CONFERENCE HANDBOOK

4th international conference on
"Modelling, Computation and Optimization in Information Systems and Management Sciences"

December 13-14, 2021 - Hanoi, Vietnam

Co-organised by **Computer Science and Applications Department (AI), LGIPM, University of Lorraine, France** and **Academy of Cryptography Techniques, Vietnam**

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Preface

MCO 2021 is the fourth event in the series of conferences on Modelling, Computation and Optimization in Information Systems and Management Sciences, traditionally organized by LITA, the Laboratory of Theoretical and Applied Computer Science (LITA has became now the Computer Science and Applications Department of LGIPM), University of Lorraine, in Metz, France. Exceptionally, MCO 2021 was co-organized by the Computer Science and Applications Department, LGIPM, University of Lorraine, France and Academy of Cryptography Techniques, Vietnam, in collaboration with the Data science and Optimization of complex systems (DataOpt) Laboratory, International School, Vietnam National University, Hanoi, Vietnam.

The first conference, MCO 2004, brought together 100 scientists from 21 countries. It included 8 invited plenary speakers, 70 papers presented and published in the proceedings, "Modelling, Computation and Optimization in Information Systems and Management Sciences", edited by Le Thi Hoai An and Pham Dinh Tao, Hermes Sciences Publishing, June 2004, 668 pages. Two special issues including 22 papers were published in the European Journal of Operational Research and in the Journal of Global Optimization. The second event, MCO 2008, gathered 6 invited plenary speakers and more than 120 scientists from 27 countries. The scientific program consisted of 6 plenary lectures and the oral presentations of 68 selected full papers as well as 34 selected abstracts covering all main topic areas. Its proceedings were edited by Le Thi Hoai An, Pascal Bouvry and Pham Dinh Tao in Communications in Computer and Information Science, Springer (618 pages). Two special issues were published in Journal of Computational, Optimization & Application and Advance on Data Analysis and Classification. The third edition, MCO 2015, was attended by more than 130 scientists from 35 countries. The scientific program includes 5 plenary lectures and the oral presentation of 86 selected full papers and several selected abstracts. The proceedings were edited by Le Thi Hoai An, Pham Dinh Tao and Nguyen Ngoc Thanh in Advances in Intelligent Systems and Computing, Springer (2 volumes for a total of 1000 pages). MCO 2015, the biggest MCO edition, was marked by the celebration of the 30th birthday of DC programming and DCA, an efficient approach in Nonconvex programming framework. One special issue in Mathematical Programming Series B was dedicated to DC programming and DCA, and the second special issue was published in Computers and Operations Research.

The MCO 2021 covers, traditionally, several fields of Management Science and Information Systems: Computer Sciences, Information Technology, Mathematical Programming, Optimization and Operations Research and related areas. It allows researchers and practitioners to clarify the recent developments in models and solutions for decision making in Engineering and Information Systems and to interact and discuss how to reinforce the role of these fields in potential applications of great impact.

The conference program includes 3 plenary lectures of world-class speakers and the oral presentation of 38 contributed talks.

We would like to thank the Chairs and the members of International Program Committee as well as the reviewers for their hard work in the review process, which helped us to guarantee the highest quality of the selected papers for the conference. We also would like to express our thanks to the plenary speakers for their interesting and informative talks. Our sincere thanks go to all the authors for their valuable contributions, and to the other participants who enriched the conference success.

General Chair
HOAI AN LE THI
HUU HUNG NGUYEN

Guideline

How to find your own session?

Each session is identified with a code where the first letter is the day of the week (**M**onday and **T**uesday, the second letter is the time slot (**M**orning, **A**fternoon).

Presentation guidelines

At least 10 minutes before your Session begins, you shall log in as a presenter via Zoom by clicking on the respective Zoom link for this particular Room.
Each presentation lasts 20 minutes following by 5 minutes of questions. Time your presentation to fit within the designated time span, leaving enough time for audience questions and change of speaker. In any case, please follow the session chair indications.

Session chair guidelines

The role of the session chair is to coordinate the smooth running of the session and introduce each speaker. The chair begins and ends each session on time. Please stick to the order of talks and times announced in the program. If a speaker does not show up, please keep to the original schedule, in order to facilitate session jumping.

Plenary lectures

Professor **Paul Barton**

Massachusetts Institute of Technology, USA
https://cheme.mit.edu/profile/paul-i-barton/

Computationally Relevant Generalized Derivatives: Theory, Evaluation and Applications

Abstract. A variety of generalizations of the concept of the derivative to classes of continuous nondifferentiable functions have been proposed. Likewise, algorithms for nondifferentiable equation solving and optimization assume the ability to evaluate some element of a generalized derivative at points visited by the algorithm. However, not all generalized derivatives are equal in the sense that the particular generalized derivative element employed can have a large influence on the performance of algorithms. This leads to the notion of computationally relevant generalized derivatives. Until recently, it has not been possible to evaluate generalized derivative elements without an (often arduous) manual analysis of specific cases. Furthermore, in settings such as implicit functions, parametric ordinary differential equations and parametric optimization problems, results enabling the evaluation of concrete, computationally relevant generalized derivatives have not been available. This talk will discuss a number of new theoretical results and algorithms that lead to automatic methods for the evaluation of computationally relevant generalized derivatives in several settings. We will also outline important applications where these advances are having an enabling impact on simulation, sensitivity analysis and optimization.

Brief bio. Paul Barton is the Lammot du Pont Professor of Chemical Engineering and Director of the Process Systems Engineering Laboratory at MIT, where he has been since 1992. He received his Ph.D. from the Centre for Process Systems Engineering at Imperial College, London University in 1992. He has held Visiting Professor appointments at CNRS-ENSIC, Nancy, France and EPFL, Lausanne, Switzerland. He has industrial experience with BP and Air Products, and has consulted for major corporations including Dow Chemical, Alstom Power and Aspen Technology. He has received a number of awards, including the Computing in Chemical Engineering Award in 2011 and the Constantin Caratheodory Prize in Global Optimization in 2021. Barton's research interests include nonsmooth and hybrid dynamic systems; numerical analysis of ordinary differential, differential-algebraic and partial differential-algebraic equations; sensitivity analysis and automatic differentiation; global, mixed-integer and dynamic optimization theory and algorithms; and open process modeling software. Some of the applications his group has focused on include energy systems engineering, continuous pharmaceutical manufacturing, and quantitative engineering of microbial consortia. He served as Director for AIChE's CAST Division from 2001-2004 and is currently an associate editor for Journal of Global Optimization and Journal of Optimization Theory and Applications. He is author or co-author of over 200 articles in refereed journals. He has been very active in the design and the development of process modeling software, having been the original author of gPROMS, and having led the development of ABACUSS/JACOBIAN, DAEPACK and DFBAlab at MIT, all of which are now commercial products widely used in industry and academia.

Professor **Hoai An Le Thi**

University of Lorraine, France
http://www.lita.univ-lorraine.fr/~lethi/index.php/en/

DC programming and DCA: recent advances and trends

Abstract. DC (Difference of Convex functions) programming and DCA (DC Algorithm) constitute a quite logical and natural extension from modern convex analysis/optimization to nonsmooth nonconvex analysis/optimization, broad enough to include

most real-world nonconvex programs but not too wide in order to leverage the powerful arsenal of the former. This field was created in 1985 by Pham Dinh Tao in its preliminary state, then our intensive research has led to decisive developments since 1993, and has now become classic and increasingly popular worldwide. The popularity of DC programming and DCA resides in their richness, pervasiveness and deep mathematical foundations. Added to these are DCA's simplicity, flexibility, efficiency and scalability, its adaptation to specific structures of addressed problems. The construction of DCA depends on both equivalent formulations of a given DC program and DC decompositions of each corresponding formulated DC programs. As a DC function has infinitely many DC decompositions, there are infinitely many DCAs for each formulated DC program. As a result, DCA isn't "one" algorithm but the generic and principled algorithm based on the fundamental DC programming, say - an algorithmic philosophy in a way. This flexibility of DCA implies its universality: with appropriate DC decompositions and suitably equivalent DC reformulations, DCA recovers standard / recent methods in convex and nonconvex programming. For 35 years from their birthday, these theoretical and algorithmic tools have been greatly enriched, thanks to a lot of their applications, by researchers and practitioners in the world, to model and solve nonconvex programs from many fields of applied sciences including Data science, Communication systems, Biology, Finance, Transport Logistic, Supply chain management, etc, and remarkable successes have been reaped.
This talk discusses about key issues, recent advances and trends in the development of DC programming and DCA. We are focused on the following matters, in order to improve DCA's efficiency and scalability and to tackle broader classes of nonconvex problems beyond DC programs:

- Reducing the computational burden of DCA
- Accelerating DCA's convergence speed
- Finding DC decompositions well adapted to DC programs: tailored DCAs
- Using the philosophy of DCA without knowing a DC decomposition of objective function
- Novel DCA based algorithms to deal with Big data
- Beyond DC programs and extended DCA
- Globalizing DCA
- Exploiting special structure of some classes of DC programs: taillored DCAs
- DC Learning and DCA based algorithms for machine learning and Big data.

Brief bio. Prof. Le Thi Hoai An earned her PhD with Highest Distinction in Optimization in 1994, and her Habilitation in 1997 both from university of Rouen, France. From 1998 to 2003 she was Associate Professor in Applied Mathematics at the National Institute for Applied Sciences, Rouen, and from 2003 to 2012 she was Full Professor in Computer Science at the University of Paul Verlaine - Metz. Since 2012 she has been Full Professor exceptional class, University of Lorraine. She held the position of Director of the Theoretical and Applied Computer Science Lab of University of Paul Verlaine and then University of Lorraine from 2008 to 2017. She is the holder of the Knight in the Order of Academic Palms Award of French government in July 2013. She is nominated Senior Member of Academic Institute of France (IUF) in June 2021, and is awarded the 2021 Constantin Caratheodory Prize of the International Society of Global Optimization which is rewarded to outstanding fundamental contributions that have stood the test of time to theory, algorithms, and applications of global optimization. Her research interests include machine learning, optimization and operations research and their applications in information systems and various complex industrial systems.
Prof. Le Thi Hoai An is the co-founder of DC programming and DCA, powerful tools of non-convex programming and global optimization which were introduced by Prof Pham Dinh Tao in 1985 and intensively developed in their joint works since 1994. These theoretical and algorithmic tools, becoming now classic and increasingly popular, have been successfully applied by researchers and practitioners all the world over to model and solve their real-world problems in various fields.
Prof. Le Thi Hoai An is the author/co-author of more than 260 journal articles, international conference papers and book chapters, the co-editor of 24 books and/or special issues of international journals, and supervisor of 32 PhD theses. She is also Chair of Scientific Committee, Chair of Organizing Committee, and member of Scientific Committee of numerous International Conferences, and leader of several regional/ national/international projects. She made rich international collaborations with more than 40 universities and institutes not only in Europe but North America, Africa and Asia, and is the leader of several great joint projects in Industry 4.0 framework with Big companies in France including RTE (the manager of the public electricity network of France), Naval Group (the leader European in naval defense).

Professor **Panos M. Pardalos**

Center for Applied Optimization, University of Florida, USA
www.ise.ufl.edu/pardalos

Artificial Intelligence, Data Sciences, and Optimization in Economics and Finance

Abstract. Artificial Intelligence (along with data sciences and optimization) has been a fundamental component of many activities in economics and finance in recent years. In this lecture we first summarize some of the major impacts of AI tools in economics and finance and discuss future developments and limitations. In the second part of the talk we present details on neural network embeddings on corporate annual filings for portfolio selection.

Bref bio. Dr. Panos Pardalos is a Distinguished Professor in the Department of Industrial and Systems Engineering at the University of Florida, and an affiliated faculty of Biomedical Engineering and Computer Science & Information & Engineering departments. In addition, he is the director of the Center for Applied Optimization.
Dr. Pardalos is a world renowned leader in Global Optimization, Mathematical Modeling, Energy Systems, and Data Sciences. He is a Fellow of AAAS, AIMBE, and INFORMS and was awarded the 2013 Constantin Caratheodory Prize of the International Society of Global Optimization. In addition, Dr. Pardalos has been awarded the 2013 EURO Gold Medal prize bestowed by the Association for European Operational Research Societies. This medal is the preeminent European award given to Operations Research (OR) professionals for "scientific contributions that stand the test of time."
Dr. Pardalos has been awarded a prestigious Humboldt Research Award (2018-2019). The Humboldt Research Award is granted in recognition of a researcher's entire achievements to date - fundamental discoveries, new theories, insights that have had significant impact on their discipline.
Dr. Pardalos is also a Member of several Academies of Sciences, and he holds several honorary PhD degrees and affiliations. He is the Founding Editor of Optimization Letters, Energy Systems, and Co-Founder of the International Journal of Global Optimization, Computational Management Science, and Springer Nature Operations Research Forum. He has published over 500 journal papers, and edited/authored over 200 books. He is one of the most cited authors and has graduated 70 PhD students so far. Details can be found in www.ise.ufl.edu/pardalos
Panos Pardalos has lectured and given invited keynote addresses worldwide in countries including Austria, Australia, Azerbaijan, Belgium, Brazil, Canada, Chile, China, Czech Republic, Denmark, Egypt, England, France, Finland, Germany, Greece, Holland, Hong Kong, Hungary, Iceland, Ireland, Italy, Japan, Lithuania, Mexico, Mongolia, Montenegro, New Zealand, Norway, Peru, Portugal, Russia, South Korea, Singapore, Serbia, South Africa, Spain, Sweden, Switzerland, Taiwan, Turkey, Ukraine, United Arab Emirates, and the USA.

Monday, December 13

GMT Time	
8:00 8:15	**Opening**
8:15 8:20	**Break**
8:20 9:35	**Parallel session 1 (3 talks)** MM1: Deep Learning and Applications 1 MM2: Operational Research and Applications 1
9:35 9:40	**Break**
9:40 10:55	**Parallel session 2 (3 talks)** MM3: Machine Learning and Applications 1 MM4: Operational Research and Applications 2
10:55 11:00	**Break**
11:00 12:00	**Plenary talk 1** DC programming and DCA: recent advances and trends Hoai An Le Thi
12:00 13:00	**Break**
13:00 14:00	**Plenary talk 2** Artificial Intelligence, Data Sciences, and Optimization in Economics and Finance Panos M. Pardalos
14:00 14:05	**Break**
14:05 15:20	**Parallel session 3 (3 talks)** MA1: Deep Learning and Applications 2 MA2: Operational Research and Applications 3

MM = Monday Morning; MA = Monday Afternoon

TM = Tuesday Morning; TA = Tuesday Afternoon

Tuesday, December 14

GMT Time	
08:30 10:10	**Parallel session 4 (4 talks)** TM1: DC Programming and DCA TM2: Operational Research and Applications 4
10:10 10:20	**Break**
10:20 12:00	**Parallel session 5 (4 talks)** TM3: Optimization methods TM4: Communication Network and Cryptography
12:00 13:00	**Break**
13:00 14:00	**Plenary talk 3** *Computationally Relevant Generalized Derivatives: Theory, Evaluation and Applications* Paul Barton
14:00 14:05	**Break**
14:05 15:20	**Parallel session 6 (3 talks)** TA1: Machine Learning and Applications 2 TA2: Operational Research and Applications 5

Monday, December 13 (GMT Time)

08:00-08:15	**OPENING**	
08:15-08:20	**BREAK**	
	MM1: Deep Learning and Applications 1 *Chairman:*	**MM2: Operational Research and Applications 1** *Chairman:*
08:20-08:45	*A New Approach to the Improvement of the Federated Deep Learning Model in A Distributed Environment* **Thuan Le Duc, Huong Pham Van, Hiep Hoang Van and Khanh Nguyen Kim**	*Algorithms for Flow Shop with Job–Dependent Buffer Requirements* **Alexander Kononov, Julia Memar, and Yakov Zinder**
08:45-09:10	*Deep Networks for Monitoring Waterway Traffic in the Mekong Delta* **Thanh Nghi Do, Minh Thu Tran Nguyen, Thanh Tri Trang, and Tri Thuc Vo**	*A new mathematical model for Hybrid Flow Shop under time-varying resource and exact time-lag constraints* **Quoc Nhat Han Tran, Nhan Quy Nguyen, Hicham Chehade, Farouk Yalaoui, and Frédéric Dugardin**
09:10-09:35	*The Multi-objective Optimization of the Convolutional Neural Network for the Problem of IoT System Attack Detection* **Thi Hong Van Le, Van Huong Pham, and Hieu Minh Nguyen**	*Multi-objective Sustainable Process Plan Generation for RMS: NSGA-III vs New NSGA-III* **Imen Khettabi, Lyes Benyoucef, and Mohamed Amine Boutiche**
09:35-09:40	**BREAK**	
	MM3: Machine Learning and Applications 1 *Chairman:*	**MM4: Operational Research and Applications 2** *Chairman:*
09:40-10:05	*Training Support Vector Machines for Dealing with the ImageNet Challenging Problem* **Thanh Nghi Do and Hoai An Le Thi**	*Traveling Salesman Problem with Truck and Drones: A case study of Parcel Delivery in Hanoi* **Quang Huy Vuong, Thi Huong Giang Dang, Trung Do Quang, and Minh Trien Pham**
10:05-10:30	*An Ensemble Learning Approach For Credit Scoring Problem: A Case Study of Taiwan Default Credit Card Dataset* **Duc Quynh Tran, Doan Dong Nguyen, Huu Hai Nguyen, and Quang Thuan Nguyen**	*MIP formulations for OWA Traveling Salesman Problems* **Thi Quynh Trang Vo and Viet Hung Nguyen**

10:30-10:55	*What to Forecast When Forecasting New Covid-19 Cases? Jordan and the United Arab Emirates as Case Studies* **Sameh Al-Shihabi and Dana Abu Abdoun**	*Bi-objective model for the distribution of COVID-19 vaccines* **Mohammad Amin Yazdani, Daniel Roy, and Sophie Hennequin**
10:55-11:00	**BREAK**	
11:00-12:00	**Plenary talk 1:** *DC programming and DCA: recent advances and trends* Speaker: **Hoai An Le Thi** Chairman: **Tao Pham Dinh**	
12:00-13:00	**BREAK**	
13:00-14:00	**Plenary talk 2:** *Artificial Intelligence, Data Sciences, and Optimization in Economics and Finance* Speaker: **Panos M. Pardalos** Chairman:	
14:00-14:05	**BREAK**	
	MA1: Deep Learning and Applications 2 *Chairman:*	**MA2: Operational Research and Applications 3** *Chairman:*
14:05-14:30	*Training Deep Network Models for Fingerprint Image Classification* **Thanh Nghi Do and Minh Thu Tran Nguyen**	*Optimizing a Binary Integer Program by Identifying its Optimal Core Problem- a New Optimization Concept Applied to the Multidimensional Knapsack Problem* **Sameh Al-Shihabi**
14:30-14:55	*An Assessment of the Weight of the Experimental Component in Physics and Chemistry Classes* **Margarida Figueiredo, M. Lurdes Esteves, Humberto Chaves, José Neves, and Henrique Vicente**	*Beyond Pointwise Submodularity: Non-Monotone Adaptive Submodular Maximization subject to Knapsack and k-System Constraints* **Shaojie Tang**
14:55-15:20	*Optimal Control in Learning Neural Network* **Marta Lipnicka and Andrzej Nowakowski**	*Exploring options for carbon abatement in the petroleum sector: a supply chain optimization-based approach* **Otman Abdussalam, Nuri Fello, and Amin Chaabane**

Tuesday, December 14 (GMT Time)

	TM1: DC Programming and DCA *Chairman:*	**TM2: Operational Research and Applications 4** *Chairman:*
08:30-08:55	*DCA for Gaussian Kernel Support Vector Machines with Feature Selection* **Hoai An Le Thi and Vinh Thanh Ho**	*Optimal operation model of heat pump for multiple residences* **Yusuke Kusunoki, Tetsuya Sato, and Takayuki Shiina**
08:55-09:20	*Solving a centralized dynamic group key management problem by an optimization approach* **Thi Tuyet Trinh Nguyen, Hoang Phuc Hau Luu and Hoai An Le Thi**	*Revenue management problem via stochastic programming in the aviation industry* **Mio Imai, Tetsuya Sato, and Takayuki Shiina**
09:20-09:45	*A Boosted DCA with Power-Sum DC Representation for Linear Constrained Polynomial Program* **Hu Zhang and Yi-Shuai Niu**	*Stochastic programming model for lateral transshipment considering rentals and returns* **Keiya Kadota, Tetsuya Sato, and Takayuki Shiina**
09:45-10:10	*A Refined Inertial DC Algorithm for DC Programming* **Yu You and Yi-Shuai Niu**	
10:10-10:20	**BREAK**	
	TM3: Optimization methods *Chairman:*	**TM4: Communication Network and Cryptography** *Chairman:*
10:20-10:45	*Bayesian optimization based on simulation conditionally to subvariety* **Frédéric Dambreville**	*Implementation of XTS - GOST 28147-89 with Pipeline Structure on FPGA* **Binh Nhung Tran, Ngoc Quynh Nguyen, Ba Anh Dao and Chung Tien Nguyen**
10:45-11:10	*A Comparison Between Optimization Tools to Solve Sectorization Problem* **Aydin Teymourifar, Julian Blank, Ana Maria Rodrigues, Jose Soeiro Ferreira and Cristina Lopes**	*4×4 recursive MDS matrices effective for for implementation from Reed-Solomon code over GF(q) field* **Luong Tran Thi, Cuong Nguyen Ngoc and Trinh Bui Duc**

11:10-11:35	*Clarke Subdifferential, Pareto-Clarke critical points and descent directions to multiobjective optimization on Hadamard manifolds* **Erik Papa Quiroz, Nancy Baygorrea and Nelson Maculan**	*Maximizing Achievable Rate for Incremental OFDM-based Cooperative Communication Systems with Out-of-band Energy Harvesting Technique* **You-Xing Lin, Tzu-Hao Wang, Chun-Wei Wu and Jyh-Horng Wen**
11:35-12:00	*An Interior Proximal Method with Proximal Distances for Quasimonotone Equilibrium Problems* **Erik Papa Quiroz**	*Estimation and Compensation of Doppler Frequency Offset in Millimeter Wave Mobile Communication Systems* **Van Linh Dinh and Van Yem Vu**
12:00-13:00	**BREAK**	
13:00-14:00	**Plenary talk 3:** *Computationally Relevant Generalized Derivatives: Theory, Evaluation and Applications* Speaker: **Paul Barton** Chairman:	
14:00-14:05	**BREAK**	
	TA1: Machine Learning and Applications 2 *Chairman:*	**TA2: Operational Research and Applications 5** *Chairman:*
14:05-14:30	*Measuring Semantic Similarity of Vietnamese Sentences based on Lexical and Distribution Similarity* **Van Tan Bui and Phuong Thai Nguyen**	*Exploiting Demand Prediction to Reduce Idling Travel Distance for Online Taxi Scheduling Problem* **Van Son Nguyen, Quang Dung Pham, and Van Hieu Nguyen**
14:30-14:55	*The effect of machine learning demand forecasting on supply chain performance-The case study of coffee in Vietnam* **Thi Thuy Hanh Nguyen, Abdelghani Bekrar, Thi Muoi Le, and Mourad Abed**	*Efficiently fair dial-a-ride problem with time-windows* **Viet Hung Nguyen and Minh Hieu Nguyen**
14:55-15:20	*ILSA Data Analysis with R Packages* **Laura Ringienė, Julius Zilinskas, and Audroné Jakaitienė**	

Abstracts

Monday, 8:20-9:35

■ MM1
Deep Learning and Applications 1

A New Approach to the Improvement of the Federated Deep Learning Model in A Distributed Environment

Thuan Le Duc, Huong Pham Van, Hiep Hoang Van and Khanh Nguyen Kim

The federated deep learning model has been successfully studied and applied in a distributed environment. The method aggregates the weight set on the server by averaging the component weight sets. The limitation of the method is that the number of training samples on the clients is different but the weights are averaged, so the importance of the component weight sets cannot be clearly shown. Therefore, this paper proposes a new method to synthesize the weight set for the distributed federated deep learning model based on the importance of the component weight sets. The importance is proportional to the number of training data samples. That is, the larger the dataset size, the more important the weight set. The proposed method is tested with the MNIST dataset by the K-fold method. The improved accuracy compared to the old method is 2.54%.

Deep Networks for Monitoring Waterway Traffic in the Mekong Delta

Thanh Nghi Do, Minh Thu Tran Nguyen, Thanh Tri Trang, and Tri Thuc Vo

Our investigation aims at training deep networks for monitoring waterway traffic means on the rivers in the Mekong Delta. We collected the real videos of the waterway traffic, and then tagging the five most popular means in frames extracted from the videos, making an image dataset. We propose to train recent deep network models such as YOLO v4 (You only look once), RetinaNet and EfficientDet on this image dataset to detect the five most popular means in the videos. The numerical test results show that YOLO v4 gives highest accuracy than two other methods, including RetinaNet and EfficientDet. YOLO v4 achieves the performances on the testset with a precision of 91%, a recall of 98%, F1-score of 94% and mean average precision (mAP@0.50) of 97.51%.

The Multi-objective Optimization of the Convolutional Neural Network for the Problem of IoT System Attack Detection

Thi Hong Van Le, Van Huong Pham, and Hieu Minh Nguyen

This paper proposes a new approach, applying multi-objective optimization to improve the convolutional neural network structure for the IoT system attack detection problem. The goal of the paper is to develop a global optimization method that balances detection speed and accuracy when using CNN. The accuracy objective function, the speed objective function and the global objective function are constructed to evaluate each network topology. Based on the value of the global objective function to choose the best network structure according to the Pareto multi-objective optimization method. The proposed method in the paper is experimentally evaluated by the K-fold method and has given positive results. The most balanced CNN structure has an accuracy of 99.94% and a classification time of 253,86s.

■ MM2
Operational Research and Applications 1

Algorithms for Flow Shop with Job-Dependent Buffer Requirements

Alexander Kononov, Julia Memar, and Yakov Zinder

The paper is concerned with algorithms for the two-machine flow shop, where each job needs storage space (a buffer) during the entire time of its processing. The buffer requirement is determined by the duration of job's first operation. The goal is to minimise the time needed for the completion of all jobs. This scheduling problem is NP-hard in the strong sense. Recently, the polynomial-time algorithms were developed for particular cases of this problem. In this paper, we discuss two heuristics based on these polynomial-time algorithms and compare them with other efficient heuristics.

A new mathematical model for Hybrid Flow Shop under time-varying resource and exact time-lag constraints

Quoc Nhat Han Tran, Nhan Quy Nguyen, Hicham Chehade, Farouk Yalaoui, and Frédéric Dugardin

This paper proposes a new mathematical formulation for the Hybrid Flow Shop problem under time-varying resources and chaining exact time-lag constraints. This formulation is named Discrete Continuous (DC) formulation to distinguish from the state-of-the-art Discrete-Time (DT) formulation in the literature. In the DC formulation, the starting time of jobs is modeled by a continuous variable, and its execution state is modeled with a binary one. The two formulations are benchmarked : the DC formulation always assures a feasible solution for any instance.

Multi-objective Sustainable Process Plan Generation for RMS: NSGA-III vs New NSGA-III

Imen Khettabi, Lyes Benyoucef, and Mohamed Amine Boutiche

Nowadays, to be relevant, the manufacturing system of a company has to be simultaneously cost and time-efficient and environmentally harmless. The RMS paradigm is proposed to cope with these new challenges. This paper addresses a multi-objective sustainable process plan generation problem in a reconfigurable manufacturing context. A non-linear multi-objective integer program (NL-MOIP) is proposed, where four objectives are minimized: the amount of greenhouse gas emitted by machines, the hazardous liquid wastes, the classical total production cost, and the total production time. To solve the problem, adapted versions of the well-known non-dominated sorting genetic algorithm (NSGA) approach, namely NSGA-III and New NSGA-III, are developed. Finally, the evaluation of the efficiency of the two approaches is performed through the use of four metrics: cardinality of the Pareto front (CPF), the cardinality of the mixed Pareto fronts (CMPF), inverted generational distance (IGD), and diversity metric (DM).

Monday, 9:40-10:55

■ MM3 Machine Learning and Applications 1

Training Support Vector Machines for Dealing with the ImageNet Challenging Problem

Thanh Nghi Do and Hoai An Le Thi

We propose the parallel multi-class support vector machines (Para-SVM) algorithm to efficiently perform the classification task of the ImageNet challenging problem with very large number of images and a thousand classes. Our Para-SVM learns in the parallel way to create ensemble binary SVM classifiers used in the One-Versus-All multi-class strategy. The stochastic gradient descent (SGD) algorithm rapidly trains the binary SVM classifier from mini-batches being created by under-sampling training dataset. The numerical test results on ImageNet challenging dataset show that the Para-SVM algorithm is faster and more accurate than the state-of-the-art SVM algorithms. Our Para-SVM achieves an accuracy of 74.89% obtained in the classification of ImageNet-1000 dataset having 1,261,405 images in 2048 deep features into 1,000 classes in 53.29 minutes using a PC Intel(R) Core i7-4790 CPU, 3.6 GHz, 4 cores.

An Ensemble Learning Approach For Credit Scoring Problem: A Case Study of Taiwan Default Credit Card Dataset

Duc Quynh Tran, Doan Dong Nguyen, Huu Hai Nguyen, and Quang Thuan Nguyen

Credit scoring is very important for financial institutions. With the advent of machine learning, credit scoring problems can be considered as classification problems. In recent years, credit scoring problems have been attracted to researchers. They explored machine learning and data preprocessing methods for specific datasets. The difficulties of the credit scoring problem reside in the imbalance of datasets and the categorical features. In this paper, we consider a Taiwan credit dataset which is shared publicly. The small number of studies on this dataset motivates us to carry out the investigation. We first proposed methods to transform and balance the dataset and then explore the performance of classical classification models. Finally, we use ensemble learning, namely Voting which combines the results of some classifiers to improve the performance. The experimental results show that our approach is better than the recent publishes and the Voting approach is very promising.

What to Forecast When Forecasting New Covid-19 Cases? Jordan and the United Arab Emirates as Case Studies

Sameh Al-Shihabi and Dana Abu Abdoun

Covid-19 has exerted tremendous pressure on countries' resources, especially the health sector. Thus, it was important for governments to predict the number of new covid-19 cases to face this sudden epidemic. Deep learning techniques have shown success in predicting new covid-19 cases. Researchers have used long-short term memory (LSTM) networks that consider the previous covid-19 numbers to predict new ones. In this work, we use LSTM networks to predict new covid-19 cases in Jordan and the United Arab Emirates (UAE) for six months. The populations of both countries are almost the same; however, they had different arrangements to deal with the epidemic. The UAE was a world leader in terms of the number of covid-19 tests per capita. Thus, we try to find if incorporating covid-19 tests in predicting the LSTM networks would improve the prediction accuracy. Building bi-variate LSTM models that consider the number of tests did not improve uni-variate LSTM models that only consider previous covid-19 cases. However, using a uni-variate LSTM model to predict the ratio of covid-19 cases to the number of covid-19 tests have shown superior results in the case of Jordan. This ratio can be used to forecast the number of new covid-19 cases by multiplying this ratio by the number of conducted tests.

■ MM4
Operational Research and Applications 2

Traveling Salesman Problem with Truck and Drones: A case study of Parcel Delivery in Hanoi

Quang Huy Vuong, Thi Huong Giang Dang, Trung Do Quang, and Minh Trien Pham

Unmanned Aerial Vehicles (UAVs), commonly known to the public as drones, have recently been utilized for military and many agriculture applications. In the near future, drones are likely to become a potential way of delivering parcels in urban areas. In this paper, we apply a heuristic solution for the parallel drone scheduling salesman problem (PDSTSP) for real-world optimization problems, where a set of customers requiring a delivery is split between a truck and a fleet of drones, with the aim of minimizing the completion time (or the makespan) required to service all of the customers. The study is based on the analysis of numerical results obtained by systematically applying the algorithm to the delivery problem in Hanoi. The results demonstrate that the utilization of drones might reduce the makespan significantly, and our approaches effectively deal with the delivery problem in Hanoi.

MIP formulations for OWA Traveling Salesman Problems

Thi Quynh Trang Vo and Viet Hung Nguyen

We study a variant of the traveling salesman problem (TSP) where both the total cost of a tour and some balance (fairness) for its edge costs are considered. The main challenge is that the sum aggregation function for the standard version of TSP can not guarantee any degree of balance for the costs of the edges composing the tour. In this paper, using the Generalized Gini Index (GGI), a special case of the ordered weighted averaging (OWA) function, we define a variant of TSP - the OWA TSP where the efficiency and the fairness for edge costs of the solution tour are achievable by minimizing the objective function. Although GGI is a non-linear aggregation function, it can be cast to Mixed Integer Programs (MIP) by several existing linearization methods [1, 2]. The focus of our work is to exploit the properties of TSP to adapt those linearization methods to the OWA TSP and compare their computational efficiency. Our adaptations not only significantly reduce the size of the formulations but also considerably improve the performance of the models as shown by numerical results.

[1] André Chassein and Marc Goerigk. Alternative formulations for the ordered weighted averaging objective. Information Processing Letters, 115(6-8):604-608, 2015.
[2] Włodzimierz Ogryczak and Tomasz Śliwiński. On solving linear programs with the ordered weighted averaging objective. European Journal of Operational Research, 148(1):80-91, 2003.

Bi-objective model for the distribution of COVID-19 vaccines

Mohammad Amin Yazdani, Daniel Roy, and Sophie Hennequin

It is important to define optimal supply chain strategies that can respond to real vaccination needs in different disasters, especially in the event of a pan-demic. The distribution of medicines and vaccines is more critical when they can decay and must arrive at their final destination as fast as possible. In this paper, to overcome these problems and respond to the pandemic of COVID-19 needs, we introduced a bi-objective model for the distribution of COVID-19 vaccines.

The objectives are to minimize cost function and to minimize the maximum traveling time of the vaccines to treat targeted populations in different time phases. The bi-objective model is solved with the well-known multi-objective augmented epsilon-constraint method. Besides, we bring numerical results and the appliance of our proposed model. By solving the pro-posed model, we can find the optimal network of the vaccines and open needed facilities in several locations. Finally, we give the decision-maker several possible answers to choose according to his preferences.

Monday, 14:05-15:20

■ MA1
Deep Learning and Applications 2

Training Deep Network Models for Fingerprint Image Classification

Thanh Nghi Do and Minh Thu Tran Nguyen

Our investigation aims to answer the research question is it possible to train deep network models that can be re-used to classify a new coming dataset of fingerprint images without re-training the new deep network model?. For this purpose, we collect real datasets of fingerprint images from students at the Can Tho University. After that, we propose to train recent deep networks, such as VGG, ResNet50, Inception-v3, Xception, on the the training dataset with 9,236 fingerprint images of 441 students, to create deep network models. And then, we re-use these resulting deep network models as the feature extraction and only fine-tune the last layer in deep network models for the new fingerprint image datasets. The empirical test results on three real fingerprint image datasets (FP-235, FP-389, FP-559) show that deep network models achieve at least the accuracy of 96.72% on the testsets. Typically, the ResNet50 models give classification accuracy of 99.00%, 98.33%, 98.05% on FP-235, FP-389 and FP-559, respectively.

An Assessment of the Weight of the Experimental Component in Physics and Chemistry Classes

Margarida Figueiredo, M. Lurdes Esteves, Humberto Chaves, José Neves, and Henrique Vicente

Experimental work plays a central role in Physics and Chemistry teaching. However, the use of experimental work depends on the perception that teacher has about the gains in terms of the students' motivation and learning. Thus, this study aims to evaluate the weight of the experimental component in the chemistry teaching focusing on four topics, i.e., material resources, teaching methodologies, learning achievements, and teacher engagement. For this purpose, a questionnaire was developed and applied to a cohort comprising 129 Physics and Chemistry teachers of both genders, aged between 26 and 60 years old. The questionnaire consists of two sections, the first of which contains general questions, whereas the second contains information on the topics mentioned above. Mathematical-logical programs are presented, considering the teachers' opinions in terms of Best

and Worst-case Scenarios, complemented with a computer approach based on artificial neural networks. The model was trained and tested with real data exhibiting an overall accuracy of 91.5%.

Optimal Control in Learning Neural Network

Marta Lipnicka and Andrzej Nowakowski

We present optimal control approach to improve the neural network learned on a given empirical data (set of observations). Artificial neural networks usually are described as black-boxes and it is difficult to say something about their properties than very general results received from learning data. For many applications, e.g. medicine or embedded system for controlling autonomous vehicles, it is essential to say not only that on training data we get some error but that we will make an error not greater than some ε for *every* data we can input to our system. To derive required theory we apply an optimal control theory to a certain family of neutral networks, considered as ordinary differential equations, defined by a set of controls and suitable constructed functional.
Very often we have additional information or knowledge on the problem the data represent. Our approach allows to include these information and knowledge in the construction of the model.
We apply a modification of classical dynamic programming ideas to formulate a new optimization problem. We use it to state and prove sufficient approximate optimality conditions for finding approximate neural network which should work correctly for given ε with respect to built functional, on a data different than the set of observations.

■ MA2 Operational Research and Applications 3

Optimizing a Binary Integer Program by Identifying its Optimal Core Problem- a New Optimization Concept Applied to the Multidimensional Knapsack Problem

Sameh Al-Shihabi

The core concept for solving a binary integer program (BIP) is about dividing the BIP's variables into core and adjunct ones. We fix the adjunct variables to either 0 or 1; consequently, we reduce the problem to the core variables only, forming a core problem (CP). An optimal solution to a CP is not optimal to the original BIP unless adjunct variables are fixed to their optimal values. Consequently, an optimal CP is a CP whose associated adjunct variables are fixed to their optimal values. This paper presents a new optimization concept that solves a BIP by searching for its optimal CP. We use a hybrid algorithm of local search and linear programming to move from a CP to a better one until we find the optimal CP. We use our algorithm to solve 180 multidimensional knapsack (MKP) instances to validate this new optimization concept. Results show that it is a promising approach to investigate because we were able to find the optimal solutions of 149 instances, of which some had 500 variables, by solving several CPs having 30 variables only.

Beyond Pointwise Submodularity: Non-Monotone Adaptive Submodular Maximization subject to Knapsack and k-System Constraints

Shaojie Tang

Although the knapsack-constrained and k-system-constrained non-monotone adaptive submodular maximization have been well studied in the literature, it has only been settled given the additional assumption of pointwise submodularity. In this paper, we remove the common assumption on pointwise submodularity and propose the first approximation solutions for both knapsack and k-system constrained adaptive submodular maximization problems. Inspired by two recent studies on non-monotone adaptive submodular maximization, we develop a sampling-based randomized algorithm that achieves a $\frac{1}{10}$ approximation for the case of a knapsack constraint and that achieves a $\frac{1}{2k+4}$ approximation ratio for the case of a k-system constraint.

Exploring options for carbon abatement in the petroleum sector: a supply chain optimization-based approach

Otman Abdussalam, Nuri Fello, and Amin Chaabane

This work aims to address the problem of green supply chain planning in the petroleum industry. Our primary objective is to minimize the crude, refinery, and petrochemical sectors' total cost and meet environmental regulations. It presents a deterministic mathematical programming model for planning the supply chain. Furthermore, the study examines the impact of incorporating investment decisions in different carbon emission reduction options and evaluating the supply chain performance based on the economic and environmental dimensions. A novel mixed-integer linear programming model is presented in this study to evaluate the impact of introducing a stringent environmental regulation limiting greenhouse gas emissions. Experiments based on the Libyan

petroleum industry are analyzed and demonstrate model capabilities to deal with the trade-off between the total cost and the petroleum sector's environmental issues. This study shows that it is possible to reduce carbon emissions by up to 32% if the carbon capture and storage projects are implemented in the different petroleum sectors.

Tuesday, 8:30-10:10

■ TM1
DC Programming and DCA

DCA for Gaussian Kernel Support Vector Machines with Feature Selection

Hoai An Le Thi and Vinh Thanh Ho

We consider the support vector machines problem with the feature selection using Gaussian kernel function. This problem takes the form of a nonconvex minimization problem with binary variables. We investigate an exact penalty technique to deal with the binary variables. The resulting optimization problem can be expressed as a DC (Difference of Convex functions) program on which DCA (DC Algorithm) is applied. Numerical experiments on four benchmark real datasets show the efficiency of the proposed algorithm in terms of both feature selection and classification when compared with the existing algorithm.

Solving a centralized dynamic group key management problem by an optimization approach

Thi Tuyet Trinh Nguyen, Hoang Phuc Hau Luu and Hoai An Le Thi

In centralized key management schemes, a single trusted entity called a Key Server is employed to manage the group key and other supporting keys of the entire group. This management mechanism usually employs a binary tree based structure. In dynamic multicast communication, members may join/leave the group at any time, which requires a certain cost to update the binary key tree. This paper addresses an important problem in centralized dynamic group key management. It consists in finding a set of leaf nodes in a binary key tree to insert new members while minimizing the insertion cost. Since the inserting cost is proportional to the distance from the root to the selected leaf node, the balance of the tree plays an important role in dynamic group key management. Therefore, our proposed approach also considers the balance of the tree after insertion. The two mentioned important objectives are combined into a unified optimization framework.

A Boosted DCA with Power-Sum DC Representation for Linear Constrained Polynomial Program

Hu Zhang and Yi-Shuai Niu

We introduce a difference-of-convex (DC) decomposition of polynomials based on power-sum representation, which can be established by solving a sparse linear system. Based on this DC decomposition, we propose a Boosted DCA for linear constrained polynomial minimization problems. Particularly, our algorithm is a combination of DCA with exact line search along a DC descent direction generated by two consecutive iterates of DCA. We show that such exact line search is equivalent to find roots of a unary polynomial in an interval, which can be computed efficiently in many applications. The subsequential convergence of our proposed algorithm to a d-stationary point is established, and the rate of convergence under Kurdyka–Łojasiewicz property is investigated. The numerical experiments on the mean-variance-skewness-kurtosis higher order portfolio model using the classical DCA, the Boosted DCA with Armijo line search, and our proposed algorithm are reported, which demonstrates the efficiency of our approach.

A Refined Inertial DC Algorithm for DC Programming

Yu You and Yi-Shuai Niu

In this paper we consider the difference-of-convex (DC) programming problems, whose objective function is the difference of two convex functions. The classical DC Algorithm (DCA) is well-known for solving this kind of problems, which generally returns a critical point. Recently, an inertial DC algorithm (InDCA) equipped with heavy-ball inertial-force procedure was proposed in de Oliveira et al. (Set-Valued and Variational Analysis 27(4):895–919, 2019), which potentially helps to improve both the convergence speed and the solution quality. Based on InDCA, we propose a refined inertial DC algorithm (RInDCA) equipped with enlarged inertial step-size compared with InDCA. Empirically, larger step-size accelerates the convergence. We demonstrate the subsequential convergence of our refined version to a critical point. In addition, by assuming the Kurdyka-Łojasiewicz (KL) property of the objective function, we establish the sequential convergence of RInDCA. Numerical simulations on checking copositivity of matrices and image denoising problem show the benefit of larger step-size.

■ TM2
Operational Research and Applications 4

Optimal operation model of heat pump for multiple residences

Yusuke Kusunoki, Tetsuya Sato, and Takayuki Shiina

In a world in which global warming is progressing and environmental problems are becoming increasingly severe, the use of energy with a low environmental load has become important. One way to solve this problem is the use of water heaters driven by a heat pump, a solution that has been widely implemented in residential homes. In this study, we endeavored to develop an optimal operation plan for the energy storage equipment in a residence. The proposed model is based on the idea of a smart community and aims to optimize electricity usage across multiple residences. We formulate the problem using a stochastic programming method with integer conditions to model the operation of complex equipment. Multiple scenarios were used to consider the uncertainty in the demand for both power and heat for a residence. The solution that is obtained corresponds to the operation of multiple models. The purpose of this study was to minimize the electricity charge and level the load in terms of the power supply. We aimed to reduce the maximum power consumption and average power demand relative to the separate electricity charges of individual homes and the demand at different times of the day.

Revenue management problem via stochastic programming in the aviation industry

Mio Imai, Tetsuya Sato, and Takayuki Shiina

This paper presents an optimization model using stochastic programming to secure the optimum seat and maximizing the profit of the airline in consideration of overbooking. Airline seat inventory control involves selling the right seats to the right people at the right time. If an airline sells tickets on a first-come, first-serve basis, it is likely to be occupied by leisure travelers and late bookers. Generally, business travelers willing to pay a higher fare will subsequently find no seats left, and revenue from such sales will be lost. The airline allows overbooking, accepting more reservations than seats to minimize losses. While there are various needs that depend on the type of passenger, we propose an optimization model using stochastic programming as a method of maximizing the profit of the airline company by securing seats appropriately and employing the concept of overbooking.

Stochastic programming model for lateral transshipment considering rentals and returns

Keiya Kadota, Tetsuya Sato, and Takayuki Shiina

Supply chain management is a large-scale planning under uncertainty. It is important to build an efficient supply chain under uncertain circumstances. There are numerous traditional lateral transshipment models targeting only demands but do not include rentals and returns. This study provides the uncertainty between rentals and returns by scenarios using a multi-period stochastic programming model of lateral transshipment problems. The moment matching method was used to reduce the number of scenarios and the computation time, and the comparative experiment demonstrated the utility of this model.

Tuesday, 10:20-12:00

■ TM3 Optimization methods

Bayesian optimization based on simulation conditionally to subvariety

Frédéric Dambreville

In a first step, the paper presents an accurate method for sampling a random vector conditionally to a subvariety within a box. In a second step, it presents how to use such simulations in order to address black-box optimizations of some kind: the criterion function depends on a control parameter to be optimized and on a model parameter which is unknown but is priorly characterized as a random vector. The approach is versatile in the choice of the function to be optimized and in the choice of the control parameter, its nature and its constraints.

A Comparison Between Optimization Tools to Solve Sectorization Problem

Aydin Teymourifar, Julian Blank, Ana Maria Rodrigues, Jose Soeiro Ferreira and Cristina Lopes

In sectorization problems, a large district is split into small ones, usually meeting certain criteria. In this study, at first, two single-objective integer programming models for sectorization are presented. Models contain sector centers and customers, which are known beforehand. Sectors are established by assigning a subset of customers to each center, regarding objective functions like equilibrium and compactness. Pulp and Pyomo libraries available in Python are utilised to solve related benchmarks. The problems are then solved using a genetic algorithm available in Pymoo, which is a library in Python that contains evolutionary algorithms. Furthermore, the multi-objective versions of the models are solved with NSGA-II and RNSGA-II from Pymoo. A comparison is made among solution approaches. Between solvers, Gurobi performs better, while in the case of setting proper parameters and operators the evolutionary algorithm in Pymoo is better in terms of solution time, particularly for larger benchmarks.

Clarke Subdifferential, Pareto-Clarke critical points and descent directions to multiobjective optimization on Hadamard manifolds

Erik Papa Quiroz, Nancy Baygorrea and Nelson Maculan

In this paper, we aim to complement our work reported in [20] by showing some further properties and results on Clarke subdifferential, Pareto-Clarke critical points and descent directions on Hadamard manifolds. These tools and results can be applied to introduce new algorithms for solving nonsmooth nonconvex multiobjective minimization problems on Hadamard manifolds.

[20] Papa Quiroz, E.A., Baygorrea, N, Maculan, N. : Inexact Proximal Point Methods for Multiobjective Quasiconvex Minimization on Hadamard Manifolds. Journal of Optimization Theory and Applications **186**, 879–898 (2020)

An Interior Proximal Method with Proximal Distances for Quasimonotone Equilibrium Problems

Erik Papa Quiroz

We introduce an interior proximal point algorithm with proximal distances to solve quasimonotone Equilibrium problems defined on convex sets. Under adequate assumptions, we prove that the sequence generated by the algorithm converges to a solution of the problem and for a broad class of proximal distances the rate of convergence of the sequence is linear or superlinear.

■ TM4 Communication Network and Cryptography

Implementation of XTS - GOST 28147-89 with Pipeline Structure on FPGA

Binh Nhung Tran, Ngoc Quynh Nguyen, Ba Anh Dao and Chung Tien Nguyen

On the disk drive protected with storage encryption, data must be capable of being randomly accessed or written at any location. Hence, the data encryption/decryption process must be done independently and arbitrarily at the Sector-level, while the size of the data remains unchanged. Furthermore, to ensure the drive's read/write speed, the cryptographic implementation is required to meet strict timing requirements such as low latency, high computation speed, and real-time operations. Therefore, the structure of the cryptographic implementation plays a decisive role. In this paper, we proposed a pipelined implementation of XTS-GOST 28147-89 on FPGA to allow real-time data storage encryption/decryption on time-critical systems.

4×4 recursive MDS matrices effective for for implementation from Reed-Solomon code over $GF(q)$ field

Luong Tran Thi, Cuong Nguyen Ngoc and Trinh Bui Duc

Maximum Distance Separable (MDS) matrices have applications not only in code theory but also in the design of block ciphers and hash functions. However, MDS matrices often cause large overhead in hardware/software implementations. Recursive MDS matrices allow this problem to be solved because they can be powers of a very sparse Serial matrix, and thus can be suitable even for limited, constrained environments. In this paper, 4×4 recursive MDS matrices effective for implementation from Reed-Solomon code over $GF(q)$ field will be shown. These matrices are very effective for implementation and can be applied in lightweight cryptography.

Maximizing Achievable Rate for Incremental OFDM-based Cooperative Communication Systems with Out-of-band Energy Harvesting Technique

You-Xing Lin, Tzu-Hao Wang, Chun-Wei Wu and Jyh-Horng Wen

Cooperative communication combined with simultaneous wireless information and power transfer (SWIPT) is a very promising technology. It can make the nodes in the relaying network more energy-efficient, and even improve system performance. In this paper, OFDM-based cooperative communication with out-of-band energy harvesting is discussed. To maximize the average achievable rate, relaying selection and sub-carrier allocation are jointly optimized. For practical application considerations, we assume that the power allocation strategy uses equal power allocation (EPA). In order to simplify the computational complexity of the original optimal problem, we proposed a sub-optimal solution with excellent performance. Numerical results verify the benefits of our solution.

Estimation and Compensation of Doppler Frequency Offset in Millimeter Wave Mobile Communication Systems

Van Linh Dinh and Van Yem Vu

In millimeter Wave (mmWave) Multiple-Input Multiple-Output Orthogonal Frequency Division Multiplexing

(MIMO-OFDM) systems that applied to high mobility applications, Carrier Frequency Offset (CFO) is a primary factor in reducing the performance of OFDM transmissions due to the destruction of the subcarrier component's orthogonality. This paper presents the bit error rate (BER) performance for various modulation techniques of Cyclic Prefix (CP) OFDM and different MIMO systems at 28 GHz and 38 GHz by applying the frequency domain estimation technique for CFO. The simulations are carried out in channels affected by Rayleigh fading. The simulation results indicate that for BPSK modulation technique, it provides better BER performance at 28 GHz when compared to other modulation techniques (QPSK, 8PSK) and 38 GHz. Moreover, the performance of mmWave MIMO-OFDM systems can be effectively improved as the number of receive antennas increases.

Tuesday, 14:05-15:20

■ TA1
Machine Learning and Applications 2

Measuring Semantic Similarity of Vietnamese Sentences based on Lexical and Distribution Similarity

Van Tan Bui and Phuong Thai Nguyen

Measuring the semantic similarity of sentence pairs is an important natural language processing (NLP) problem and has many applications in many NLP systems. Sentence similarity is used to improve the performance of many systems such as machine translation, speech recognition, automatic question and answer, text summarization. However, accurately evaluate the semantic similarity between sentences is still a challenge. Up to now, there are not sentence similarity methods, which exploit Vietnamese specific characteristics, have been proposed. Moreover, there are not sentence similarity datasets for Vietnamese that have been published. In this paper, we propose a new method to measure the semantic similarity of Vietnamese sentence pairs based on combining lexical similarity score and distribution semantic similarity score of two sentences. The experimental results have shown that our proposed model has high performance for the Vietnamese semantic similarity problem.

The effect of machine learning demand forecasting on supply chain performance-The case study of coffee in Vietnam

Thi Thuy Hanh Nguyen, Abdelghani Bekrar, Thi Muoi Le, and Mourad Abed

Demand forecasting methods are one of the variables that have a considerable influence on supply chain performance. However, there is a lack of empirical proof on the magnitude of savings as observable supply chain performance results. In the literature, most scholars have paid more attention to non-financial performance while ignoring financial performance. This study compared the effect of two famous forecasting models on the operational and financial performance of the supply chain. ARIMAX (Auto-Regressive Integrated Moving Average with exogenous factors as a traditional model) and LSTM (Long Short-Term Memory as machine learning model) have been chosen. These two models were tested on Vietnamese coffee demand data. The results

demonstrated that traditional and machine learning forecasting methods have different impacts on supply chain performance. The machine learning forecasting method outperformed the traditional method regarding operational and financial metrics. Three relevant operating and one financial metrics are selected, such as bullwhip effect (BWE), net stock amplification (NSAmp), and transportation cost (TC), and inventory turn (IT), respectively.

ILSA Data Analysis with R Packages

Laura Ringienė, Julius Zilinskas, and Audronė Jakaitienė

High volume and special structure International Large-Scale Assessment data such as PISA (Programme for International Student Assessment), TIMSS (Trends in International Mathematics and Science Study), and others are of interest to social scientists around the world. Such data can be analysed using commercial software such as SPSS, SAS, Mplus, etc. However, the use of open-source R software for statistical calculations has recently increased in popularity. To encourage the social sciences to use open source R software, we overview the possibilities of five packages for statistical analysis of International Large-Scale Assessment data: BIFIEsurvey, EdSurvey, intsvy, RALSA, and svyPVpack. We test and compare the packages using PISA and TIMSS data. We conclude that each package has its advantages and disadvantages. To conduct a comprehensive data analysis of International Large-Scale Assessment surveys one might require to use more than one package.

■ TA2
Operational Research and Applications 5

Exploiting Demand Prediction to Reduce Idling Travel Distance for Online Taxi Scheduling Problem

Van Son Nguyen, Quang Dung Pham, and Van Hieu Nguyen

Taxi-scheduling systems are gaining increasing popularity for their benefit in scheduling taxis to serve passengers in need. The taxi-scheduling system is decomposed into two fundamental components: routing with known requests and routing with unknown requests. In the online scenario, one of the critical components of the taxi-scheduling system is the scheduling system with unknown requests, which aims to suggest more efficient routes for drivers. Therefore, this paper focuses on the taxi-scheduling problem based on predictive information in online scenarios. We propose a novel scheduling algorithm based on the predicted spatio-temporal information that attempts to exploit prediction information to recommend profitable driving routes to taxi drivers as well as to reduce the idling travel distance. We experiment on real taxi data sets. The predictive information is input data and generated by a simple probabilistic network model. The results show that our method is able to save from 9.64% to 12.76% total idling travel distance compared with previous works.

Efficiently fair dial-a-ride problem with time-windows

Viet Hung Nguyen and Minh Hieu Nguyen

In this paper, we address a variant of the dial-a-ride problem with time-windows [1], called efficiently fair dial-a-ride problem with time-windows (EFDRP) where instead of minimizing the total cost, the total profit is maximized while undertaking some equity over the individual profits associated with each vehicle. In particular, we search for a solution achieving a Nash equilibrium [2] between two players: the first aims to maximize the total profit and the second aims to minimize the difference between the maximum individual profit and the minimum individual profit. We show that such a solution can be found by optimizing a suitable convex combination of the two players objectives [3]. In addition, the obtained solution can be proved Pareto-optimal. Finally, we propose a practical iterative algorithm to solve EFDRP and present several numerical results.

[1] Dimitris Bertsimas, Patrick Jaillet, Sebastien Martin, “Online Vehicle Routing : The Edge of Optimization in Large-Scale Applications”, Operations Research, March 2018.
[2] Dimitris Bertsimas, V.F.Farias, Nikolaos Trichakis, “The Price of Fairness” , Operations Research, Vol. 59, No. 1, January-Febuary 2011, pp. 17-31.
[3] I.P.Stanimirovic, M.Lj.Zlatanovic, M.D.Petkovic, “On the linear weighted sum method for multi-objective optimization” , Mathematics Subject Classification, 2011.