the organizing committee as faculty in different Chilean universities.

Valparaiso is a colorful and lively port city, with great scenery and cafes with stunning views to the ocean. The beautiful location helps to attract people, from great speakers to young students. We were honored to host world-renowned experts given lectures on different key topics, including *Christos Papadimitriou* (Columbia University, USA), *Éva Tardos* (Cornell University, USA), and *Kurt Mehlhorn* (MPI-INF, Germany), among many others.

This year the school confronted the challenge of the COVID pandemic, which made us consider canceling it. After all, one of the great aspects of the event is the interaction of its participants, which is severely limited via online lectures. But complex circumstances call for perseverance and new options were considered. We decided to hold the school online via the *Gather.town* platform. This is an online space that allows participants to move around in a virtual world, interacting with people and objects in their vicinity. The system imitates the serendipity of interacting in the actual world. A lecture hall was implemented, with a link to ZOOM to hold the lectures. Other activities were also in place, with the main objective of incentivizing interaction among participants. We implemented a board game night, where students and researchers enjoyed playing online board games together, a *speed dating* activity, where people got to quickly meet other people, and a poster session where advanced students got to present their own work.

As in any summer school, the highlights are the lectures. We were fortunate to have three wonderful lectures by top-notch speakers:



"Approximation Algorithms for Stochastic Combinatorial Optimization" by Anupam Gupta (Carnegie Mellon University, USA).



"Introduction to Differential Privacy" by Katrina Ligett (Hebrew University, Israel)



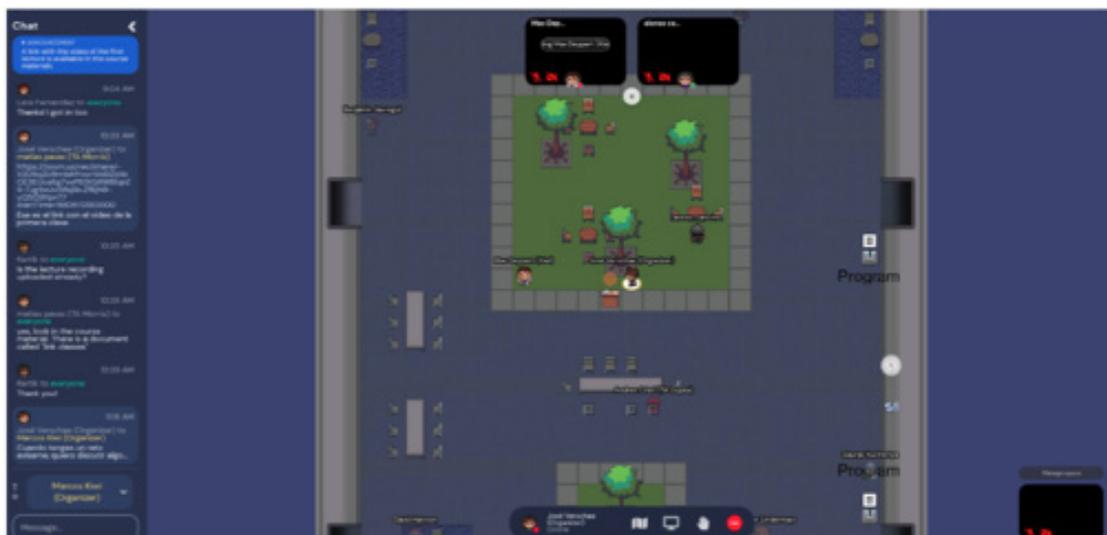
"The method of hypergraph containers" by Rob Morris (IMPA, Brazil)

Each course consisted of 4 lectures and an assignment sheet was given after each lecture for the students to solve. Time was given for the students to collaborate and solve the exercises in online whiteboards, all within the *Gather.town* platform. The course by *Prof. Ligett* was a wonderful introduction to the area of differential privacy, with plenty of discussion on the difficulties of attaining workable and usable concepts and definitions. *Prof. Ligett* did also a great job incentivizing the participants to interact in class, to ask questions and participate in general. *Prof. Morris* gave a beautiful lecture on method of hypergraph containers, which helps to bound the number of objects with some forbidden structure. The basic ideas were introduced by bounding the size of triangle-free subgraphs of a random graph and then addressed more advanced problems. *Prof. Gupta's* course started with a gentle introduction to approximation algorithms, and then continued to slowly build tools to provide insightful ideas to deal with data uncertainty in combinatorial optimization problems.

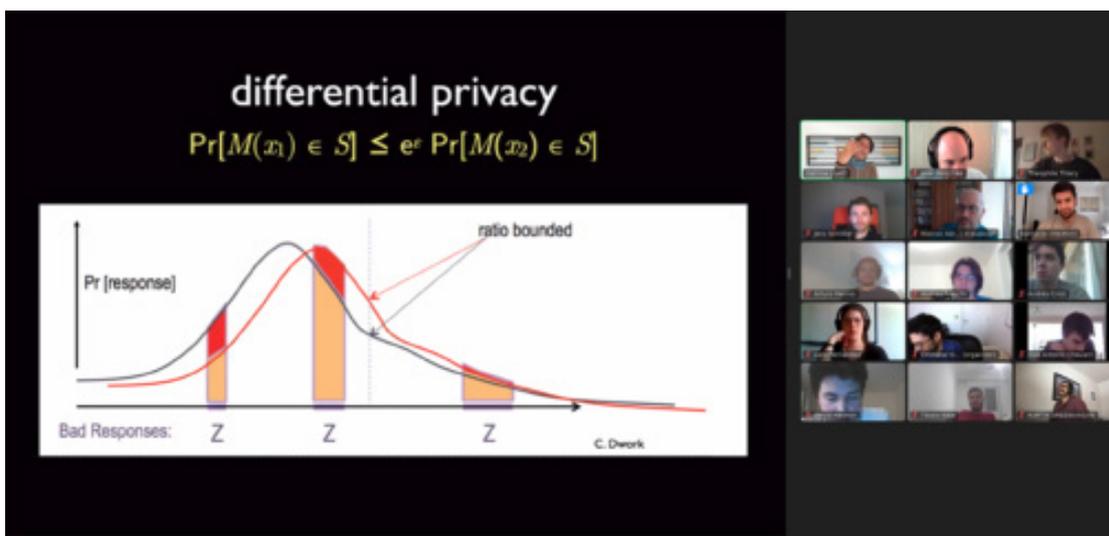
The summer school had about 100 participants, and attendance was high throughout the week. The participants were enthusiastic, asked many questions, and participated in most of the activities. At the end of the week, the organizers gave out prizes to the best handed-in homework. The winners were *Thiago Lima Oliveira* (U. São Paulo), *Pedro Izquierdo* (U. Católica), and *Andrea Freschi* (U. Birmingham), who will get books related to the topics of the school.

This year's organizing committee consisted of a team from three different Chilean universities: *Cristóbal Guzmán* (U. Católica, IMC), *Marcos Kiwi* (U. Chile, DIM & CMM), *Iván Rapaport* (U. Chile, DIM & CMM), *Victor Verdugo* (U. O'Higgins, ICI), and *José Verschae* (Chair, U. Católica, IMC). We would like to thank the Center for Mathematical Modelling (CMM) for providing generous funds for the school's organization.

Further information on the summer school and its previous versions can be found in the school's webpage: <https://eventos.cmm.uchile.cl/discretas2021/> 



▲ *Summer School in Valparaiso*: screenshot of the main room of the virtual venue in *Gather.town*.



▲ *Summer School in Valparaiso*: lecture by *Katrina Ligett*.



▲ *Summer School in Valparaiso*: working room, where students could access course material and work in online whiteboards.

Young OR enthusiasts at 4th AIROYoung Workshop in Bozen/Bolzano, Italy

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Veronica Dal Sasso <veronica.dalsasso@gmail.com>; **Martina Fischetti** <martina.fischetti@vattenfall.com>;
Serena Fugaro <serena.fugaro@unina.it>; **Valentina Morandi** <valentina.morandi@unibz.it>;
Alice Raffaele <alice.raffaele@unitn.it>

The 4th AIROYoung Workshop (AYW, [1]), organized by AIROYoung [2], the Young Researchers Chapter of the Italian Operational Research Society (AIRO) [3], was held in presence just before the COVID-19 pandemic outbreak (February 5-7, 2020). Since its first edition in 2017, the AYW has become an annual international appointment for PhD students and young researchers to meet, exchange knowledge and present novel research contributions in the field of *Operational Research (OR)*. The 4th AYW took place at the Free University of Bozen/Bolzano, Italy, and was organized by Valentina Morandi (Chair; Free University of Bozen/Bolzano), Lavinia Amorosi (Sapienza University of Rome), Rossana Cavagnini (RWTH Aachen University), Veronica Dal Sasso (Optrail), Martina Fischetti (Vattenfall) and Alice Raffaele (University of Trento).



▲ The 4th AYW Organizing Committee in Bozen/Bolzano. From left to right: Veronica Dal Sasso, Martina Fischetti, Lavinia Amorosi, Valentina Morandi, Rossana Cavagnini and Alice Raffaele.

Similarly to the previous editions, this fourth one included two high-quality plenary talks, held this year by David Pisinger (DTU, Copenhagen) and Claudia Archetti (ESSEC Business School, Paris), and talk sessions held by the participants. The workshop program was further enriched with two new sessions: “Building bridges between Operations Research and Data Science”, i.e., an invited session given by Tullia Padellini (Imperial College, London), and “Pitch talk for 1st year PhD students”, i.e., a brief presentation given by participants on their research fields. The former provided an introduction to new research directions which open for collaborations with academics and practitioners coming from multidisciplinary fields, such as *OR and Data Science (DS)*. As to the latter, the organizers introduced a pitch-talk session by triggering the

question of why *OR* is often unknown to a broad audience, even if *OR* challenges arise in many practical applications. *Are we good communicators?* Each participant was then encouraged to explain her/his research topic in simple words in just one minute. Being able to summarize and highlight the very essential features of a project is a very precious competence for a researcher. The participants got enthusiastically involved in this activity as it was a further opportunity to know each other and to easily exchange knowledge and research ideas in a friendly environment. The 4th AYW also included a social dinner and a guided tour of Bozen/Bolzano, where participants enjoyed the city, the typical food and the company. It is one of the goals of AIROYoung, indeed, to create an inclusive atmosphere where all young researchers can feel involved and network. There were more than 50 participants, coming from several countries in Europe and giving more than 20 talks. As for previous editions, the event was free of charge for participants. Indeed, the AYW workshops have always been designed to include all kinds of students, independently from their university funds. For this reason, some of the funds were also dedicated to offer grants (i.e., free accommodation) for some participants (in order to help even more those with limited funds for traveling). This was possible both thanks to the support of AIRO and to sponsors engaged among the local industrial realities.



▲ Tullia Padellini (Imperial College, London) during her invited session on *bridges between OR and DS*.

One great novelty of this last edition is the Special Issue dedicated to the *AIROYoung* community and to the 4th AYW, published on the *Springer Nature Operations Research Forum* journal [4]. In particular, this Special Issue has two purposes: to disseminate latest advances on the topics of interest but also to provide an overview of the community behind *AIROYoung*, showing why feeling part of a community is important for young OR researchers around the world. For this purpose, the Special Issue collects articles regarding the OR community itself [5], the main ideas behind the organization of the AYWs [6], the gender gap [7], the role of OR and how to communicate what we do outside our community [8], and a review on how OR can be introduced to Grades 9–12 students [9].



▲ Claudia Archetti (ESSEC Business School, Paris) and David Pisinger (DTU, Copenhagen) at 4th *AIROYoung* Workshop.

The participants, as well as the invited speakers, enjoyed the atmosphere of the 4th AYW. In fact, Claudia Archetti - plenary speaker - said: *"I had the privilege and the pleasure to be invited as plenary speaker at the 4th AYW in Bozen/Bolzano. It was indeed a wonderful experience: a great group of talented, passionate and super-active young OR researchers, eager to learn and exchange new challenging ideas. I was especially impressed by the enthusiasm and the energy of the members of the AIROYoung Board: five fantastic young OR women who will certainly leave their mark in our scientific community. A special thanks to all of them and in particular to the local organizer, Valentina Morandi, for the great experience, the fantastic atmosphere and the excellent scientific quality of the workshop. Unforgettable!"*.

Also the other plenary speaker, David Pisinger, confirmed: *"The AIRO Young conference in Bozen/Bolzano was of a high-academic standard with many interesting talks and an excellent social program. One could feel a willingness for cooperation and knowledge exchange that you seldom meet at other conferences. A must-go for PhD students."*

Now the *AIROYoung* community is ready for the next workshop, the fifth one. Jointly organized with the *AIRO PhD School 2021*, it will take place in a blended form (due to the current pandemic situation) on February 10-12, 2021, at the



▲ Cheer and community at 4th *AIROYoung* Workshop!

Accademia di Scienze Fisiche e Matematiche of Naples. New OR enthusiasts are always welcome and the *AIROYoung* Board, together with the organizing committee of the 5th *AIROYoung* Workshop, are looking forward to meeting you!

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EURO WISDOM Forum: “Christmas Webinar and Celebrating Progress toward Gender Equality in OR

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EURO WISDOM (Women In Society: Doing Operational Research and Management Science) Forum, launched in January 2020, celebrated its first year. During its first year, *WISDOM* established its structures and communication channels, issued a White Paper on promoting gender equality and inclusivity in *EURO* activities, and organized a series of Webinars. The *WISDOM* webpage was set up at <https://www.euro-online.org/web/pages/1654/wisdom>, and the first *WISDOM* Newsletter was issued in December 2020. The *Research Committee of WISDOM* has started a number of projects exploring the gender dimension in OR and in scientific networking.

To support and motivate more active participation of young women in OR, *WISDOM* launched an initiative called **YoungWomen4OR**. This initiative aims to introduce to our community emerging young women working in OR, either in academia or in the 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 event was launched for the first time in July 2020 and will be repeated annually. More than thirty applications were received for the 2020 edition, of which twelve were final year PhD students and twenty early career researchers. Applications came from fifteen different countries. The names of twelve finalists in the first figure were announced in January 2021, and an interview with the first awardee, *Lavinia Amorosi* was published on the *WISDOM* website. Every month, *WISDOM* will publish an



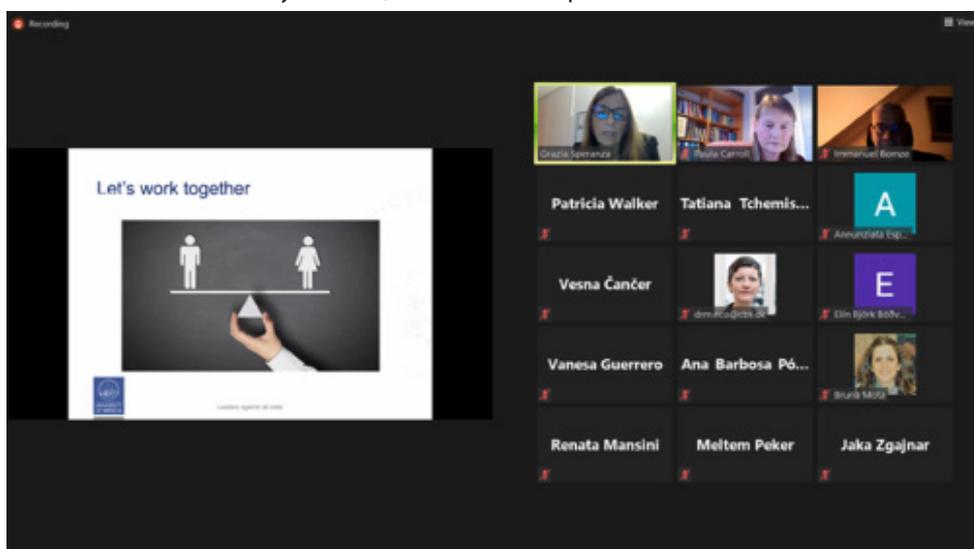
▲ *YoungWomen4OR*: top row, left to right: *Bruna Mota*, *Mercedes Pelegrin*, *Lucy Morgan*, *Cátia Da Silva*; middle row, left to right: *Lavinia Amorosi*, *Meltem Peker*, *Martina Fischetti*, *Beatriz Brito Oliveira*; bottom row, left to right: *Alina G. Dragomir*, *Jessica Rodriguez Pereira*, *Annarita De Maio*, *Melanie Reuter-Oppermann*.

interview with one of the **YoungWomen4OR** awardees.

On December 21, *WISDOM* facilitated a “Christmas Webinar” *Leadership in OR*. In this webinar, leaders from the *EURO* community, the *President of the International Federation of Operational Research Societies (IFORS)*, *Professor M. Grazia Speranza*, and the *President of EURO (now: Past President)*, *Professor Immanuel Bomze*, shared their experiences and vision on leadership in the world of OR and reflected on their definition of leadership, and what they propose leaders in OR and Analytics should aspire to achieve. They addressed specific questions on *Equality, Diversity and Inclusion (EDI)* challenges for *OR/Analytics*, and discussed how leaders in OR can contribute to tackling *EDI* challenges; see the second figure.

There were 50 registered participants who participated in a lively discussion after each presentation.

To read more about *WISDOM* activities and view recordings of the *WISDOM Webinars* we invite readers to visit the *WISDOM* webpage <https://www.euro-online.org/web/pages/1654/wisdom>. 



▲ The *EURO WISDOM “Christmas Webinar”*; top row, left to right: *Prof. M. Grazia Speranza (IFORS President)*, *Dr. Paula Carroll (WISDOM Chair)*, and *Prof. Immanuel Bomze (EURO President; now: Past President)*.

Reflections on the Women in Leadership: OR and Analytics Profession OR62 online pre-conference, Joint Session by WISDOM and WORAN

Rosemary Byde <rosemary.byde@natwest.com>; Frances O'Brien <frances.o-brien@wbs.ac.uk>

The UK OR Society's *Women in OR & Analytics Network (WORAN)* was launched in October 2019 and had been invited to contribute an event to the OR62 conference. As the first wave of the pandemic spread through Europe in March 2020 it quickly became clear that the conference would have to be held online which would mean some form of online contribution from WORAN. As it turned out, WORAN held a series of monthly events during the UK lockdown. Through these events we gained experience of hosting a variety of different events, involving individual speakers, panel discussions and lightening talks. Common to all of our events was the informal networking that followed the formal activity of the event. Armed with this experience we were confident that WORAN could contribute an exciting event to OR62 online.

After some discussions with *Paula Carroll* who chairs the *WISDOM (Women in Society: Doing Operations Research & Management Science) Forum*, we agreed to host a joint event with an introduction to our respective networks and a panel discussion on the topic of *Women in Leadership*, followed by an informal networking session to end the event.

Our event was run on *September 14, 2020*, the day before the formal OR62 online conference as one of series of pre-conference events. We attracted a good audience from all around the world. After our network/forum introductions, we handed over to *Sally Brailsford* (Associate Dean of Research & Enterprise, University of Southampton) who had kindly agreed to chair the panel discussion. The panel consisted of two academics and two practitioners. This inspirational group of women in leadership across a range of professions answered questions and shared their stories and advice. Everyone who attended would have found something that resonated personally and these are just some of our own highlights.

Julia Bennell (Executive Dean, Leeds University Business School) talked about how important "systemic thinking" is for strategic leadership. What might come naturally to us is not necessarily a given for everyone else. Her talk brought to mind the need to understand and appreciate our own value.

Hiroko Plant (Lead Analyst, Land Registry) showed passion about the value of her role in UK government OR. She shared a very insightful story about what happened when she took some challenging team feedback personally and was too acquiescent in trying to fix everything. Many would recognise this in themselves and thus it was valuable to hear how she had reflected and changed her approach.

We were inspired when *Leila Seith Hassan* (Head of Data Science



▲ Mosaic of participants at *OR and Analytics Profession OR62 online pre-conference joint session* (from above-left to below-right): *Prof. Dr. Sally Brailsford* (Associate Dean of Research & Enterprise, University of Southampton, UK), *Prof. Dr. Julia Bennell* (Executive Dean, Leeds University Business School, UK), *Dr. Hiroko Plant* (Lead Analyst, Land Registry, UK), *Dr. Leila Seith Hassan* (Head of Data Science and Analytics, Digitas, UK), *Prof. Dr. Noel-Ann Bradshaw* (Head of School of Computing and Digital Media, London Metropolitan University, UK), and *Prof. Dr. Annunziata Esposito Amideo* (University College Dublin, Ireland; WORAN committee member).

and Analytics, Digitas) talked about leaving a role where the culture was "toxic" and unsupportive. It is "*OK to walk away and leave, and realise it's not your fault*", she said. Although we all can and should work to change things, sometimes you can only take it so far. These actions came across as a powerful way of not sitting back and accepting cultural norms through inaction.

Noel-Ann Bradshaw (Head of School of Computing and Digital Media, London Metropolitan University) talked about being true to her own leadership style, centred around good communications, being caring and supportive and focussing on building trust. Despite some initial scepticism from others, she persisted with this in a new role with longer-term success. This showed authentic leadership and demonstrated that we do not all have to follow the same stereotypical template to be successful leaders. The final point of the panel session that everyone agreed on was the value of different kinds of coaching and mentoring. We were very grateful to *Sally's* expertly chairing of the discussion as it had great flow, a balance of questions and time with all the panellists.

After a short break we had a chance for small group networking in ZOOM breakout rooms, sharing and discussing the points that had struck a chord for us. There was a lot to take from this session whether you are a woman in OR anywhere on a leadership journey, or a man open to hearing from more female voices in the profession. The replay is already available online if you missed it - WORAN event at OR62 online. If you would like to find out more about WORAN, please visit their page on the OR Society's website (<https://www.theorsociety.com/get-involved/society-groups/special-interest-groups-and-networks/women-in-or-analytics-network/>) and for WISDOM, please visit their page on the EURO website (<https://www.euro-online.org/web/pages/1654/wisdom>). 

Even Convexity and Optimization Handling Strict Inequalities

by

María D. Fajardo, Miguel A. Goberna, Margarita M.L. Rodríguez, José Vicente-Pérez

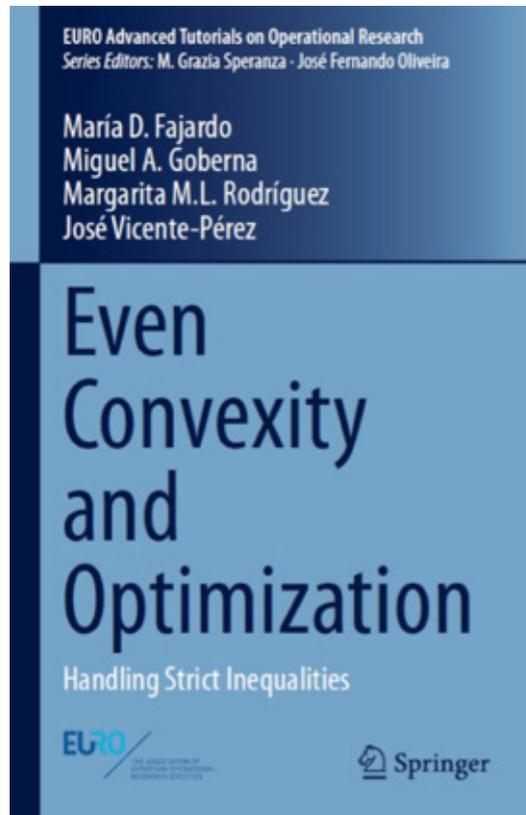
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The book by María D. Fajardo, Miguel A. Goberna, Margarita M.L. Rodríguez and José Vicente-Pérez is a valuable contribution to Optimization, especially, generalized versions of Convex Analysis and Convex Optimization, its Theory, Methods and Applications, on the interface between (i) Algebra and Linear Algebra, Calculus and Analysis, Functional Analysis and Numerical Analysis, with an emphasis on both existence and computational aspects, and rapidly growing fields of (ii) Operational Research (OR), Mathematical Modeling, Game Theory and further applied areas, herewith paving the way to future advances in (iii) Data Science, Statistical and Machine Learning, Deep Learning and, ultimately, mathematically supported Artificial Intelligence. The new monograph is timely and needed, theoretically and methodologically rigorous, and promising for practice. A main reason for the expected promises of this book lies in the fact that so many of our present and upcoming highly complex problems are nonlinear and tackled by locally approximating them with the help of linear ones, such as deeply investigated in this book. With this book's help in upcoming times, the gifted youth of mathematics, OR and other applied disciplines can be educated, guided and trained better. Many further scientific and practical inquiries can be conducted and real-world applications may be conducted, in the vast and quickly expanding world of modern research in the quantum and the cosmic worlds, for our emerging industries, our environment, for health, prosperity, justice and freedom of our humankind and whole creation.



Operational Research and Optimization for Tomorrow.

This book is the first one dedicated to linear systems with both general or weak lower inequalities (with “less or equal” relation) and strict lower inequalities (with “less than” relation), in total maybe infinitely many constraints, in n -dimensional Euclidean space with standard inner product, with the *solution set* or *feasible set* σ (called *evenly convex* by Fenchel in 1952) implicitly defined by these linear systems, and to those extended real-valued functions whose epigraphs (or, at least, their lower level sets) are *evenly convex*. To the authors the necessity of this book arose from the almost vanishing number of available monographs so far mind about Existence Theorems for linear systems containing strict inequalities. On the one hand, these were the monographs of Schrijver (on linear programming) and Mangasarian (on nonlinear optimization), Owen (on game theory), all referring to the overall index set of inequalities, T , being finite. On the other hand, Goberna and López (on semi-infinite optimization) address an arbitrary

entity T . The situation is even harder regarding evenly convex sets and related functions, which have just been mentioned by now in Soltan's book, its 2nd edition, on convex sets (devoting 2 notes to evenly convex sets and evenly convex hulls) and the PhD thesis of Maggis (where evenly convex and evenly quasiconvex functions are used in finance and economics). This basically complete absence of linear systems containing strict inequalities, evenly convex sets and related functions in monographs and textbooks, has caused decades of delay and stagnation of interesting research and, over the years, rediscoveries of already known facts on mathematical subjects under different names.

The authors call σ as *ordinary* if there are no strict inequality constraints, in symbols: $S = \emptyset$ (i.e., the solution set is exclusively set up by weak linear inequalities). Then the solution set is closed and convex (a well-known type of evenly convex set). The authors say that the above linear system σ is finite if T is finite. Otherwise they call it as *semi-infinite* (a name coming from their finitely many variables or dimensions, and their infinitely many inequalities). *Finite ordinary linear systems* were firstly considered by *Fourier* in 1826 and secondly by *Farkas* around 1900, characterizing equilibrium points in mechanics. For their crucial role in linear programming, they have been well analyzed, because this widely used optimization model is computationally equivalent to Feasibility Problem for finite ordinary linear systems. This comes out of Duality Theorem and Fourier–Motzkin Elimination Method. *Semi-infinite ordinary linear systems* were first studied by *Haar* in 1824, in a paper unnoticed until the publication of a free translation by *Charnes, Cooper and Kortanek* in 1963, in their seminal paper on linear semi-infinite programming. Here the authors merely address ordinary linear systems with comparative purposes as they are treated in the abovementioned monographs, whereas their *non-ordinary* counterparts have been systematically neglected by now. *Finite non-ordinary linear systems* were first regarded by *Gordan* in 1873. They were used a couple of times in the 20th century, e.g., by *Kuhn* in 1956, *Walkup* and *Wets* in 1969, and *Kannan* in 1992, while they have become intensively employed in the 21st century in OR (such as in optimization and games), computational sciences, etc. Their feasible sets, which the authors name as *evenly convex polyhedra*, were rediscovered and studied repeatedly under names such as wholefaced polyhedra, copolyhedra, not necessarily closed convex polyhedra, G-polyhedra, and semiclosed polyhedra. As much as functions are concerned, right in same way as quasiconvex and convex functions are defined by their lower level sets or epigraphs being convex, respectively, *evenly quasiconvex* and *evenly convex* functions are defined by their lower level sets or epigraphs being evenly convex, respectively. *Evenly quasiconvex* functions, applied in economics, were introduced by *Martínez-Legaz* under the name of normal quasiconvex. Independently they were presented by *Passy* and *Prisman* in the early 1980s. *Evenly convex* functions became introduced by *Rodríguez* and *Vicente-Pérez* in 2011.

The authors' team enjoy a remarkable reputation, especially, for their strong research achievements over many decades, for example, in semi-infinite optimization and related subjects, along with their coauthors from Alicante, from other Spanish cities – premium centers as well, and from all over the world. Therefore the present book stands another academic success of the authors and their team. It bases on vast experience and strong foundation in mathematics and OR.

This innovative and truly unique work is offered to us together with several special and additional benefits and promises, namely: (i) It contains numerous “classical” OR and mathematical applications, so that the reader is well motivated to get involved into the scientific terminology of the book and trust in its real-world meaning and impact. Those applications could also be used by the reader in education and other lectures and presentations, (ii) It contains many classical and, especially, emerging conditions and their characterizations which enrich the mathematics of OR and intellectually train and trim the readers both from theory and from practice, (iii) It is highly flexible in order to be applied in future on other



▲ The “writers”;
*Kind regards from Spain by the team (from left to right):
 José Vicente-Pérez, Margarita M.L. Rodríguez, María D. Fajardo,
 Miguel A. Goberna.*

“linear problems”, to be generalized in theory for “nonlinear problems” and applied on them, and on infinite-dimensional and stochastic problems, both linear and nonlinear ones. Here we may think of infinite programming, infinite kernel learning, calculus of variations, theories of optimal control and dynamical games, and of their stochastic counterparts.

The four chapters and all the other parts of this book are these. After *Preface, Acknowledgments*, etc., there are: *Chapter 1: Evenly Convex Sets: Linear Systems Containing Strict Inequalities, Chapter 2: Evenly Convex Polyhedra: Finite Linear Systems Containing Strict Inequalities, Chapter 3: Evenly Quasiconvex Functions, Chapter 4: Evenly Convex Functions*, and the *Appendix: Extensions to Infinite-Dimensional Spaces*.

On Chapter 1: Here the authors are concerned with linear systems of a possibly infinite number of weak or strict inequalities and with their solution sets, which they name as evenly convex sets. Both sets and functions are “equivalent” to each other. In different ways they first characterize evenly convex sets which fulfill most of the well-known properties of closed convex sets. Any set has an evenly convex hull. Then they turn to the operations with evenly convex hulls and how they relate to other hulls. Next on the agenda are diverse Separation Theorems with evenly convex sets, followed by Existence Theorems for linear systems with strict inequalities and characterizations of linear inequalities. This permits them to tackle Set Containment problems with convex sets. Next the authors turn to evenly linear semi-infinite programming problems, before they make applications to the following subjects: Polarity that once inspired the authors to their evenly convex set, Semi-infinite Games, Approximate Reasoning, Optimality Conditions, and Strict Separation of Set Families.

On Chapter 2: Here the authors deal with linear systems containing finitely many weak or strict inequalities, whose solution of feasible sets (if nonempty) are called as evenly (or: e-) convex polyhedral. All corresponding results in Chapter 1 remain valid, but the finiteness of linear representations of e-polyhedra allows obtaining specific results and methods. Many convex-set families have both Internal and External Representations. The outstanding advantage of the polyhedra against the other two families of convex sets is given by the Double Description Methods permitting an external representation from the internal one, and vice versa. In this chapter, the authors extend this method from polyhedra to e-polyhedra. They first describe Fourier-Motzkin Elimination Method to project a given e-polyhedron on the coordinate planes. Iteratively applied this allows the finding of solutions for finite linear systems containing strict inequalities. Then they associate each finite non-ordinary system with its so-called “representative cone”, containing all relevant information about the systems. By this, Existence Theorems and Characterizations of the consequent inequalities can be simplified for an arbitrary number of constraints. Then they present the aimed Double Description Method for e-polyhedra, before they investigate the minimization of linear functions under weak and strict linear inequalities, named as Evenly Linear Programming Problems.

On Chapter 3: After all the careful preparations made in the previous chapters, now the authors investigate deeply on evenly quasiconvex functions, evenly quasiconvex hulls, conjugacy and subdifferentiability, duality in quasiconvex optimization, and an application to consumer theory, and bibliographic notes. In this chapter, again the mathematics is done with rigor and completely. Many small examples facilitate an easier understanding and help the newcomer in the field, or any reader who comes from fields rather different from mathematics, to endure, enjoy and memorized key conditions, configurations and results.

On Chapter 4: Now the authors introduce evenly convex functions as such whose epigraphs are evenly convex sets. They unfold a Duality Theory for nonlinear optimization involving evenly convex optimization. First they present the main properties of this problem class of convex functions which includes the important subclass of lower semicontinuous convex functions, whose relevance in convex analysis comes from the fact that Fenchel Conjugacy is an “involution” on most of them. Then the authors offer the evenly convex hull of a function and schemes of conjugation for evenly convex functions, before they unfold the c-Conjugate Duality Theory along with regularity conditions of type “closedness”. The latter ones will be expressed by even convexity of the functions involved, for both strong and stable strong duality of convex problems.

Appendix A: At least a dozen of results provided by this book also possess an infinite-dimensional counterpart, in which the finite-dimensional Euclidean space can be substituted and in fact generalized by some Banach spaces or even a locally convex separated, i.e., Hausdorff, topological vector space. These cases and places of the book are carefully listed in a table.

This excellent book is clearly and well structured, analytically

deep, well exemplified, beautifully illustrated, and written with care and taste.

In the future, refinements and extensions in analytic, theoretical foundations and algorithmic techniques may be considered by the authors and within the academic family, prepared, supported and inspired by this book. These could be made in the form of articles and monographs, and in terms of, e.g., Singularity and Morse Theory, of Non-smooth, Discontinuous or Robust Optimization, Optimal Control, Stochastic Optimal Control, and of Discrete-Combinatorial elements such as Thresholds, Regime Switching and Hybrid Systems, Collaborative Game theory and Stochastic Games.

Those future advancements could nurture and support successes in management, economics and finance, in the natural sciences and high-technology, in bio-, cognitive and medical sciences, in environmental, geo-, earth- and space-time-sciences, and in societal and developmental sciences.

Just to mention one recent research area of physics and cosmology, neuroscience and spirituality where those particular mixtures between weak and strict inequality constraints naturally occur and can help in modeling, we give a tentative quotation by one of the authors:

“As far as mathematics can serve, our boundaries, surfaces and membranes, interiors and exteriors, in dimensionally generalized space-time, and in all states of matter, may in a natural way be modeled by possibly infinite sets which consist of both “weak inequalities” and also “strict” ones. These mixtures and the related generalized manifolds have been the subjects of studies by a scientific optimization team in Spain. Its members are María D. Fajardo, Miguel A. Goberna, Margarita M.L. Rodríguez, and José Vicente-Pérez. Their underlying scientific school mainly comes from the deep investigation of the “linear” branch of semi-infinite optimization which we will discuss [...]”

(from the upcoming book “Times and Lives” by G.-W. Weber).

PS: Some more information about the book and its underlying book series are noteworthy. We quote it here.

The EURO Advanced Tutorials on Operational Research are a series of short books devoted to an advanced topic - a topic that is not treated in depth in available textbooks. The series covers comprehensively all aspects of Operations Research. The scope of a Tutorial is to provide an understanding of an advanced topic to young researchers, such as Ph.D. students or Post-docs, but also to senior researchers and practitioners. Tutorials may be used as textbooks in graduate courses. More information about this series can be found at <http://www.springer.com/series/13840>.

The editors of EURO Advanced Tutorials on Operational Research are Prof. Dr. M. Grazia Speranza (University of Brescia, Italy) and Prof. Dr. José Fernando Oliveira (University of Porto, Portugal). 

Francisco Sagasti: The President of Peru

Paul Randall <randallp@live.co.uk>

Paul Randall (formerly adviser to the Governments of both Namibia and the United Kingdom) reflects on the career and ideas of the President of Peru

Francisco Sagasti, who became President of Peru on 17 November, is no stranger to the OR community, both for his contribution to OR in development and for the roles he played in a number of international bodies. Many of us also remember his inspirational presentation as the closing Plenary speaker at IFORS 2002 in Edinburgh.



▲ Francisco Sagasti

Initially an industrial engineer, he went on to complete a PhD in Operational Research and Social Systems Science at the University of Pennsylvania. He became a welcome lecturer at universities around the world and an adviser, in various capacities, to the Government of Peru. From there, as his abilities gained wider recognition, he served on various International Bodies, including as Chief of the Strategic Planning Division and Senior Advisor at the World Bank and chairman of the United Nations Advisory Committee on Science and Technology for Development. More recently, he was a member of the member of the World Economic Forum's Global Strategic Foresight Community

Returning to Peru in 1992, he founded a think tank and research consultancy – FORO. The following year he, and others, launched the Agenda: PERU programme designed to improve governance and development. As he remarked “this was carried out under difficult conditions because of opposition from the authoritarian regime in power at that time”. Surely, an understatement.

In 2016 he helped form the Purple Party and was elected to Congress in 2020. It would not

be appropriate to attempt and explanation of the Byzantine complexities of Peruvian politics here. Suffice it to say, he became the third person to serve as President within 8 days, after the impeachment of the sitting President for being ‘morally incompetent’ and the resignation, following popular protest, of Sagasti’s immediate predecessor.

As leader of a small party in a politically volatile environment, with elections due in April, his ability to implement his ideas may be circumscribed, even as President. Nonetheless, the emphasis, in his inaugural address, on ‘long-term policies to make science and technology a prominent part of policies’, suggests he intends trying.

Sagasti’s wide range of interests is demonstrated in his 25 books and over 150 papers. As, he explains he had a “highly eclectic education, built on engineering, economic and mathematical foundations, complemented with excursions into strategic planning, behavioural sciences, history and philosophy”. That background has led to a focus on integrating apparently disconnected elements into coherent wholes. He has done so in a way that has recognised the counterpoint between broad intellectual pursuits and the practicalities of actually getting things done. His grounding in the theoretical and practical approach to systems thinking meant that the political, and policy, was integral to his work. That was exemplified when he delivered the closing Plenary session of IFORS 2002 under the title “Operations Research and Management Sciences for development in a fractured global order”.

He explained how OR had evolved in the 70s from being a collection of tools and techniques to a range of intervention methods and roles. A similar evolution could be seen in the 90s where OR, especially for developing countries and international institutions, was increasingly a matter of finding metaphors.



The increasingly fractured world order (and how much more so today) brought with it new challenges for OR so that it is:

- no longer possible to focus only on resource allocation and on setting priorities for activities within stable institutions and contexts;
- necessary to examine institutions and focus on institutional redesign;
- essential to continuously assess the impact of a rapidly changing context;
- essential to articulate visions, explicitly considering values and aspirations.

He illustrated his thinking with a number of case studies. Particularly memorable was his description of a software tool (ascribed to Alejandro Afuso) employing OR techniques to

improve project selection and resource allocation using data on outcomes and local poverty levels. The result, as he pointed out with some delight, was to reduce the possibility of political influence and corruption in project funding decisions.

His closing rallying call to the OR community was:

“Let us not wait until the emerging global fractured order leads to disasters and chaos before taking action. Operational research was born at a time of crisis and of extreme danger: we are facing a similar situation now”

In the eighteen years that have elapsed since, one can see how prescient he was. His conviction that Operational Researchers could make a real difference was an inspiration to many of us; and, he has certainly led by example. 🌐

OR in for Development in a Fractured Global Order

Francisco Sagasti <fsagasti@amauta.rcp.net.pe>

Dr. Sagasti, President - FORO Nacional Internacional, Peru and Director of Agenda: PERÚ will draw on his extensive international experience in planning major development programmes. His wide research and consulting background as an OR scientist since the mid-1960s, to outline the opportunities he sees ahead for the thinking of OR scientists to increase its influence on the management of sustainable human development at international, national and local levels. He will relate this theme to the overall conference theme of OR in a Globalised, Networked World Economy.

Francisco Sagasti obtained his Industrial Engineering degree in Lima and his Ph.D. in OR and Social Systems Sciences at the University of Pennsylvania. He has been Chief of Strategic Planning at the World Bank, Visiting Professor at the Wharton School of the University of Pennsylvania, Chairman of the UN

Advisory Committee on Science and Technology, and advisor to various ministers, international organizations, government agencies and private firms in Peru and in other countries. He has published more than 200 papers and 20 books on development strategies, science and technology policy; systems thinking and modeling. At present he is Director of Agenda:

PERU, research associate at the Institute of Development Studies (Sussex University), advisor to the Primer Minister of Peru and special advisor to the Rector of the University for Peace in Costa Rica. 🌐



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