MOPGP 2021

20/12 MONDAY

Main

start*	Track 1	Chair	Track 2	Chair
08:00	Opening Session			
08:15	Prof. Davide La Torre (SKEMA Business School), Prof. Hatem Masri (University of Bahrain), Prof Fouad Ben-Abdelaziz (NEOMA Business School)			
08:30	Key note 1			
08:45	"Multi-criteria sorting methods for AHP"			
09:00	Prof. Alessio Ishizaka, Neoma Business School, France (chair: La Torre)			
09:15	Break — Track 1		Track 2	
09:30	**9** "Multi-objective optimization of the flow of goods in a logistic chain via the physical internet" Salah et al.	(ch:JB)	**1** "Composite indicators as decision making tools: …" El Gibari et al.	(ch:AJ)
09:45	**10** "A Weighted Fuzzy GP Model for Selecting the Best Design of Hybrid Energy System in Tunisia" Koubaa et al.	-	**3** "MO fractional interval optimization problem with interval solution" Patel, et al.	-
10:00	**34** "MO stochastic VRPTW: cash transportation vehicle routing" Alaya et al.	-	**4** "On the existence of pareto solutions to vector pol. opt. problems with constraints" Liguo Jiao	-
10:15	**79** "Performance Measurement of the Integration of Reverse Flows in a Manufact. Company" Elouchdi et al.	-	**5** "MO Programming Approach for Solving Fully Fuzzy Pentagonal LFP" Wahed Khalifa et al.	-
10:30	**11** "MCDM combined with Factor Analysis to Rank OECD countries in Function of the Quality of Life" Eufrazio et al.	-	**6** "A new method for optimizing fuzzy multi-objective LFP" Wahed Khalifa et al.	-
10:45	**24** "A new discrete MC method based on strength and weakness. Application to well-being" Muñoz et al.	-	**13** "A multi-criteria fuzzy neutrosophic decision-making model for solving the SC" Gupta	-
11:00	Break — Track 1		Track 2	
11:15	**73** "A Novel MO Feature Selection Method using Henry Gas Solubility Optimization" Soumaia et al.	(ch:JB)	**8** "Finite Mixture AR Parsim Models for Stock Markets during Times of Crisis" Saadaoui et al.	(ch:AJ)
11:30	**12** "Multicriteria interpretability driven Deep Learning" Repetto	-	**67** "Volatility and time varying corr across stock and commodity markets: COVID-19" Kazouz et al.	-
11:45	**40** "A Machine Learning Based Auditing Quality Measure" Ding et al.	-	**50** "Sparsity, Accuracy and Discordant Datasets in NAS for Stock Market Prediction" Hafiz et al.	-
12:00	**26** "Proactive and reactive approach for no-wait hybrid flow shop scheduling prob. under uncertainty" Hejer et al.	-	**27** "Prioritzation of value chain processes exposed to fraud and corruption." da Silva et al.	-
12:15	**33** "Ordering classifier models from the PROPPAGA method: an appl to affective computing" Carvalho et al.	-	**32** "Designing Personalized Tourism Packages: A MO Meta-Heuristic Framework" Piya et al.	-
12:30	**2** "Flexible Manufacturing System MO simulation-based optimization: Design of Exp and GP hybridization." Jerbi	-	**16** "Continuous time surplus maximization for the bi-objective user equilibrium problem" Xu et al.	-
12:45				
13:00	Lunch			
13:15	Main			
13:30	Prof. Philippe Monin, SKEMA Business School, Directeur de la Faculté & Recherche			
13:45	Key note 2:			
14:00	"Big data for social impact investing and social impact of big data"			
14:15	Prof. Blanca Maria Pérez Gladish, University of Oviedo, Spain (chair: La Torre)			
14:30	Break — Track 1		Track 2	
14:45	**30** ""Multi-objective Optimization for Disruption Risk Management in Supply Chains" Singh	(ch:DR)	**15** "Lagrange dual. & saddle point opt. MO semi-infinite prog with vanishing constraints" Tung et al.	(ch:BPG)
15:00	**14** "Assessing risk of disruption of supply chains due to Covid-19 with Fuzzy VIKORSort" Khan et al.	-	**18** "Analytical critical flow method: a reliability allocation method based MCDM" Di Bona	-
15:15	**44** "Application of Multi-Objective Optimal Stopping Theory to Pandemic Lockdown Policies" El Hassan et al.	-	**19** "Non-dominated solutions for multi-level MO LP problems and the adaptive method" Kaci et al.	-
15:30	**31** "Store-Wide Space Planning Balancing Impulse and Convenience" Abdelaziz et al.	-	**53** "Structural Characteristics of an NP-Hard Combinatorial Puzzle" Querido et al.	-
15:45	**35** "Critic WASPAS MCDA method for Rio De Janeiro's police supplier selection problem." dos Santos et al.	-	**22** "A Novel Rhythmic Approach in Interactive Fuzzy MOP Optimization" Torgul et al.	-
16:00	**17** "an optimal design of berthing service quay configuration using M/M/n queuing" Fru-Weyegho et al.	-	**23** "On approximate solutions for robust semi-inf MO conv symmetric cone optim" Alzalg et al.	-
16:15	Break — Track 1		Track 2	
16:30	**37** "Coalition Formation for Horizontal Supply Chain Collaboration: A Multiobjective Approach" Mjahed et al.	(ch:HM)	**20** "Extensive vs intensive options optim w.r.t air transp management in uncertainty" Goncharenko	(ch:FBA)
16:45	**43** "Multi objective Optimization of Supply and Transportation Decision During Pandemics" Jaafar et al.	-	**64** "How do fuzzy voters try to manipulate?" Meddeb	-
17:00	**55** "MO optimization of active human-robot collaboration: case study of the aircraft industry" Hémono et al.	-	**70** "Optimal human robot collaboration in Assembly tasks" Sahnoun et al.	-
17:15	**45** "Blockchain Enabled and MCD Aided Vaccine SC: Identifying Risks and Collaboration Practices" Gurgur	-	**74** "Fusion of expert recommendations as ref points in MC group decision support" Skulimowski	-
17:30	**47** "Ordering hosting services for websites from superiority and inferiority ranking MCDA" de Almeida et al.	-	**58** "Interval value based lexicographic fuzzy GP for facility layout design parameters" Turgay	-
17:45	**85** "SC resiliency strategies based on SC Reference Model using hybrid fuzzy DEA-AHP" Kumaresan et al.	-	**59** "Fuzzy GP with symm. triangle membership function: closed loop SC management" Turgay	-
18:00	End			

* Please be aware that times are CET.

** titles have been abbreviated for enhanced overview.

21/12 TUESDAY

Track 1	Chair	Track 2	Chair	start*
38 "An evol MO optim algorithm based on two reference points" Gonzalez-Gallado et al.	(ch:FH)	**51** "Evolutionary MO optimization algorithms for portfolio selection" González-Senent et al.	(ch:JB)	08:30
41 "Non-dominated Sorting Biased Random-key Genetic Algorithm" Pauleti-Mendes et al.	-	**57** "Socially responsible portfolio selection: an inter. intuitionistic fuzzy approach" Hanine et al.	-	08:45
42 "Product line design using a bi-objective Mayfly optimization" Zervoudakis et al.	-	**60** "Ranking economies according to levels of financial inclusion using DEA" Takouda et al.	-	09:00
54 "MADM under Fuzzy Environment: an Online Recommender System" Gupta	-	**61** "Comp indic of business init processes in the African entrepren ecosyst" Takouda et al.	-	09:15
56 "A MO flow shop scheduling problem under Resources Constraints" Laribi et al.	-	**29** "Strategic support in [ ] investment portfolio with VFT and [ ] methods" de Almeida et al.	-	09:30
66 "A stochastic genetic algorithm for mining related optim problems" Amponsah et al.	-	-		09:45
Break				10:00
Key note 3				10:15
"Robust Multiobjective Optimization: Sensitivity to Uncertainty"				10:30
Prof. Matteo Rocca, Università degli Studi dell'Insubria, Italia (chair: La Torre)				10:45
Break — Track 1		Track 2		11:00
62 "Bi-objective algorithms for joint optim of transp costs and CO2 emissions" Harrir et al.	(ch:MR)	**25** "On Multi Objective Primal Heuristics" Gandibleux et al.	(ch:DR)	11:15
71 "AHP-TOPSIS-2N to prioritize vulnerabilities in cybersecurity" Santos et al.	-	**39** "Solving procedure for MO dyn problem with changeable hierarchy" Trzaskalik et al.	-	11:30
63 "A coop. platform for the optim of cost & energy in a ML distrib. network" Benfriha et al.	-	**48** "A parallel two-phase method for the MO knapsack problem" Chaabane et al.	-	11:45
75 "Production, Distribution and Inventory Management Integrated Problem" Hejer et al.	-	**49** "A new algorithm for optimization a linear function over integer efficient set" Hamadou	-	12:00
81 "Bi-objective optim for joint production and maintenance scheduling" Boufellouh et al.	-	**52** "Application of the Hardy-Littlewood Method to NP-Hard Problems" Fergusson et al.	-	12:15
77 "MO optim for production routing with mult prod lines and mixed fleet" Zeddam et al.	-	**76** "Nash equilibrium as a quadratic optimization problem for annealers" Khan	-	12:30
				12:45
Lunch				13:00
Main				13:15
Key note 4				13:30
"Interactive Approaches and Underlying Value Functions"				13:45
Prof. Murat Köksalan, Ross School of Business, University of Michigan, USA (chair: La Torre)				14:00
Break — Track 1		Track 2		14:15
78 "Solving capacitated multi-product lot sizing with direct shipment" Benfedel et al.	(ch:FH)	**68** "Multi-Objective Optimization for Electrical Demand Forecasting" Ihsane et al.	(ch:JB)	14:30
46 "Waste reduction using THOR 2 Hybrid Method: DM in Lean Healthcare" Drei et al.	-	**7** "Incorporating an Entropy Criterion in Neural Network Models" Boreland et al.	-	14:45
80 "An effective approach for solving MO cap. lot sizing & energy contracts" Mechaacha et al.	-	**69** "Parallel EDEV for Hard Optimization Problems" Manel et al.	-	15:00
82 "Parallel machines scheduling problem w deterioration & human resource" Sekkal et al.	-	**36** "Optim for generative product design and manufact cost in mass custom" Kielarova et al.	-	15:15
83 "Job shop problem optim under comp consumption and unidir transp" Hadri et al.	-	**28** "Speech signal enhancement based on MO optim using adapted firefly algor" Ouznadji et al	-	15:30
65 "Multi-Item capacitated lot-sizing parallel ress, setup t, costs, energy" Djama Maafa et al.	-	**72** "Visualization of Bank Customers' Tweets on Product Experience " Jibri et al.	-	15:45
84 "MO optim for economic and environ study in poultry SC networks" Tharaoui et al.	-	**21** "A division algorithm for optimizing over the integer efficient set" Zaidi et al.	-	16:00
Conclusions				16:15
End				16:30

Legend	Chair
GENERAL	FBA: Fouad-Ben Abdelaziz
KEY NOTE	JB: Jan Broekaert
MOPGP & Industry processes	FH: Faizal Hafiz
MOPGP & Fundamentals	AJ : Aida Jebali
MOPGP & Machine Learning	HK: Herb Kunze
MOPGP & Economics, Finance and Management	DLT: Davide La Torre
	HM: Hatem Masri
	BPG: Blanca Pérez Gladish
	DR: David Rey

MOPGP 2021 conference contributions

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1	Samira El Gibari, Jose M. Cabello, Trinidad Gomez and Francisco Ruiz	Composite indicators as decision making tools: the joint use of compensatory and non-compensatory schemes.
2	Abdessalem Jerbi	Flexible Manufacturing System multi-objective simulation-based optimization: Design of Experiment and Goal Programming hybridization.
3	Mridul Patel, Pankaj Kumar and Ajay Bhurjee	Multi-objective fractional interval optimization problem with interval solution
4	Liguo Jiao	On the existence of Pareto solutions to vector polynomial optimization problems with constraints
5	Hamiden Abd El Wahed Khalifa, Pavan Kumar and Seyedali Mirjalili	Multi-Objective Programming Approach for Solving Fully Fuzzy Pentagonal Linear Fractional Programming Problem
6	Hamiden Abd El Wahed Khalifa and Pavan Kumar	A new method for optimizing fuzzy multi-objective linear fractional programming problem
7	Bryson Boreland, Herb Kunze and Kim Levere	Incorporating an Entropy Criterion in Neural Network Models
8	Foued SaÂdaoui, Hana Rabbouch and Mohammed Aldohaiman	Finite Mixture Autoregressive Parsimonious Models for Analyzing Stock Markets during Times of Crisis
9	Yasmina Salah, Kenza Baadoud, Fouad Maliki and Mehdi Souier	Multi-objective optimization of the flow of goods in a logistic chain via the physical internet
10	Zainab Koubaa	A Weighted Fuzzy Goal Programming Model for Selecting the Best Design of Hybrid Energy System in Tunisia
11	Edilvando Pereira Eufrazio, Helder Gomes Costa, Igor Pinheiro de Araújo Costa, Sérgio Mitihiro do Nascimento Maêda, Miguel Ângelo Lellis Moreira, Carlos Francisco Simões Gomes and Marcos dos Santos	Multiple Criteria Decision Making combined with Factor Analysis for Rank OECD countries in Function of the Quality of Life
12	Marco Repetto	Multicriteria interpretability driven Deep Learning
13	Srikant Gupta	A multi-criteria fuzzy neutrosophic decision-making model for solving the supply chain network problem
14	Jehangir Khan, Alessio Ishizaka and Sachin Mangla	Assessing risk of disruption of supply chains due to Covid-19 with Fuzzy VIKORSort
15	Tung Thanh Le, Tam Hoang Dang and Khai Thien Tran	Lagrange duality and saddle point optimality conditions for multiobjective semi-infinite programming with vanishing constraints
16	Zhandong Xu and Anthony Chen	Continuous time surplus maximization for the bi-objective user equilibrium problem
17	Lezin Seba Minsili and Eliane Fru Weyegho	AN OPTIMAL DESIGN OF BERTHING SERVICE QUAY CONFIGURATION USING M/M/n QUEUING MODEL IN MARINE VESSELS
18	Gianpaolo Di Bona	ANALYTIC CRITICAL FLOW METHOD (A-CFM): A RELIABILITY ALLOCATION METHOD BASED MULTI CRITERIA DECISION MAKING (MCDM)
19	Mustapha Kaci and Sonia Radjef	The set of all non-dominated solutions for multilevel multi-objective linear programming problems and the adaptive method
20	Andriy V. Goncharenko	Dilemma of Extensive versus Intensive Options Optimization with Regards to Air Transportation Management in Uncertainty: Theoretical Contemplations
21	Zaidi Ali and Chaabane Djamal	A division algorithm for optimizing over the integer efficient set
22	Belkız TorĞul and Turan Paksoy	A Novel Rhythmic Approach in İnteractive Fuzzy Multi-Objective Programming Optimization
23	Baha Alzalg and Amira Oulha	On approximate solutions for robust semi-infinite multi-objective convex symmetric cone optimization
24	María M. Muñoz, Carmen Molina and María-Mercedes Rojas-de-Gracia	A new discrete multicriteria method based on strengths and weaknesses. Application to well-being analysis
25	Xavier Gandibleux and Saïd Hanafi	On Multi Objective Primal Heuristics
26	Hejer Khlif Hachicha and Sana Bouajaja	Proactive and reactive approach for no-wait hybrid flow shop scheduling problem under uncertainty
27	Andre Silva, Marcos Santos and Carlos Gomes	PROBLEM OF PRIORITIZATION OF VALUE CHAIN PROCESSES MOST EXPOSED TO THE RISKS OF FRAUD AND CORRUPTION: AN ANALYSIS FROM THE THOR-2 METHOD
28	Ouznadji Said, Chaabane Djamal and Thameri Messaoud	Speech signal enhancement based on multi-objective optimization techniques using an adapted firefly algorithm
29	Isaque David Pereira de Almeida, Sérgio Mitihiro do Nascimento Maêda, Igor Pinheiro de Araújo Costa, Marcos dos Santos and Carlos Francisco Simões Gomes	STRATEGIC SUPPORT IN THE CHOICE OF AN INVESTMENT PORTFOLIO WITH THE APPLICATION OF VFT AND COMPARISON OF THE CRITIC-GRA-2N AND SAPEVO-M-NC METHODS
30	Sujeet Kumar Singh	Multi-objective Optimization for Disruption Risk Management in Supply Chains
31	Bacel Maddah, Fouad Ben Abdelaziz, Tulay Flamand and Jimmy Azar	Store-Wide Space Planning Balancing Impulse and Convenience
32	Sujan Piya, Chefi Triki, Abdulwahab Al Maimani and Mahdi Mokhtarzadeh	Designing Personalized Tourism Packages: A Multi-Objective Meta-Heuristic Framework
33	Leandro Carvalho, Marcos Dos Santos, Arthur Pinheiro de Araújo Costa, Sandro Bessa de Lima, Igor Pinheiro de Araújo Costa and José Victor de Pina Corriça	ORDERING CLASSIFIER MODELS FROM THE PROPPAGA METHOD: AN APPLICATION TO AFFECTIVE COMPUTING
34	Houda Alaya, Fouad Ben Abdelaziz and Hatem Masri	Multiobjective stochastic VRPTW: cash transportation vehicle routing
35	Raphael Nascimento dos Santos, Leandro de Mattos Bento Soares, Brayan de Almeida Lima and Marcos dos Santos	CRITIC-WASPAS MCDA METHOD FOR RIO DE JANEIRO'S POLICE SUPPLIER SELECTION PROBLEM: A CASE STUDY
36	Somlak Wannarumon Kielarova, Prapasson Pradujphongphet and Sunisa Sansri	Multi-Objective Optimization for Generative Product Design and Manufacturing Cost in Mass Customization

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37	Mirna Abou Mjahed, Fouad Ben Abdelaziz and Bacel Maddah	Coalition Formation for Horizontal Supply Chain Collaboration: A Multiobjective Approach
38	Sandra González-Gallardo, Rubén Saborido, Ana B. Ruiz and Mariano Luque	An Evolutionary Multiobjective Optimization Algorithm Based on Two Reference Points
39	Tadeusz Trzaskalik	SOLVING PROCEDURE FOR MULTIOBJECTIVE DYNAMIC PROBLEM WITH CHANGEABLE HIERARCHY DEPENDENT ON THE VALUES OF CRITERIA
40	Yiyi Xu, Wenhong Ding and Fouad Ben Abdelaziz	A Machine Learning Based Auditing Quality Measure
41	Luis Henrique Pauleti Mendes, Fábio Luiz Usberti and Mário César San Felice	Non-dominated Sorting Biased Random-key Genetic Algorithm
42	Konstantinos Zervoudakis and Stelios Tsafarakis	Addressing the product line design problem using a bi-objective Mayfly optimization algorithm
43	Maysaa Jaafar, Fouad Ben Abdelaziz and Bacel Maddah	Multi objective Optimization of Supply and Transportation decisions during Pandemics
44	Noura El Hassan, Bacel Maddah and Fouad Ben Abdelaziz	Application of Multi-Objective Optimal Stopping Theory to Pandemic Lockdown Policies
45	Cigdem Gurgur	Blockchain Enabled and Multi-Criteria Decision Aided Vaccine Supply Chains: Identifying Risks and Collaboration Practices
46	Samuel Martins Drei, Marcos Santos, Carlos Francisco Simões Gomes and Lidia Angulo-Meza	Waste reduction using the THOR 2 Hybrid Method: Decision making in the context of Lean Healthcare
47	Brayan de Almeida Lima, Raphael Nascimento dos Santos, Leandro de Mattos Bento Soares and Marcos Santos	ORDERING HOSTING SERVICES FOR WEBSITES FROM THE SUPERIORITY AND INFERIORITY RANKING (SIR) MCDA METHOD
48	Khadidja Chaabane, Nadjmeddine Kantour and Sadek Bouroubi	A PARALLEL TWO-PHASE METHOD FOR THE MUTIOBJECTIVE KNAPSACK PROBLEM
49	Sara Hamadou and Djamal Chaabane	A new algorithm for Optimization a Linear Function over Integer Efficient Set
50	Faizal Hafiz, Jan Broekaert, Davide La Torre and Akshya Swain	Balancing Sparsity, Accuracy and Discordant Datasets in Neural Architecture Search for Stock Market Prediction
51	Jesús González-Senent, Ana B. Ruiz and Mariano Luque	Evolutionary Multiobjective Optimization Algorithms for Portfolio Selection
52	Kevin Fergusson, Geoff Harris, Volodymyr Novykov, Liam Querido and Isaac Tonkin	Application of the Hardy-Littlewood Method to NP-Hard Problems
53	Liam Querido, Kevin Fergusson, Geoff Harris, Volodymyr Novykov and Isaac Tonkin	Structural Characteristics of an NP-Hard Combinatorial Puzzle
54	Niharika Gupta	Multiple Attribute Decision Making under Fuzzy Environment- An Application in Online Recommender System
55	Pierre Hémono, Ahmed Nait Chabane and M'Hammed Sahnoun	Multi-Objective Optimization of Active Human-Robot collaboration: Case Study of the Aircraft Industry
56	Imane Laribi and Mehdi Souier	A multi-objective flow shop scheduling problem under Resources Constraints
57	Yahya Hanine, Youssef Lamrani Alaoui, Mohamed Tkiouat and Younes Lahrichi	Socially Responsible Portfolio Selection: An Interactive Intuitionistic Fuzzy Approach
58	Safiye Turgay	INTERVAL VALUE BASED LEXICOGRAPHIC FUZZY GOAL PROGRAMMING FOR FACILITY LAYOUT DESIGN PARAMETERS
59	Safiye Turgay	Fuzzy Goal Programming with Symmetric Triangle Membership Function: Case of Closed Loop Supply Chain Management
60	Pawoumodom Matthias Takouda, Mohamed Dia and Alassane Ouattara	Ranking economies with respect with their levels of financial inclusion using DEA
61	Pawoumodom Matthias Takouda, Mohamed Dia and Alassane Ouattara	Composite indicators of the Business Initiation processes in the African Entrepreneurial Ecosystem
62	Harrir Mohamed Mounir, Triqui Sari Lamia and Idoumghar Lhassane	Bi-objective algorithms for joint optimization of transport costs and CO2 emissions in a multi-product, multi-period distribution network: a case study
63	Abdennour Ilyas Benfriha, Lamia Triqui-Sari and Mohammed Bennekrouf	A cooperative platform for the optimisation of costs and energy consumption in a multi-level distribution network with perishable products
64	Olfa Meddeb	HOW DO FUZZY VOTERS TRY TO MANIPULATE?
65	Djama Asmaa Zohra, Triqui Sari Lamia and Belkaid Fayçal	Multi-Item Capacitated Lot-Sizing Problem with Parallel Ressources, Setups times, costs and Energy consumption
66	Shadrach Yaw Amponsah, Pawoumodom Matthias Takouda and Eugene Ben-Awuah	A Stochastic Genetic Algorithm for Mining-Related Optimization Problems
67	Hayfa Kazouz and Saloua Benammou	Volatility spillovers and time varying correlations across stock and commodity markets: a comparative analysis before and during COVID-19 crisis
68	Ihsane Imane and Ahmed Nait Chabane	Multi-Objective Optimization for Electrical Demand Forecasting
69	Manel Houimli, Kahloul Laïd and Selma Sahraoui	Parallel EDEV for Hard Optimization Problems
70	M'Hammed Sahnoun and Abderraouf Benali	Optimal human robot collaboration in Assembly tasks
71	Sandro Lima, Marcos dos Santos, Andrei Gomes and Leandro Carvalho	Application of the AHP-TOPSIS-2N method to prioritize vulnerabilities in solution development in cybersecurity
72	Abdul Bashiru Jibril, Raphael Kwaku Botchway, Zuzana Komínková Oplatková and Najlae Zhani	Visualization of Bank Customers' Tweets on Product Experience from European Bank: A Sentiment Analysis and Topic Modelling Approach
73	Soumaia Kahloul, Djaafar Zouache and Boualem Brahmi	A Novel Multi-Objective Feature Selection Method using Henry Gas Solubility Optimization

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74	Andrzej M.J. Skulimowski	Fusion of expert recommendations expressed as reference points in multicriteria group decision support procedures
75	Hejer Khlif Hachicha and Sana Bouajaja	Production, Distribution and Inventory Management Integrated Problem
76	Faisal Shah Khan	Nash equilibrium as a quadratic optimizationproblem for annealers
77	Besma Zeddam, Fayçal Belkaid and Mohammed Bennekrouf	Multi-objective optimization for the production routing problem with multiple production lines and mixed fleet of vehicles
78	Rachida Benfedel and Belkaid Fayçal	Solving a Capacitated Multi-product Lot Sizing Problem with Direct Shipment
79	Mouna Elouchdi and Fayçal Belkaid	Performance Measurement of the Integration of Reverse Flows in a Manufacturing Company
80	Abdelkader Mechaacha and Fayçal Belkaid	An effective approach for solving a multi-objective capacitated lot sizing problem with energy contracts
81	Radhwane Boufellouh and Fayçal Belkaid	Bi-objective optimization algorithms for joint production and maintenance scheduling under shared resources for a flowshop problem with sequence and resource dependent setups
82	Norelhouda Sekkal and Belkaid Fayçal	Parallel machines scheduling problem with deterioration effect and skilled human resources constraints
83	Abdelkader Hadri, Fayçal Belkaid and Imad Eddine Bougloula	Job shop problem optimization under components consumption and unidirectional transport constraints: A case of study
84	Nacéra Tahraoui, Triqui Sari Lamia and Bennekrouf Mohammed	Multi-objective optimization for economic and environmental study in poultry supply chain networks: case study
85	Midun Karthi Kumaresan and Yen-Tsang Chen	Prioritizing supply chain resiliency strategies based on Supply Chain Operations Reference Model using a hybrid fuzzy DEA-AHP method

A PARALLEL TWO-PHASE METHOD FOR THE MUTIOBJECTIVE KNAPSACK PROBLEM

KHADIDJA CHAABANE[1], NEDJMEDDINE KANTOUR[2], SADEK BOUROUBI[3]

Abstract. Recently, there has been a noticeable tendency in research for combinatorial optimization issues toward the hybridization of metaheuristics with other optimization techniques. On the other hand, parallel conception of multiobjective evolutionary algorithms (MOEAs) provides a significant enhancements in terms of efficiency and effectiveness. In this work, we propose a hybrid parallel multiobjective evolutionary algorithm for to the multiobjective Knapsack Problem (MOKP). The suggested approach can be considered as an enhanced parallel variant of Two-phase method with an intermediate step for reducing the problem' size using solutions found in the first phase.

Key words. Two-phase method, Parallel Multiobjective Evolutionary Algorithms, Reduction Strategy, Multiobjective Knapsack Problem,Integer Linear Programming, Combinatorial Optimization.

1. Introduction

Multiobjective Problems consists of optimizing p objective functions simultaneously. The general form of MOP is stated as follows:

$$\begin{cases} \text{“}max\text{”}\ Z(x) = (Z^1(x), Z^2(x), \dots, Z^p(x)), \\ s.t., \quad x \in \Omega. \end{cases}$$

where Ω is the decision space, $x \in \Omega$ is a decision vector, and the vector $Z(x)$ consists of p objective functions $Z^i(x) : \Omega \to \mathbb{D}_i,\ i \in \{1, \dots, p\}$. The dominance relation, used to define optimality in MOPs is as follows: for any couple of feasible solutions x and x' in Ω, the vector $Z(x) = (Z^1(x), \dots, Z^p(x))$ dominates the vector $Z(x^{'}) = (Z^1(x^{'}), \dots, Z^p(x^{'}))$, written as $Z(x) \succ Z(x')$, if and only if, $\forall i \in \{1, \dots, p\},\ Z^i(x) \leq Z^i(x')$ and $Z(x) \neq Z(x')$. A feasible solution $x^* \in \Omega$ is called a Pareto optimal solution or an efficient solution, if and only if, $\nexists y \in \Omega$ such that $Z(y) \succ Z(x^*)$. The set of Pareto optimal solutions is called the Pareto-optimal Set (PS): $PS = \{x \in \Omega \,|\, \nexists y \in \Omega, Z(y) \succ Z(x^*)\}$. The evaluation of solutions in PS is called the Pareto Front (PF): $PF = \{Z(x)|x \in PS\}$.

Furthermore, there exists an important classification of efficient solutions: supported efficient solutions X_{SE} that are solutions of the parametric single-objective problems, P_λ, obtained by optimizing a linear aggregation of the criteria :

$$(P_\lambda) \begin{cases} max \displaystyle\sum_{i=1}^{p} \lambda_i Z^i(x), \\ s.t., \quad x \in \Omega, \end{cases}$$

where, $\lambda = (\lambda_1, \lambda_2, \ldots, \lambda_p) \in \mathbb{R}^p_+$ is a weight vector with all positive components (necessary condition of the Geoffrion's theorem [3]) and non-supported efficient solutions that are difficult to find. The corresponding set is denoted by X_{NS}. The image of the unsupported solutions are not located on the boundary of the convex envelope.

In the last three decades, 0-1 knapsack problem (0-1 KP) received a considerable attention from researchers, in term of applications, variants and dedicated methods. In a multiple objective framework, the knapsack problem can be written as follows:

$$(MOKP) \begin{cases} \text{“}\min\text{”} Z^k(x) & = & c^k x, & k \in \{1, 2, \ldots, p\}, \\ s.t. & & x \in X, & \end{cases}$$

where $X = \{x \in \mathbb{R}^n \,| Ax \leq W, x \in \{0,1\}^n\}$, $c^k \in \mathbb{N}^{1\times n}, \forall k \in \{1, \ldots, p\}$, $A \in \mathbb{N}^{1\times n}$ and $W \in \mathbb{N}$. In order to avoid the trivial case, we suppose that $\omega_j \leq W$, $\forall j \in \{1, \ldots, n\}$ and $\sum_{i=1}^{n} \omega_i > W$. This peoblem is a mutiobjective variant of the Knapsack Problem (i.e., called the Multiobjective Knapsack Problem, MOKP), which is known to be NP-hard [2].

In this paper, we propose a parallel hybrid multiobjective evolutionary algorithm for the MOKP, designed in a master/salve model. The suggested algorithm is an enhanced two-phase type algorithm, where the first phase consists of finding the supported solutions set using an exact method. In the second phase, the decision space is structurally decomposed and allocated to multiple MOEAs operating in parallel. Each MOEA is dedicated to a specific region of the decision space that is initially characterized by a subset of the supported solutions found in the first phase. We designed the suggested method for tackling the Multiobjective Knapsack Problem (MOKP). That is, by introducing an intermediate pretreatment procedure to reduce the dimension of the KP in hand using the supported solutions found in the first phase. That is, by using the reduction strategy introduced in [1].

2. Description of the Suggested Algorithm

In this section, we present a resumed description of the suggested algorithm, which is, as we already mentioned, an enhanced variant of the two-phase method.

Phase I (generating X_{SE}). The first phase of the suggested algorithm method remains unchanged, as it is the case for all two-phase algorithms. It consists in the construction of the set of efficient solutions supported by the dichotomy method proposed by J. Teghem and al. [4], based on Geoffrion's theorem [3]. This algorithm generates all the supported efficient solutions, including extreme and non-extreme ones, using a single objective problem whose objective function is a linear aggregation of two objectives (see, P_λ in the introduction).

Intermediate procedure (reduction of the KP size). The set of efficient supported solutions, gathered in the first phase, provides further understanding of the Pareto solutions. Hence, we apply an efficient reduction strategy for the Knapsack problem proposed in [1]. This procedure uses supported efficient solutions combined with the dominance relationship between items' efficiency (i.e., profit over weight ratio), to determine regular variable within the true Pareto set. Consequently, it reduces the KP instance size, and we, henceforth, address in the second phase a reduced MOKP.

Phase II (approximation of X_{NS}). Once the supported efficient solutions set is obtained, the second phase consists of approximating the set of non-supported solutions using multiple asynchronous parallel MOEAs. Each one of the parallel search entity is designed to target a specific region of the Pareto optimal front. This is by initializing its archive solutions set using a subset of the supported efficient solutions set gathered form the same region. Furthermore, the selection operator is defined according to the following order relation : let P_t be the current population of a search entity, PS_t be the set of Pareto solutions obtained at iteration t (i.e., $PS_t = \{x \in P_t | \nexists y \in P_t : y \succ x\}$), and $R \subset Z(X_{SE})$ the extreme points enclosing the predefined region for the search entity, $|R| = k$ the number of objective functions. The order relation is defined as follows:

$$\forall x, y \in P_t, x \geq y \iff (x \succeq y) \vee (\phi(x) \geq \phi(y)),$$

where, the function $\phi(x)$ verifies the following :

$$\max_{x \in X} \phi(x) \in R, \text{ and } \phi(x) = \sum_{i=1}^{p} \lambda_i Z^i(x).$$

In other words, the function ϕ is obtained by a linear aggregation of the objective functions, and its optimal solution is in the specified region enclosed by the extreme points R. That is, to define a section operator that guides the search towards the predefined region. The adequate direction of optimization λ with regards to its target region in the decision space.

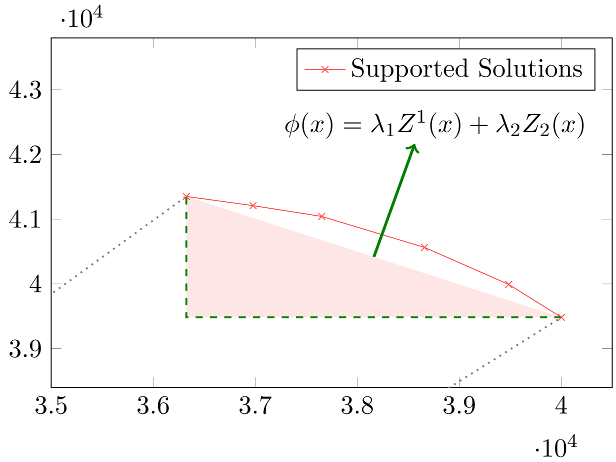

FIGURE 1. Illustrative example of the guidance vector for one target-region (Bazgan KP instance [5], 2KP100-TA-0)

Hence, the process of selecting individuals that pass to the next generation P_{t+1} is given explicitly as follows:

$$P_{t+1} = \{x \in P_t | (x \in PS_t) \vee (rank(x, P_t \backslash PS_t \leq N))\},$$

where, $rank(x, P)$ is the order of a solution x compared to elements of a set P according to the function ϕ, and N is the parameter fixing the size of the current directing population.

The suggested pMOEA can be classified as an algorithmic level parallel model designed in a master/worker paradigm, handling: (1) a master entity in charge of initializing, gathering, and computing the global approximated Pareto solutions, (2) multiple MOEAs with directed the search to specific regions of the true Pareto front, with the help of a specific selection operator described above defined with a subset of supported efficient solutions. Regarding the decomposition procedure, this occurs over the decision space using the supported efficient solutions set found in the first phase. This is by partitioning this set into p equally sized sets, according to one of the objective functions (i.e., using successive quantiles). As we mentioned earlier, the extreme solutions of each subset is used to construct the selection operator of each parallel MOEAs. Figure 2 presents an example of the decomposition procedure applied to a bi-objective Knapsack instance: 2KP100-TA-0 [5]. The decision space is decomposed into $p = 4$ regions.

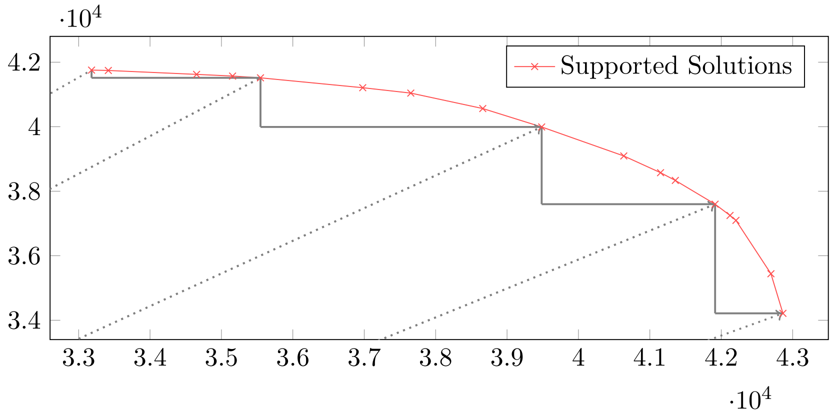

FIGURE 2. Illustrative example of the used decision space decomposition (Bazgan KP instance [5], 2KP100-TA-0)

3. CONCLUSIONS

In this work, we have presented a parallel two-phase type algorithm with an application to the multiobjective knapsack Problem. The suggested algorithm is a hybrid algorithm, combining an exact method for finding the set of supported solutions, and a parallel MOEA with weighted-criteria selection operator, designed in a master/worker paradigm, as to target specific regions of the true Pareto set. An intermediate step is included to reduce the problem' size using information provided by the supported efficient solutions set.

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[1,2,3]LIFORCE Laboratory, Faculty of Mathematics, Department of Operations Research, P.B. 32 El-Alia, 16111, Bab Ezzouar, Algiers, Algeria.

E-mail address: [1]khadidja03@gmail.com, [2]nkantour@usthb.dz, [3]sbouroubi@usthb.dz