IFORS

International Federation of Operational Research Societies

What's Inside

From the President

# A Bumper Crop of Conferences

Mike Trick <trick@cmu.edu>

IFORS holds its major conference every three years. We had a great conference in Quebec City last year, so there is no IFORS Triennial this year. But there are certainly a lot of wonderful conferences being planned by IFORS Regional Groupings, member societies, and other groups. I suspect that an assiduous person could attend a conference every week without straying far from the core definition of operational research.

All three of our Regional Groupings have conferences planned this year. The 29th EURO conference will be held in Valencia Spain, July 8-11. I understand that one session will be held at the stunning City of Arts and Sciences. ALIO, our grouping of primarily South American societies, will hold their CLAIO conference September 24-27 in Lima, Peru, a city of great history and beauty. APORS, the grouping of Asian Pacific OR societies, will be held in Kathmandu, Nepal, August 6-9. Kathmandu is, of course, the gateway to the Himalyas, and the city is one of intense historic, artistic, and cultural interest. Our fourth regional grouping, NORAM, comprises the Canadian OR Society and INFORMS, our United States member. They will be meeting in Halifax, June 4-6, and in Phoenix November 4 through 7, respectively.

At the EURO, APORS, ALIO, and INFORMS conferences, there will be an IFORS Distinguished Lecturer, a senior member of our field discussing a topic of broad interest. For EURO, that speaker is Cindy Barnhart, MIT's Chancellor. Other IDLs are Leo Lerti (APORS), Mario Veiga Ferraz Pereira (INFORMS) and Edoardo Amaldi (CLAIO). We also have IFORS Distinguished Tutorialists at a number of conferences, including Andres Medaglia (EURO), James MacGregor Smith (APORS) and Dohoon Kim (CLAIO). So IFORS will be well represented at these conferences.

One very interesting conference coming up is the AFROS (African Federation of Operational Research) conference to be held in Tunis, Tunisia, July 2-4. AFROS is a new initiative that aims to bring together all those who do operational research in Africa. IFORS has just three African member societies (South Africa, Nigeria, and Tunisia), so there are a tremendous number of academics and practitioners across the continent that do not have a national society. AFROS is trying to encourage national societies and bring together individuals from throughout Africa. I'll be speaking at that conference, along with a number of other impressive plenary speakers.

So, bringing it together, there are some conferences in June, July (2), August, September, and November. I wonder if anyone will be at all of them? I hope that you find a conference you like, and that those conferences continue to put out the message that operational research is active, vibrant, and influential in the world. 🌐
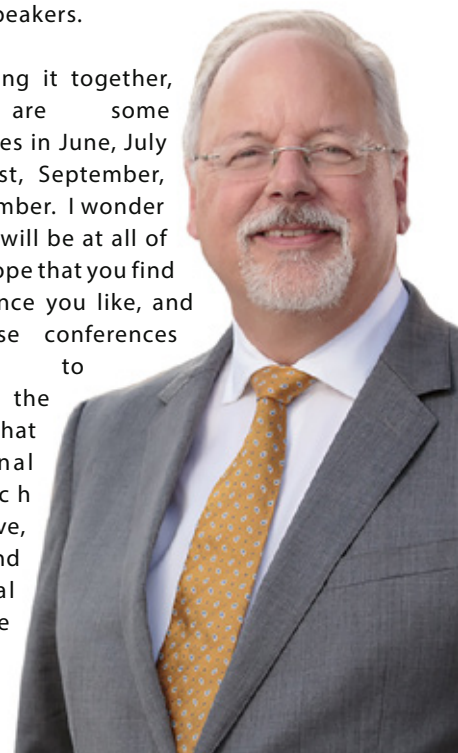
Africa in Focus
Luciana Salete Buriol <buriol@inf.ufrgs.br>

This issue brings news from the African OR community, and I am sure that in the coming issues we will read much more from them! The African Federation of OR Societies (AFROS) was formed in November 2016. We are happy to announce that its first conference will be held in Tunis, Tunisia, in July 2018. The OR for Development section has an article with details about the event.

This section also brings an article about the Operations Research Society of Eastern Africa (ORSEA), whose members are drawn from three different African countries.

AFROS aims to bring together all those who work in OR in Africa, as expressed by IFORS President Michael Trick in his editorial. Besides announcing AFROS 2018 conference in this issue we are glad to announce the Latin-Ibero American Conference on Operations Research (CLAIO), which will be held in Lima, Peru in September 2018.

The OR Society in Focus section reports some of the OR events held recently: "Celebrating Optimization, Optimal Control and Operational Research in the Pacific Region" an event held in Australia, the "OR Working Group Pricing & Revenue Management" meeting, held in Germany, and the Workshop on Graph Spectra, Combinatorics and Optimization" held in Portugal. These are just a sample of events that our OR community organizes.

The Book Review section brings a very nice overview by Hans W. Ittmann of the monograph "Optimization by GRASP: Greedy Randomized Adaptive Search Procedures", by Mauricio G. C. Resende and Celso C. Ribeiro.

Mauricio Resende worked for more than 20 years as a research scientist at the Algorithms & Optimization Research Department of AT&T Labs Research, USA and since 2014 he is a Principal Research Scientist at Amazon. Celso Ribeiro, besides being a leading OR academic in Brazil, has been serving as editor-in-chief of International Transactions in Operational Research (ITOR) for over a decade. I already bought my own copy of the book!

The Tutorial section brings an article that briefly summarizes how metaheuristics have been applied in the Three-dimensional Protein Structure Prediction (PSP) Problem. Those familiar with structural bioinformatics know the relevance of this research topic. Still speaking about 3D, but on a completely different application, a 3D Virtual Factory is shown in the OR Impact section, in an article that describes the application that awarded the UK OR Society the President's Medal in 2017.

With this summary of OR good news, I finish my first editorial for IFORS Newsletter. Since January 2018 IFORS Newsletter has a new editor. However, I intend to keep the same sections, structure and high standards established by Elise del Rosario, who has served as editor for the past ten years. Language editing service will be provided by James Bleach and the obex project editorial team. I invite you all to contribute with articles or suggestions to the IFORS Newsletter. I look forward to hearing from you! 🌐

OR *Impact*

Using WITNESS to create a 'virtual factory' for Hayward Tyler's strategic manufacturing operations

Hara Papachristou, Senior Consultant at Lanner <HPapachristou@lanner.com>

Hayward Tyler[1] (HT) is one of the world's leading suppliers of mission critical electric motors and pumps. In order to capitalise on growth across a number of its markets, Hayward Tyler recognised that it needed to undertake a business transformation project focused on maximising efficiency, increasing capacity to meet demand as closely as possible, and boosting profitability.

Having already achieved a substantial growth in the turnover of its Luton operations, from £18 million in 2011 to £26 million in the financial year to 31 March 2014, the next stage was to create a plan designed to achieve two key objectives: doubling the size of its Luton facility and increasing the number of units produced, whilst ensuring the facility remained fit for purpose.

Having previously used Excel as its primary tool for planning, HT did not consider it accurate enough, given the extent of change required to meet accelerating demand across its markets. Hence, other methods such as discrete event simulation were explored. As a result, a model using WITNESS[2] software was proposed to simulate the rotor and stator manufacturing flow lines (See picture below), assist in understanding the proposed layout, identify constraints, resource changes and support confidence in the future output capacity, as well as returning all the essential figures to support HT's investment strategy. The model would also be a communication tool, enable demonstration of this new approach, and lead to acceptance by all personnel of the model's results.
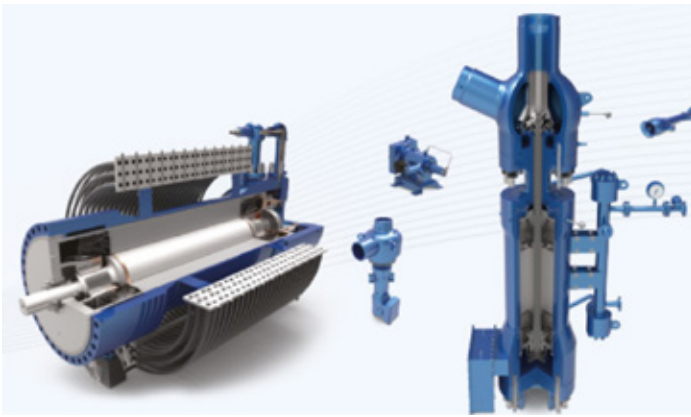
● Rotor Assembly

The project work commenced back in 2014 and the simulation model was built in stages starting from a high-level representation of manufacturing lines. The first stage of the project aimed at delivering a proof-of-concept model which comprised of a simplified version of HT's complex Bill of Materials (BOM). The model's User Interface was built in Excel, allowing the user to run 'what-if' scenarios by modifying resource quantities, shift patterns and layout configurations. Given that the simulation model was built to assess the future state of the facility, verification and validation of the model were performed using historical BOM data, confirming that the model's predictions conformed to known throughput and resource utilisations. The model was then enhanced with additional detail on material handling options and their priorities in performing tasks.

At that point a detailed 2D model was available for HT to run 'what-if' scenarios by modifying input parameters and manufacturing schedules to present a highly visual picture of HT's manufacturing


● Witness Model Representation of the Manufacturing Flow Lines

operations as they evolve over the next 5-10 years. The model effectively shows how the business will look in 2022 and any point between now and then. To put things into perspective, the team was able to identify when all resources will be utilised and identify potential bottlenecks in the manufacturing process and possible asset investment requirements (see example of resource utilisation below).
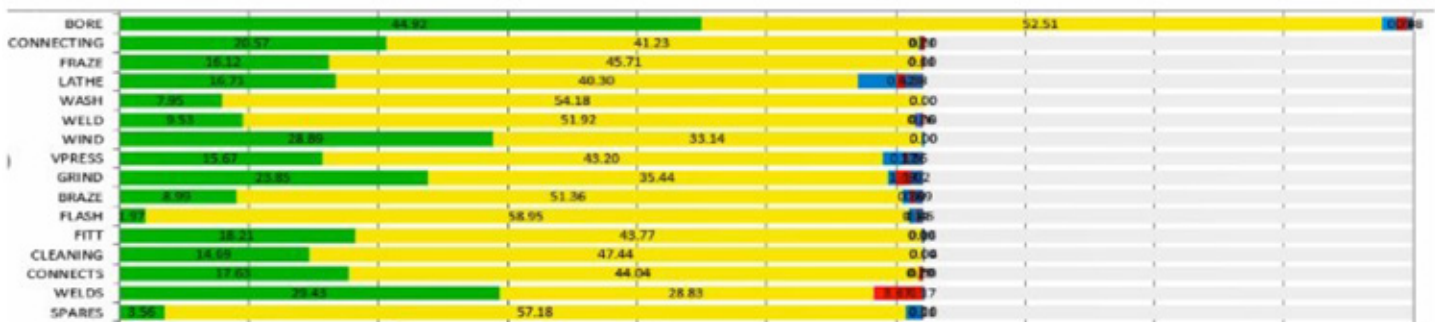
Further model modifications incorporated a 3-Dimensional model of the future assembly facility and the ability to immerse into the future factory using Visionary Render[3] a software tool, which enabled the creation of a 'virtual smart factory'. This was demonstrated on HT's Mega Day in June 2015 and provided the opportunity to enable all employees to experience at first-hand the facility in operation by wearing 3D glasses. The model delivered the same level of information to different business levels (from people on the shop floor to senior management) resulting in buy-in of the future investment plans by all involved.
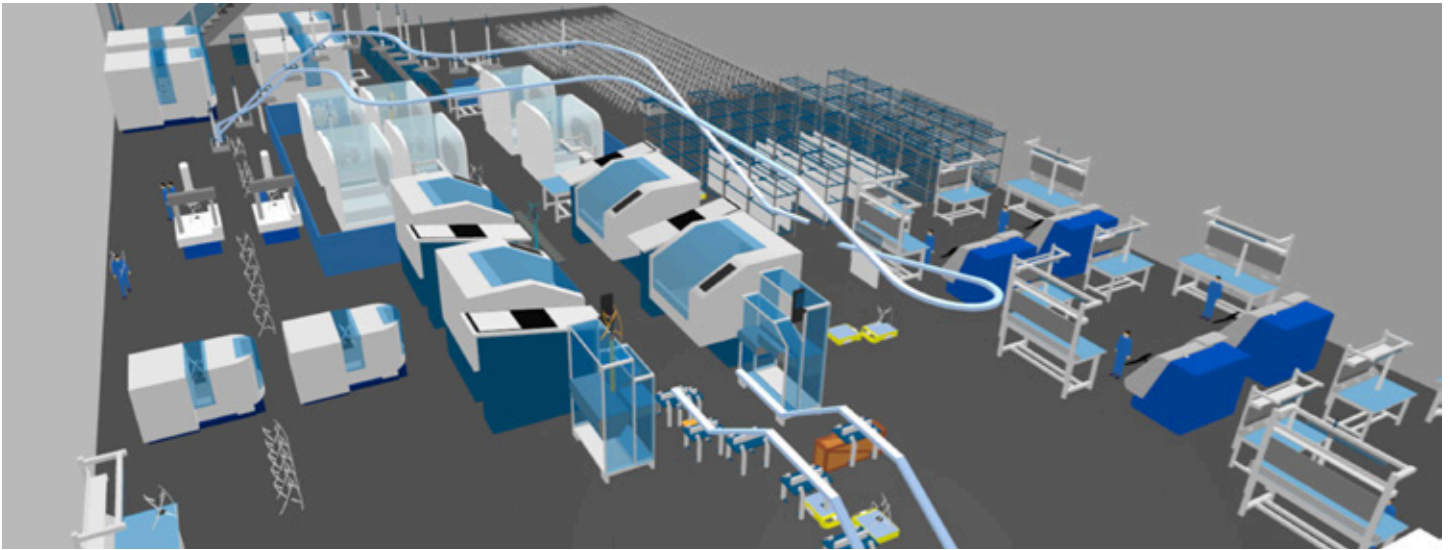
● The Virtual Factory in 3D

To sum up, the benefits realised from this bespoke simulation model can be quantified in asset investment savings of approximately £500k, reduction of the original equipment lead time from 72 weeks to 22 weeks and also the winning of new customers.

 Dr Martin Clocherty, Chief Information Officer at HT commented "WITNESS is hugely powerful in that it can run a year's simulation in a second, facilitating a detailed picture of exactly what business processes and resources we need to deliver against future demand. In my 20 years of working with software this is the first time a solution has genuinely delivered on its 'out of the box' promises and equipped us with insight to transform our business and boost profitability exponentially."

Oliver Buhlinger, Group Technology Engineer at HT commented "Such is the power of the technology that we now have the clarity and insight to understand what our business will look like in 5-10 years. In fact we can fast forward an entire year or more in seconds to provide accurate projections and predictions. The model tells us everything we need to do to achieve our plans in the most efficient way possible, and allows us to drive our business transformation confidently, whilst demonstrating diligence to all key stakeholders. This just wouldn't be possible without WITNESS."

The team were awarded the UK OR Society's President's Medal for this work in 2017. 🌐

● The team receiving the UK OR Society's President's Medal 2017: Hara Papachristou, Chris Henzel, Morgan Knapton, Martin Clocherty and Chris Legge (left to right)

Acknowledgements: The above project has been the result of collaborative work between Lanner: Chris Legge, Roger England, Hara Papachristou; and Hayward Tyler: Oliver Buhlinger, Martin Clocherty, Chris Henzel, and Morgan Knapton.

References
[1] Website http://haywardtyler.com/
[2] Website https://www.lanner.com/technology/witness-simulation-software.html
[3] Website https://www.virtalis.com/visionary-render

TUTORIAL

Metaheuristics in Structural Bioinformatics: The Art of 3D Protein Structure Prediction

Márcio Dorn <mdorn@inf.ufrgs.br>
Luciana S. Buriol <buriol@inf.ufrgs.br>
Luis C. Lamb <lamb@inf.ufrgs.br>

In Structural Bioinformatics there are several problems that still do not have a computational method that can guarantee a minimum quality of solution. Even with the advances in technology and the power of computers, clusters and cloud computing, it is not possible to deliver a definitive solution for those problems. In particular, structural bioinformatics deals with problems where the rules that govern the biochemical processes and relations are only partially known, which makes it harder to design efficient computational strategies for these situations.

Among those problems, one of the most challenging is the three-dimensional Protein Structure Prediction (PSP) problem. The three-dimensional shape assumed by a protein is also called the native or functional structure. This structure is formed by the interplay of the various thermodynamic factors, i.e., covalent interactions, hydrogen bonds, hydrophobic interactions, electrostatic interactions, *van der Waals*, and repulsive forces. The structure of one protein is defined by its amino acid sequence that folds spontaneously during or after biosynthesis (see Fig. 1).

Predicting the folded structure of a protein only from its amino acid sequence remains a challenging problem in mathematical optimization and is classified in computational complexity theory as an NP-complete problem. The challenge arises due to the combinatorial explosion of plausible shapes, where a long amino acid chain ends up in one out of a vast number of 3D conformations. Since this problem is very complex, there is the need to use computational techniques – and metaheuristics are one of the most common and powerful techniques used in this case. They do not guarantee an optimal solution, but give a good approximation, with a

Fig 1: Paradigm Structure-Function: the case of the haemoglobin tetrahedral arrangement, whose function is blood oxygen transport.

limited computational effort. Depending on the problem, metaheuristics can be computationally expensive, allowing the solution of only limited instances of the problems. In order to overcome this, it is possible to develop massive parallel models of metaheuristics, which will allow the exploration of a larger number of plausible solutions.

Over recent years several computational strategies have been proposed as a solution to the 3D Protein Structure Prediction (PSP) problem. These methods can be divided into four classes: (I) *First principle methods without database information*; (II) *First principle methods with database information*; (III) Fold Recognition (FR) methods; and (IV) *Comparative Modeling methods*. Figure 2 summarizes the whole process from a given primary structure, until its corresponding tertiary structure.

Fig. 2: A scheme of a prediction of the tertiary structure (right) from its primary structure (top-left).

The first group of methods, which cannot rely on sequence similarity to known structures, aims at predicting new folds only through computational simulation of physicochemical properties of the folding process of the proteins in nature. This class of methods uses the concept of a free energy (*Anfinsen's Hypothesis*) to find the native state of a protein.

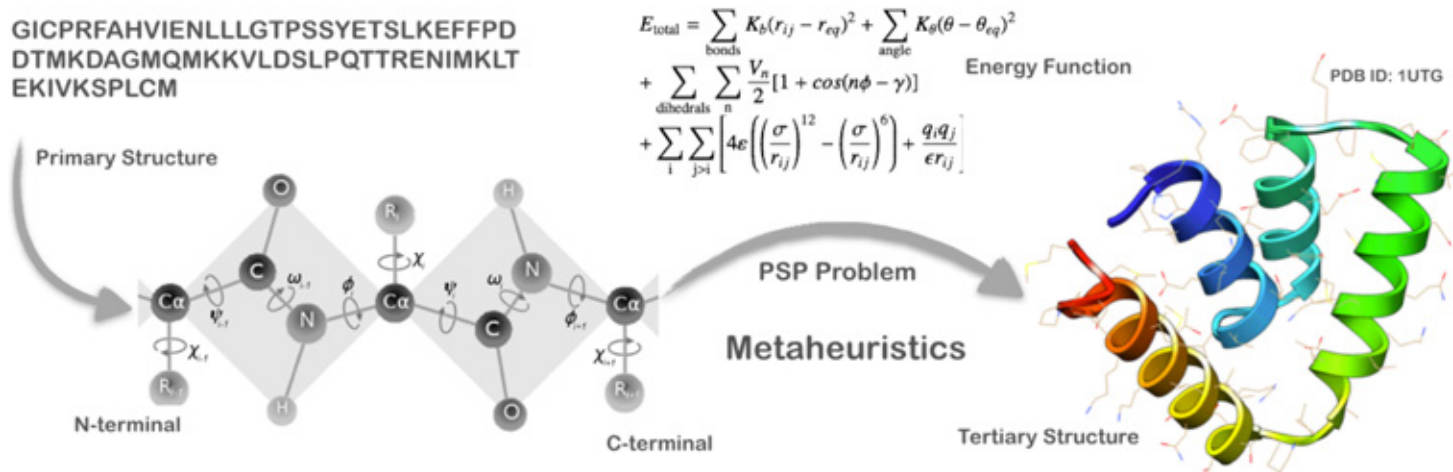Groups II, III, and IV represent methods that are capable of making a fast and effective prediction of protein 3D structures, when known template structures and fold libraries are available. In first principle methods with database information, general rules of protein structures are extracted from protein databases and used to build starting point 3D protein structures. Robetta and I-Tasser are examples of methods belonging to this group. Comparative modeling by homology can be applied whenever it is possible to detect a sequence evolutionary relationship between the target protein and the template protein of which the 3D structure is known. The structure of these proteins is similar in the sense that amino acid residues with identical physicochemical properties and structure occupy the same position in homologous proteins.

Fold Recognition methods are motivated by the notion that structure is more stable than sequence, i.e., proteins with no similar sequences could have similar folds. Fold Recognition methods are focused on predicting the 3D folded structure of protein amino acid sequences for which comparative methods provide no reliable predictions. Fold-recognition via threading is limited to the fold library derived from the PDB.

Metaheuristics based on *Genetic Algorithms* (GA), *Simulated Annealing* (SA), *Particle Swarm Optimisation* (PSO), *Differential Evolution* (DE), *Ant Colony Optimization* (ACO), *Greedy Randomised Adaptive Search Procedure* (GRASP), *Biased random-key genetic algorithms* (BRKGA), *Memetic Algorithms* (MA), among many others are widely used in all four classes. Despite the significant progress in *Critical Assessment of protein Structure Prediction* (CASP) experiments, it is still necessary to develop new strategies for extracting, representing and manipulating data from experimentally determined 3D protein structures. There is also a need to develop computational strategies to use this information to predict, from the amino acid sequence of a protein, its corresponding 3D structure. The development of computer prediction methods, which reduce the computational effort and allow the prediction of the three-dimensional structure of proteins, is regarded as one of the main challenges in Structural Bioinformatics and molecular biology of the XXI century. 🌐

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SBCB Lab: http://sbcb.inf.ufrgs.br
Correa, L.L.; Borguesan, B.; Farfan, C.; Inostroza-Ponta, M. and Dorn, M. A *Memetic Algorithm for 3-D Protein Structure Prediction Problem*. IEEE/ACM Transactions on Computational Biology and Bioinformatics, v.PP, p. 1-14, 2016.

Dorn, M.; Barbachan e Silva, M.; Buriol, L.S. and Lamb, L.C. *Three-Dimensional Protein Structure Prediction: Methods and Computational Strategies*. Computational Biology and Chemistry, v. 53, p. 251-276, 2014.

OR *for* Development Section

Briefing on the Operations Research Society of Eastern Africa ORSEA

Gituro Wainaina -Secretary General <wainainagituro@yahoo.com>

Background
The establishment of the Operations Research Society of Eastern Africa (ORSEA) is a result of the resolutions of the fourth International Conference on Operations Research in Development (ICORD) that was held in South Africa in May 2001, as part of the EURO Operations Research Society - Africa (EURO ORS – A) initiative for the networking of operations researchers within Africa, and between African countries and other parts of the world. At the ICORD 4 conference, the issue of Operations Research (OR) activities in Africa was discussed deeply, and it was observed that OR activities in Africa were not given the attention they deserved. Thus, one of the conference resolutions was that African OR professionals and practitioners should endeavour to form national or regional societies that would spearhead/foresee OR related activities in the area. Further to that resolution, and with support from the EURO-Africa Project, the first Africa Conference of Operations Research (ACOR-1) was held, organised by the Association of West Africa universities. At the same time, ORSEA organized and held its first international conference on Operations Research and Development (ORDA) in East Africa from September 17 to 19, 2003, with support from EURO ORS - A and Makerere University Business School, University of Dar-es-Salaam Business School and University of Nairobi School of Business. The 13th ORSEA international conference will be held in March 2018.

Today, ORSEA is a regional body for the Eastern African region and the founding members are: Makerere University Business School, Business School University of Dar es Salaam and School of Business University of Nairobi. Each country (Kenya, Tanzania and Uganda) has already established a country chapter. At the same time, relevant schools/faculties in Rwanda and Burundi will soon join ORSEA. Currently, the Department of Management Science in the School of Business, University of Nairobi provides the Secretariat and also acts as the coordinating office of ORSEA activities.

Operations Research Society of Eastern Africa
The Operations Research Society of Eastern Africa was formed in order to organize conferences, workshops, seminars, training programs and, indeed, to undertake activities that foster the development of OR in Africa, including research and publication. The purpose of ORSEA is to foster the development of the OR discipline in the Eastern Africa region for the benefit of its people and in particular for socio-economic development.

Chairman	Isaac M. Mbeche	Organizing Secretary	Erasmus S. Kaijage
Vice Chairman	Ulingeta Mbamba	Uganda Chapter Rep.	Musa Moya
Vice Chairman	Waswa Balunywa	Tanzania Chapter Rep.	Severine Kessy
Secretary General	Gituro Wainaina	Kenya Chapter Rep.	James Njihia
Treasurer	Isaac Nkote		

The general objectives of ORSEA are fourfold and are to:

1. Bring together existing OR people, particularly trainers, researchers and practitioners, in order to provide an opportunity for the exchange of knowledge, information and experiences among themselves and with others around the world and hence support the development of OR training and research activities in the region.

2. Provide a forum for promoting OR activities and applications in the East African region in collaboration with the rest of the world.

3. Offer an interface between training institutions and practitioners, thereby facilitating the development of curricular and teaching methodologies that are responsive to the needs of the economies within the region.

4. Create and develop sustained ownership and partnership among the general public, the public and private sectors, the business community and academia on the application of OR for socio-economic development.

Over the years, some of the key initiatives of ORSEA have included: holding annual international conferences since 2003, except in 2007; holding a 10 year anniversary in 2014; starting a semi-annual ORSEA Journal; and launching a book on OR as well as Master of Science (MSc) and Doctor of Philosophy (PhD) programs in OR. The PhD program commenced in March 2017. Since 2003 when the ORSEA conference was initiated, an average of 40 papers have been presented in each conference, which means that for 12 conferences about 480 papers have been presented. Furthermore, an average of 120 faculty members (not to mention students, and in particular PhD and masters students who have attended in large numbers since the inception) attend the conferences each year - this translates to about 1,440 faculty members. Concerning themes and sub-themes, they have varied but were guided by the application of OR in various sectors. The theme for the 2017 conference, which will held in March 2018 at the School of Business University of Nairobi, is 'Business Analytics: Operations Research Perspective'.

For the semi-annual ORSEA Journal that was started in 2011, 12 issues have so far been released with an average of four papers per journal. In addition, a book titled "Operation Research in Developing Countries: The Case of Eastern Africa" was peer reviewed and published in 2014 as part of the 10 years celebrations since the birth of ORSEA. The sub-themes included: case studies in OR applications in specific organizational and business areas; hard and soft OR; mixed or integrated approaches; community OR; innovations in OR techniques; innovations in analytical support for OR; experiences and innovations in the teaching of OR; and emergent issues and the future of OR in developing countries.

The PhD program within the three business schools (Makerere University Business School, University of Dar-es-Salaam Business School and University of Nairobi School of Business) is being started in order to enhance the teaching of OR, as well as to train and provide academic staff to serve the East Africa region and Africa as a whole. This initiative was due to the realization that, despite OR's importance, the teaching of it has not been a core discipline within the three business schools. Indeed, the teaching of OR at undergraduate and post-graduate levels has been limited and no school offers a specialization in OR. The three business schools will be able to train and develop students at post-graduate levels who specialize in OR for the public and private sectors, the business community, the government, and the general public as well as academia.

The masters program will be offered as a two-year degree program and will lead to the award of the MSc in OR degree from the University of Dar es Salaam. For the entire program, students will take a total of 18 courses and will end by writing a project which will have the same weight as a full semester; students will take six courses in each semester. The PhD in OR will be offered as a three-year degree program and will lead to the award of the PhD in OR degree from the University of Dar es Salaam. It will be offered as a course work and thesis program; for the entire program students will take a total of 8 courses and will end by writing a thesis. 🌍

AFROS Forges Ahead

Berndt Lindner - Secretary of AFROS <berndtlindner@gmail.com>
Hatem Masri - Treasurer of AFROS & local organizer for AFROS 2018 conference <hatem.masri@gmail.com>

The winds of change might blow slowly in Africa, but they blow none the less. The African Federation of OR Societies (AFROS) was formed following a meeting in Nairobi, Kenya in November 2016 in order to consolidate, extend and promote the good OR work being undertaken in Africa (please see the IFORS News article http://ifors.org/december-2016-issue/ for more details). It is now steadily making progress on a number of fronts described below.

AFROS is in the process of registering as a Not-for-profit Organization with the Companies and Intellectual Property Commission (CIPC). It now has a website devoted to providing information, guidance and links to African Researchers in OR, which will be monitored and improved regularly, and it also maintains, separately, a repository of AFROS stakeholders and their affiliations. For more details and information about AFROS, please visit http://www.afrosocieties.org/.
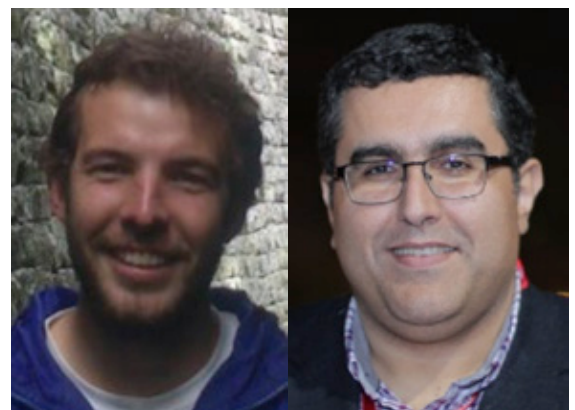
We are very excited to announce that AFROS will hold its first conference in Tunis, Tunisia, from 2 to 4 July 2018. The conference, organized by the Tunisian Decision Aid Society, is considered to be a kick start for the wider use of OR in Africa. It includes plenary talks by guest speakers from IFORS as well as presentations of high quality research papers by researchers and practitioners from Africa and all over the world. Selected extended abstracts among those presented in the conference will be considered as potential full-paper publications, subject to peer reviews, in the 'Operational Research - An International Journal' (ORIJ) published by Springer. A good number of conference grants, offered by IFORS and EURO to PhD students, and a 40% reduction in registration fees offered by TDAS to participants from developing countries, are available for researchers who plan to present a paper at AFROS 2018. For more details about the conference, please visit http://afros.tdasociety.org/.

If you have any questions, comments, or any other feedback please do not be shy to contact AFROS secretary, Berndt Lindner (berndtlindner@gmail.com) or the AFROS 2018 program, Chair Hatem Masri (hatem.masri@gmail.com).

We look forward to welcoming you in Tunis and to take part in this African initiative to promote OR across Africa! 🌍

Invitations to Regional Conferences

CLAIO 2018 in Lima, Perú

David Mauricio Sánchez <dms_research@yahoo.com>

The Latin-Ibero-American Conference on Operations Research (CLAIO) takes place biennial since 1982 in different Latin American cities and is the biggest and the most important event of the Operational Research organized by the Latin-Ibero-American Association for Operational Research (ALIO). This year, CLAIO's XIX will take place in Lima, the capital of Perú from September 24 to 27, 2018.

Lima is considered one of the most important capitals in South America and is known as financial center of Peru. Peru has 80% of the world's weather, with coast, Andes and Amazon. It harbored great civilizations like Caral, the first civilization of America, and the Incas. In 2017, for the sixth consecutive year Peru received the award of the 'Best Culinary Destination in the World´, and the archeological complex of MachuPichu was awarded as the ´Best Tourist Attraction´ in the latest edition of the prestigious World Travel Awards (WTA).

CLAIO's XIX's organizers invite you to discover and share firsthand the most recent Operational Research scientific breakthroughs and its applications, and to be part of the history of the development of societies. The Conference will also include panels with the participation of government and industries, and a technological fair. 🌍

🌐 Conferences

Celebrating Optimization, Optimal Control and Operational Research in the Pacific Region - Scientists Meeting in Perth, Australia

Julien Ugon School of Information Technology, Deakin University, Australia <julien.ugon@deakin.edu.au>
Gerhard-Wilhelm Weber Faculty of Engineering Management, Chair of Marketing and Economic Engineering, Poznan University of Technology, Poland <gerhard.weber@put.poznan.pl>

The Second Pacific Optimization Conference (POC 2017; https://scieng.curtin.edu.au/schools/electrical-eng-computing-maths/mathematics-and-statistics/joc-2017/poc-2017/) was held from December 4 to 10, 2017, at Curtin University (http://www.curtin.edu.au/) in Perth, Western Australia. This conference was held for the first time outside of China and Japan, reflecting the change of

name and widening of scope of the Sino-Japanese Optimization Meeting.

The subject of the conference was optimization, optimal control and their application, and each of these topics were covered by one or more of the six Plenary Speakers:
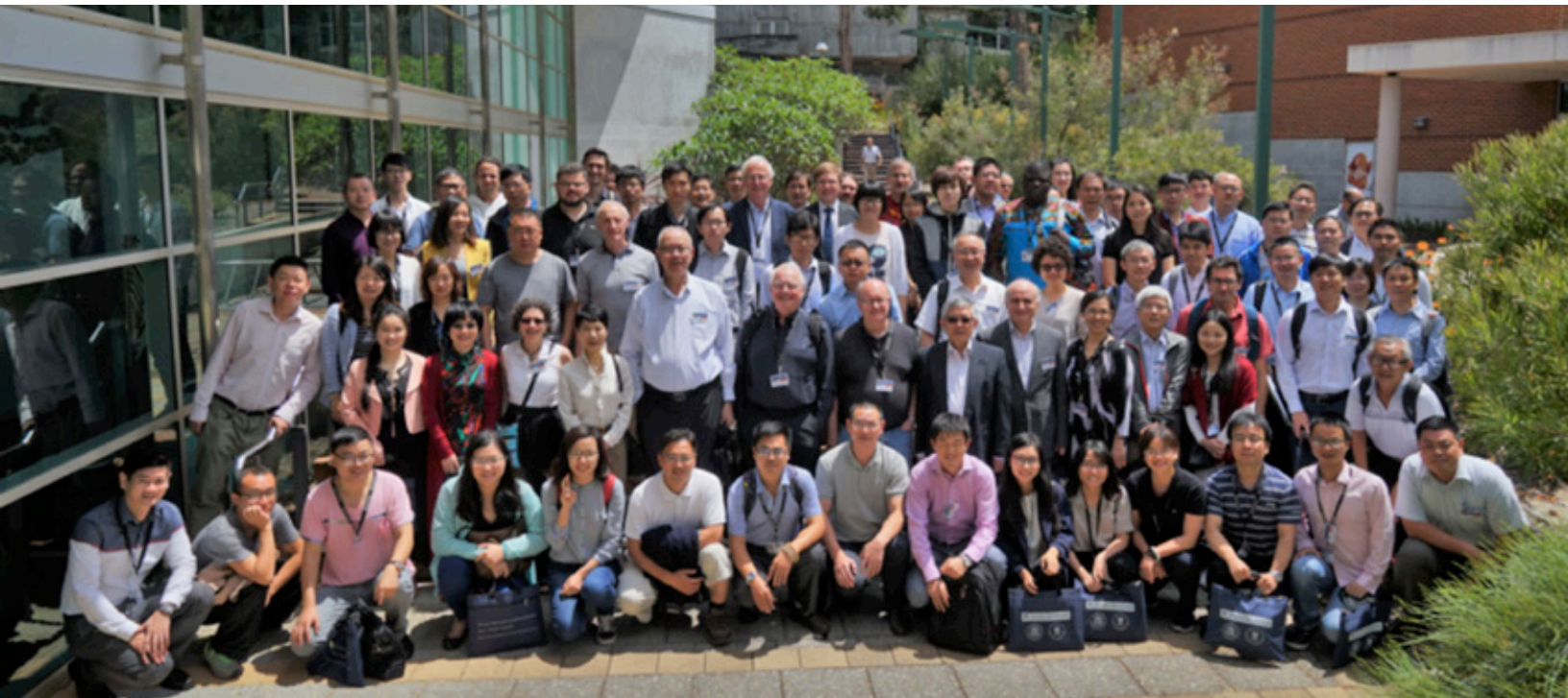
Linear Programming:

Prof. Dr. Shinji Mizuno (Tokyo Institute of Technology, Japan): "On the Number of Iterations of the Simplex Method for LP and the Length of a Path";

Applications of Optimization:

Prof. Dr. Moses Tade (Curtin University, Perth, Australia): "Applications of Optimization Methods in Solid Oxide Fuel Cell Design and Operation";

Nonlinear Optimization:

Prof. Dr. Jong-shi Peng (University of Southern California, Los Angeles, USA): "A Class of Composite Difference-Convex-Piecewise Programs with Application to Statistical Estimation",

and

Prof. Dr. Defeng Sun (National University of Singapore, Singapore): "Second Order Sparsity and Big Data Optimization".

The conference *POC 2017* was the second of three optimization conferences held in sequence, comprised by the overall name *The Joint Optimization Conferences 2017 (JOC 2017)* whose further 2 conferences were *The Eighth Australia-China Workshop on Optimization: Theory, Methods and Applications (ACWO 2017) being the first, and The South Pacific Optimization Meeting in Western Australia 2017 (SPOM in WA 2017)* being the third conference. For closer details please visit https://scieng.curtin.edu.au/schools/electrical-eng-computing-maths/mathematics-and-statistics/joc-2017/.

POC 2017 was very well attended, in particular thanks to a large delegation of researchers and students from China. It was particularly encouraging to attend many interesting presentations by students

and early career researchers, which offers promises for many more iterations of this conference. These talks supplemented well the high quality of the plenary talks and of the presentations by more seasoned researchers from Australia, China, Japan, but also Europe.

POC is one of the series of conferences which aims to provide an international forum for scientists, engineers, researchers and practitioners to exchange scientifically and bring to optimization and control new approaches. In fact, it is one of the official conference series of *POP, Pacific Optimization Research Activity Group* (cf. https://apps-bschool.nus.edu.sg/asp/pop/). Willi is a member of the Working Committee of *POP*, where he serves for the liaison with Europe – in acknowledgement of the very good relations of *POP* with *EURO* - and with Africa. *POP* is an Internet-based group of researchers, aiming at promoting optimization research activities in Pacific Region. It was founded in 2000, at the *First Sino-Japanese Optimization Meeting* in Hong Kong, initiated by *Prof. Dr. Masao Fukushima, Prof. Dr. Masakazu Kojima, Prof. Dr. Liqun Qi, Prof. Dr. Jie Sun* and *Prof. Dr. Kok Lay Teo* (the latter being initiators of JOC 2017 also) and late Prof. Dr. Alex Rubinov – all of them friends of us at *EURO*. The group *POP* has now about 600-700 members from ca. 50 countries and regions, ranging from Asia, Europe, North America, Oceania, and South America. *POP* looks for fruitful scientific relations in the international communities of Science and Engineering, Operational Research and Economics.

At the end of a plenary session, during all the conference *POC 2017*, and by an e-mail of the organizers sent to the participants, Willi kindly welcomed the participants of POC 2017 to two main highlights of OR in Europe, namely, *EURO 2018* (Valencia, Spain; http://euro2018valencia.com/), and *EURO 2019* (Dublin, Ireland; https://www.euro2019dublin.com/), respectively.

As dear Julien expressed, **we continue being students of life, but still find it heartening to see so many young people show their enthusiasm for our field!** 🌍

Promoting a broad exchange on new developments in Theory of Graph Spectra, Combinatorics and Optimization

Eloísa Macedo Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, Portugal <macedo@ua.pt>
Gerhard-Wilhelm Weber Faculty of Engineering Management, Chair of Marketing and Economic Engineering, Poznan University of Technology, Poland <gerhard.weber@put.poznan.pl>

The Workshop on Graph Spectra, Combinatorics and Optimization – WGSCO2018 (http://wgsco2018.web.ua.pt/) took place during January 25-27, 2018, in the University of Aveiro (https://www.ua.pt/#), in the city of Aveiro, Portugal, a city often known as the Portuguese Venice because of its system of canals with typical boats, called moliceiros.

The event was organized on the occasion of the 65th birthday of *Prof. Dr. Domingos Cardoso*, professor at the *Department of Mathematics* in the *University of Aveiro*, Portugal, director of the Doctoral Programme in Mathematics, Member of the Scientific Council of the University of Aveiro, and responsible for the Research Group "Optimization, Graph Theory and Combinatorics" of the Centre of Research and Development in Mathematics and Application (CIDMA). Professor Cardoso was nominated in 2015 "Excellent Reviewer" of Discrete Mathematics, an exceptional statute awarded by Elsevier to reviewers who are at the top 10 per cent. Professor Cardoso has played a very important role in Operational Research, e.g., as a former President of *APDIO - Associação Portuguesa de Investigação Operacional* (https://www.euro-online.org/web/ms/21/Portugal, http://www.apdio.pt/), and by his important services to *EWG EUROPT - EURO Working Group on Continuous Optimization* (https://www.euro-online.org/web/ewg/20/ewg-europt-euro-working-group-on-continuous-optimization, https://www.euro-online.org/websites/continuous-optimization/).

The meeting was held with the support of the Mathematics Department of the University of Aveiro, as well as reference societies and *R&D Units*, such as *FCT - Fundação para a Ciência e a Tecnologia, CIDMA - Centro de I&D em Matemática e Aplicações, APDIO, EWG EUROPT, CIM - Centro Internacional de Matemática*, and *ILAS – International Linear Algebra Society*.

The *Organizing Committee* from the Department of Mathematics of the University of Aveiro (http://wgsco2018.web.ua.pt/node/8) joined efforts to prepare an interesting forum. The topics of the WGSCO 2018 included not only Graph Theory, Combinatorics and Optimization, but all related fields: Algebraic Combinatorics,

Algebraic Graph Theory, Algorithms and Computing Techniques, Combinatorial Optimization, Communications and Control Theory, Enumerative Combinatorics, Extremal Combinatorics, Graph Theory, Optimization in Graphs, Graph Spectra and applications, Linear Optimization, Networks, Nonlinear Optimization. In fact, the meeting sought to provide a forum to gather researchers and practitioners from different areas and backgrounds, in a friendly environment suitable for discussion and exchange of ideas. The event was full of networking opportunities!

Prof. Dr. Tatiana Tchemisova (University of Aveiro) opened the conference with kind welcome words for all the participants and

● This big and lovely event of WGSCO2018 gave everyone the opportunity to exchange ideas and establish a new collaboration with other researchers from different universities and countries. We are looking forward to seeing you soon!

devoted special words to *Professor Domingos Cardoso*. Then, the Rector of the University of Aveiro, *Professor Manuel Assunção*, emphasized the importance of such events. *Professor João Santos* and *Professor Luís Filipe Castro*, Director of the Department of Mathematics and Coordinator of the R&D Unit CIDMA, respectively, welcomed all participants and wished them a fruitful meeting.

The meeting was attended by more than 120 participants from 27 countries!

Speakers of international recognition in several areas of research, in particular, in the field of operations research were present and many, many remarkable research works were shared and contributed to the quality of the meeting.

During the three-day event, leading researchers took part as plenary speakers,
In each day of the event, participants could attend different parallel sessions. There were 23 sessions covering many topics, such as graph theory, combinatorics, optimization, network optimization, dynamic systems and control, and related applications from biology, chemistry, engineering and economy.

The first day ended with a welcome reception. The evening of the second day featured the gala dinner in honor of Professor *Domingos Cardoso*. The third day ended with a lovely visit to the Vista Alegre Museum and Chapel.

WGSCO2018 participants have the opportunity to submit their full papers to two special issues dedicated to the Workshop: Special issue of *Discrete Applied Mathematics (DAM)* and Special issue of *Optimization* (http://wgsco2018.web.ua.pt/node/56). Submitted papers will be considered as potential full-paper publications based on the quality and originality of the contribution and subject to peer reviews.

In the *Closing Session*, *Willi* kindly invited the participants of WGSCO2018 to our upcoming EURO conferences, namely, *EURO 2018* in Valencia, Spain (http://euro2018valencia.com/), and *EURO 2019* in Dublin, Ireland (https://www.euro2019dublin.com/), respectively.

Book Review
Optimization by GRASP

Hans W. Ittmann, University of Johannesburg <hittmann01@gmail.com>

Optimization by GRASP – Greedy Randomized Adaptive Search Procedures by Mauricio G. C. Resende and Celso C. Ribeiro, 2016, Springer, New York, USA, pp. 312, ISBN 978-1-4939-6528-1 (Print) and ISBN 978-1-4939-6530-4 (eBook), 79.99 EURO (Hardcover), 59.99 EURO (eBook).

Heuristics, or approximate algorithms, were introduced in the 1960s to find solutions, typically, to combinatorial optimization problems. Today a whole variety of heuristic methods and approaches are available. These methods are capable of handling larger problems, finding feasible solutions, usually faster than by exact methods, although they are not necessarily optimal. Metaheuristics on the other hand are general high-level procedures that coordinate simple heuristics and rules to find solutions to computationally difficult and complex optimization problems. Well known metaheuristics include genetic algorithms, tabu search, simulated annealing, variable neighbourhood search (VNS), and ant colony optimization. In 1989 Feo and Resende introduced a new metaheuristic called Greedy Randomized Adaptive Search Procedure (GRASP). This was a probabilistic heuristic for solving hard set-covering problems.

Since being introduced GRASP has been used widely and successfully to address many different real-world combinatorial optimization problems. The main reasons for this success are that it has a strong intuitive appeal with an impeccable empirical track record whilst being fairly trivial to implement on parallel processors. GRASP typically consists of iterations made from successive constructions of a greedy randomized solution and subsequent iterative improvements of it through a local search. There are thus two phases associated with each of the GRASP iterations: (1) an initial solution is constructed via an adaptive randomized greedy function; and (2) a local search procedure is applied to the constructed solution in an effort to find an improvement. *Optimization by GRASP* is the first book dedicated to this metaheuristic method.

There are twelve chapters in total. At the end of each chapter bibliographic notes, specific to the chapter, are given. Optimization is introduced in Chapter 1. The problems discussed here are classified into two classes: those with continuous variables and those with discrete variables. Most of the book is devoted to the latter and specifically to combinatorial optimization problems. Six typical and fundamental combinatorial problems are described and defined: the shortest path problem, the minimum spanning tree problem, the Steiner tree problem in graphs, the maximum clique problem, the knapsack problem and the travelling salesman problem. These are used throughout the book for illustrative purposes. Finally, exact and approximate solution methods are discussed in Chapter 1 which leads to an outline of heuristics and metaheuristics.

Chapter 2 introduces combinatorial optimization and for each of the six problem types the model formulation is presented with practical examples, graphically illustrated. The theory of computational complexity, the second main topic of this chapter, is then outlined in detail. This is again explained through the different problem examples. The concept of polynomial-time algorithms and non-polynomial-time algorithms are discussed and illustrated making ample use of examples. The notion of *NP*-hard problems is described as well as solution approaches which include heuristics and metaheuristics.

The two main phases that typify GRASP, construction and local search, are dealt with in the next two chapters. The construction of feasible solutions via greedy algorithms is outlined step-by-step with ample use of pseudo code and examples. Adaptive greedy and semi-greedy algorithms are touched on as well as repair procedures. It is shown that local search methods start from any feasible solution and different techniques and ways of determining other solutions are discussed in detail. Neighbourhood search, illustrated with search space graphs, is explained using examples while implementation strategies are outlined as well. In the end it is shown that a great number of feasible solutions are visited until one is found that cannot be improved further. The various methods are described in depth.

With the necessary theory and background covered in the introductory chapters, Chapter 5 introduces the basic structure of GRASP as a semi-greedy multi-start procedure with local search. Random multi-start as well as semi-greedy multi-start algorithms are outlined and this leads to a description of the basic GRASP heuristic. Again, ample use is made of examples to illustrate how these algorithms, methods and procedures work. Ways of accelerating GRASP with stopping rules including probabilistic stopping rules are presented. There is a short section on how to solve multiple objective minimization problems using GRASP.

Chapter 6 presents ways of determining how well the heuristic performs using runtime distributions. The objective is to show how well the heuristic is performing both in terms of running time and proximity to a given target value. Comparisons with other algorithms are also made. The runtime distribution methodology is used to evaluate and compare parallel implementation of stochastic local search algorithms.

A whole variety of extensions, enhancements and variants of GRASP is considered in Chapter 7. The fundamentals of part-relinking are introduced in Chapter 8 and all the different implementation issues and strategies are described in detail. Path-relinking as it relates to the basic GRASP heuristic is outlined in Chapter 9. Here consideration is given to variants of the basic scheme, evolutionary path-relinking and also restart strategies in the case of part-relinking for GRASP.

The implementation of GRASP on parallel computers is described in Chapter 10. Typically this is done by partitioning the search space for the iterations, and then assigning each partition to a processor. The two main approaches to parallelization namely multiple-walk independent-thread or the cooperative-walk independent-thread are discussed. The implementation of the parallel GRASP heuristic for three examples is given. The problem types are the three index assignment problem, the job shop scheduling problem and the 2-path network design problem.
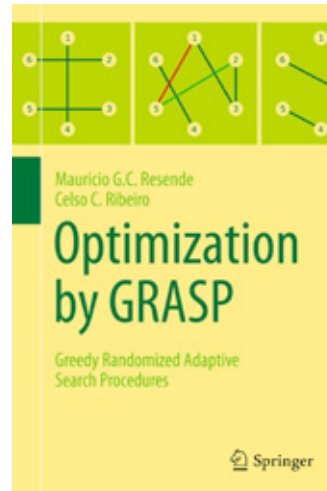
Optimization by GRASP – Greedy Randomized Adaptive Search Procedures by Mauricio G. C. Resende and Celso C. Ribeiro, 2016, Springer, New York, USA, pp. 312, ISBN 978-1-4939-6528-1 (Print) and ISBN 978-1-4939-6530-4 (eBook), 79.99 EURO (Hardcover), 59.99 EURO (eBook).

The GRASP heuristic can also be extended to address continuous box-constrained global optimization problems and this is the topic of Chapter 11. Like the discrete GRASP heuristic the continuous GRASP, or C-GRASP, heuristic also has two phases. In the construction phase a greedy randomized solution is constructed while during the local search phase a local search algorithm leads to an approximate local optimal solution. A deterministic rule triggers a restart search after each of the iterations.

In the final chapter four case studies are presented that illustrate use of the GRASP heuristic. The focus is on how to customize the method for each case. The four problem types are the 2-path network design problem, graph planarization, unsplittable multicommodity flows and maximum cut in a graph. Each step is clearly described, in particular the construction and local search procedure. Path-relinking is covered and illustrated in a number of these case studies while a parallel GRASP is briefly touched on.

Optimization by GRASP is a well-structured and well written introduction to GRASP. In addition it is very suitable for and highly accessible to students, researchers and practitioners who want to familiarize themselves with combinatorial optimization and greedy algorithms. The same holds true for those wanting exposure to heuristics and metaheuristics and how these methods are structured. The book provides an excellent overview of GRASP and will appeal to researchers and practitioners of combinatorial optimization. 🌐

OR Society in Focus

GOR Working Group Pricing & Revenue Management

Claudius Steinhardt
Chair of Business Analytics & Management Science
Bundeswehr University Munich (UniBw)

Over the last decade, the working group "Pricing and Revenue Management" has evolved to one of the largest groups in the German Operational Research Society (GOR). The group is dedicated to all topics around revenue management and pricing analytics, specifically focusing on analytic approaches originating from Operations Research and on using large amounts of data, mathematics and computers to support decisions related to revenue maximization. Its annual meetings attract researchers as well as practitioners from many different industries, such as, e.g., airlines, rental companies, hotels, tour operators, retailers, software vendors, and consultants. The meetings usually take place in January or February, and consist of a one-day workshop with talks and presentations by different contributors. The evening before, an informal get-together allows the participants to make new contacts and dis-cuss the latest developments in the Revenue Management scene.

The latest meeting was hosted in cooperation with the TUI Group on January 19, 2018. Despite the complete shut-down of rail-traffic and many flight cancellations in Germany caused by the winter storm named "Friederike" on that day, at least half of the more than 120 registered participants made it to TUI's headquarter in Hannover (the photo shows the participants of this year's meeting). Divided into four sessions, a total of eight talks was given, with topics ranging from the latest methodological developments in traditional network revenue management such as bid prices and decomposition approaches, up to recently upcoming challenges such as personalized dynamic pricing and online customers interaction analysis. This year's speakers originated from research and industry, e.g. from Lufthansa, from BCG, from different universities, as well as from different consultancies dedicated to pricing analytics, online distribution, and artificial intelligence.

We cordially invite all interested "Pricing & Revenue Management" enthusiasts to attend one of our meetings. The next meeting will take place in spring 2019. For the latest news on upcoming events as well as information regarding our past meetings, please register at our community platform http://www.pricing-und-revenue.management. 🌐

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