

**Editorial Board Members**

Joaquim Filipe 

*Polytechnic Institute of Setúbal, Setúbal, Portugal*

Ashish Ghosh

*Indian Statistical Institute, Kolkata, India*

Raquel Oliveira Prates 

*Federal University of Minas Gerais (UFMG), Belo Horizonte, Brazil*

Lizhu Zhou

*Tsinghua University, Beijing, China*

More information about this series at <https://link.springer.com/bookseries/7899>

Ana I. Pereira · Florbela P. Fernandes ·  
João P. Coelho · João P. Teixeira ·  
Maria F. Pacheco · Paulo Alves ·  
Rui P. Lopes (Eds.)

# Optimization, Learning Algorithms and Applications

First International Conference, OL2A 2021  
Bragança, Portugal, July 19–21, 2021  
Revised Selected Papers



Springer

*Editors*

Ana I. Pereira 

Instituto Politécnico de Bragança  
Bragança, Portugal

João P. Coelho 

Instituto Politécnico de Bragança  
Bragança, Portugal

Maria F. Pacheco 

Instituto Politécnico de Bragança  
Bragança, Portugal

Rui P. Lopes 

Instituto Politécnico de Bragança  
Bragança, Portugal

Florbel P. Fernandes 

Instituto Politécnico de Bragança  
Bragança, Portugal

João P. Teixeira 

Instituto Politécnico de Bragança  
Bragança, Portugal

Paulo Alves 

Instituto Politécnico de Bragança  
Bragança, Portugal

ISSN 1865-0929

ISSN 1865-0937 (electronic)

Communications in Computer and Information Science

ISBN 978-3-030-91884-2

ISBN 978-3-030-91885-9 (eBook)

<https://doi.org/10.1007/978-3-030-91885-9>

© Springer Nature Switzerland AG 2021

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

## Preface

The volume CCIS 1488 contains the refereed proceedings of the International Conference on Optimization, Learning Algorithms and Applications (OL2A 2021), an event that, due to the COVID-19 pandemic, was held online.

OL2A 2021 provided a space for the research community on optimization and learning to get together and share the latest developments, trends, and techniques as well as develop new paths and collaborations. OL2A 2021 had more than 400 participants in an online environment throughout the three days of the conference (July 19–21, 2021), discussing topics associated to areas such as optimization and learning and state-of-the-art applications related to multi-objective optimization, optimization for machine learning, robotics, health informatics, data analysis, optimization and learning under uncertainty, and the Fourth Industrial Revolution.

Four special sessions were organized under the following topics: Trends in Engineering Education, Optimization in Control Systems Design, Data Visualization and Virtual Reality, and Measurements with the Internet of Things. The event had 52 accepted papers, among which 39 were full papers. All papers were carefully reviewed and selected from 134 submissions. All the reviews were carefully carried out by a Scientific Committee of 61 PhD researchers from 18 countries.

July 2021

Ana I. Pereira

# **Organization**

## **General Chair**

Ana Isabel Pereira

Polytechnic Institute of Bragança, Portugal

## **Organizing Committee Chairs**

Florbel P. Fernandes

Polytechnic Institute of Bragança, Portugal

João Paulo Coelho

Polytechnic Institute of Bragança, Portugal

João Paulo Teixeira

Polytechnic Institute of Bragança, Portugal

M. Fátima Pacheco

Polytechnic Institute of Bragança, Portugal

Paulo Alves

Polytechnic Institute of Bragança, Portugal

Rui Pedro Lopes

Polytechnic Institute of Bragança, Portugal

## **Scientific Committee**

Ana Maria A. C. Rocha

University of Minho, Portugal

Ana Paula Teixeira

University of Trás-os-Montes and Alto Douro, Portugal

André Pinz Borges

Federal University of Technology – Paraná, Brazil

Andrej Košir

University of Ljubljana, Slovenia

Arnaldo Cândido Júnior

Federal University of Technology – Paraná, Brazil

Bruno Bispo

Federal University of Santa Catarina, Brazil

Carmen Galé

University of Zaragoza, Spain

B. Rajesh Kanna

Vellore Institute of Technology, India

C. Sweetlin Hemalatha

Vellore Institute of Technology, India

Damir Vrančić

Jozef Stefan Institute, Slovenia

Daiva Petkevičiute

Kaunas University of Technology, Lithuania

Diamantino Silva Freitas

University of Porto, Portugal

Esteban Clua

Federal Fluminense University, Brazil

Eric Rogers

University of Southampton, UK

Felipe Nascimento Martins

Hanze University of Applied Sciences,

The Netherlands

Gaukhar Muratova

Dulaty University, Kazakhstan

Gediminas Daukšys

Kauno Technikos Kolegija, Lithuania

Glaucia Maria Bressan

Federal University of Technology – Paraná, Brazil

Humberto Rocha

University of Coimbra, Portugal

José Boaventura-Cunha

University of Trás-os-Montes and Alto Douro, Portugal

José Lima

Polytechnic Institute of Bragança, Portugal

Joseane Pontes

Federal University of Technology – Ponta Grossa,

Brazil

Juani López Redondo

University of Almería, Spain

Jorge Ribeiro	Polytechnic Institute of Viana do Castelo, Portugal
José Ramos	NOVA University Lisbon, Portugal
Kristina Sutiene	Kaunas University of Technology, Lithuania
Lidia Sánchez	University of León, Spain
Lino Costa	University of Minho, Portugal
Luís Coelho	Polytechnic Institute of Porto, Portugal
Luca Spalazzi	Marche Polytechnic University, Italy
Manuel Castejón Limas	University of León, Spain
Marc Jungers	Université de Lorraine, France
Maria do Rosário de Pinho	University of Porto, Portugal
Marco Aurélio Wehrmeister	Federal University of Technology – Paraná, Brazil
Mikulas Huba	Slovak University of Technology in Bratislava, Slovakia
Michał Podpora	Opole University of Technology, Poland
Miguel Ángel Prada	University of León, Spain
Nicolae Cleju	Technical University of Iasi, Romania
Paulo Lopes dos Santos	University of Porto, Portugal
Paulo Moura Oliveira	University of Trás-os-Montes and Alto Douro, Portugal
Pavel Pakshin	Nizhny Novgorod State Technical University, Russia
Pedro Luiz de Paula Filho	Federal University of Technology – Paraná, Brazil
Pedro Miguel Rodrigues	Catholic University of Portugal, Portugal
Pedro Morais	Polytechnic Institute of Cávado e Ave, Portugal
Pedro Pinto	Polytechnic Institute of Viana do Castelo, Portugal
Rudolf Rabenstein	Friedrich-Alexander-University of Erlangen-Nürnberg, Germany
Sani Rutz da Silva	Federal University of Technology – Paraná, Brazil
Sara Paiva	Polytechnic Institute of Viana do Castelo, Portugal
Sofia Rodrigues	Polytechnic Institute of Viana do Castelo, Portugal
Sławomir Stępień	Poznan University of Technology, Poland
Teresa Paula Perdicoulis	University of Trás-os-Montes and Alto Douro, Portugal
Toma Roncevic	University of Split, Croatia
Vitor Duarte dos Santos	NOVA University Lisbon, Portugal
Wojciech Paszke	University of Zielona Gora, Poland
Wojciech Giernacki	Poznan University of Technology, Poland

# Contents

## Optimization Theory

Dynamic Response Surface Method Combined with Genetic Algorithm to Optimize Extraction Process Problem .....	3
<i>Laires A. Lima, Ana I. Pereira, Clara B. Vaz, Olga Ferreira, Márcio Carocho, and Lillian Barros</i>	
Towards a High-Performance Implementation of the MCSFilter Optimization Algorithm .....	15
<i>Leonardo Araújo, Maria F. Pacheco, José Rufino, and Florbela P. Fernandes</i>	
On the Performance of the ORTHOMADS Algorithm on Continuous and Mixed-Integer Optimization Problems .....	31
<i>Marie-Ange Dahito, Laurent Genest, Alessandro Maddaloni, and José Neto</i>	
A Look-Ahead Based Meta-heuristics for Optimizing Continuous Optimization Problems .....	48
<i>Thomas Nordli and Noureddine Bouhmala</i>	
Inverse Optimization for Warehouse Management .....	56
<i>Hannu Rummukainen</i>	
Model-Agnostic Multi-objective Approach for the Evolutionary Discovery of Mathematical Models .....	72
<i>Alexander Hvatov, Mikhail Maslyaev, Iana S. Polonskaya, Mikhail Sarafanov, Mark Merezhnikov, and Nikolay O. Nikitin</i>	
A Simple Clustering Algorithm Based on Weighted Expected Distances .....	86
<i>Ana Maria A. C. Rocha, M. Fernanda P. Costa, and Edite M. G. P. Fernandes</i>	
Optimization of Wind Turbines Placement in Offshore Wind Farms: Wake Effects Concerns .....	102
<i>José Baptista, Filipe Lima, and Adelaide Cerveira</i>	
A Simulation Tool for Optimizing a 3D Spray Painting System .....	110
<i>João Casanova, José Lima, and Paulo Costa</i>	

Optimization of Glottal Onset Peak Detection Algorithm for Accurate Jitter Measurement .....	123
<i>Joana Fernandes, Pedro Henrique Borghi, Diamantino Silva Freitas, and João Paulo Teixeira</i>	

Searching the Optimal Parameters of a 3D Scanner Through Particle Swarm Optimization .....	138
<i>João Braun, José Lima, Ana I. Pereira, Cláudia Rocha, and Paulo Costa</i>	

Optimal Sizing of a Hybrid Energy System Based on Renewable Energy Using Evolutionary Optimization Algorithms .....	153
<i>Yahia Amoura, Ângela P. Ferreira, José Lima, and Ana I. Pereira</i>	

## Robotics

Human Detector Smart Sensor for Autonomous Disinfection Mobile Robot .....	171
<i>Hugo Mendonça, José Lima, Paulo Costa, António Paulo Moreira, and Filipe Santos</i>	

Multiple Mobile Robots Scheduling Based on Simulated Annealing Algorithm .....	187
<i>Diogo Matos, Pedro Costa, José Lima, and António Valente</i>	

Multi AGV Industrial Supervisory System .....	203
<i>Ana Cruz, Diogo Matos, José Lima, Paulo Costa, and Pedro Costa</i>	

Dual Coulomb Counting Extended Kalman Filter for Battery SOC Determination .....	219
<i>Arezki A. Chellal, José Lima, José Gonçalves, and Hicham Megnafi</i>	

Sensor Fusion for Mobile Robot Localization Using Extended Kalman Filter, UWB ToF and ArUco Markers .....	235
<i>Sílvia Faria, José Lima, and Paulo Costa</i>	

Deep Reinforcement Learning Applied to a Robotic Pick-and-Place Application .....	251
<i>Natanael Magno Gomes, Felipe N. Martins, José Lima, and Heinrich Wörtche</i>	

## Measurements with the Internet of Things

An IoT Approach for Animals Tracking .....	269
<i>Matheus Zorawski, Thadeu Brito, José Castro, João Paulo Castro, Marina Castro, and José Lima</i>	

Optimizing Data Transmission in a Wireless Sensor Network Based on LoRaWAN Protocol .....	281
---	-----

*Thadeu Brito, Matheus Zorawski, João Mendes,  
Beatriz Flamia Azevedo, Ana I. Pereira, José Lima, and Paulo Costa*

Indoor Location Estimation Based on Diffused Beacon Network .....	294
---	-----

*André Mendes and Miguel Diaz-Cacho*

SMACovid-19 – Autonomous Monitoring System for Covid-19 .....	309
---	-----

*Rui Fernandes and José Barbosa*

## Optimization in Control Systems Design

Economic Burden of Personal Protective Strategies for Dengue Disease: an Optimal Control Approach .....	319
--	-----

*Artur M. C. Brito da Cruz and Helena Sofia Rodrigues*

ERP Business Speed – A Measuring Framework .....	336
--	-----

*Zornitsa Yordanova*

BELBIC Based Step-Down Controller Design Using PSO .....	345
--	-----

*João Paulo Coelho, Manuel Braz-César, and José Gonçalves*

Robotic Welding Optimization Using A* Parallel Path Planning .....	357
--	-----

*Tiago Couto, Pedro Costa, Pedro Malaca, Daniel Marques,  
and Pedro Tavares*

## Deep Learning

Leaf-Based Species Recognition Using Convolutional Neural Networks .....	367
--	-----

*Willian Oliveira Pires, Ricardo Corso Fernandes Jr,  
Pedro Luiz de Paula Filho, Arnaldo Cândido Junior,  
and João Paulo Teixeira*

Deep Learning Recognition of a Large Number of Pollen Grain Types .....	381
---	-----

*Fernando C. Monteiro, Cristina M. Pinto, and José Rufino*

Predicting Canine Hip Dysplasia in X-Ray Images Using Deep Learning .....	393
---	-----

*Daniel Adorno Gomes, Maria Sofia Alves-Pimenta, Mário Ginja,  
and Vitor Filipe*

Convergence of the Reinforcement Learning Mechanism Applied to the Channel Detection Sequence Problem .....	401
--	-----

*André Mendes*

Approaches to Classify Knee Osteoarthritis Using Biomechanical Data . . . . .	417
<i>Tiago Franco, P. R. Henriques, P. Alves, and M. J. Varanda Pereira</i>	
Artificial Intelligence Architecture Based on Planar LiDAR Scan Data to Detect Energy Pylon Structures in a UAV Autonomous Detailed Inspection Process . . . . .	430
<i>Matheus F. Ferraz, Luciano B. Júnior, Aroldo S. K. Komori, Lucas C. Rech, Guilherme H. T. Schneider, Guido S. Berger, Álvaro R. Cantieri, José Lima, and Marco A. Wehrmeister</i>	
<b>Data Visualization and Virtual Reality</b>	
Machine Vision to Empower an Intelligent Personal Assistant for Assembly Tasks . . . . .	447
<i>Matheus Talacio, Gustavo Funchal, Victória Melo, Luis Piardi, Marcos Vallim, and Paulo Leitao</i>	
Smart River Platform - River Quality Monitoring and Environmental Awareness . . . . .	463
<i>Kenedy P. Cabanga, Edmilson V. Soares, Lucas C. Viveiros, Estefânia Gonçalves, Ivone Fachada, José Lima, and Ana I. Pereira</i>	
<b>Health Informatics</b>	
Analysis of the Middle and Long Latency ERP Components in Schizophrenia . . . . .	477
<i>Miguel Rocha e Costa, Felipe Teixeira, and João Paulo Teixeira</i>	
Feature Selection Optimization for Breast Cancer Diagnosis . . . . .	492
<i>Ana Rita Antunes, Marina A. Matos, Lino A. Costa, Ana Maria A. C. Rocha, and Ana Cristina Braga</i>	
Cluster Analysis for Breast Cancer Patterns Identification . . . . .	507
<i>Beatriz Flamia Azevedo, Filipe Alves, Ana Maria A. C. Rocha, and Ana I. Pereira</i>	
Overview of Robotic Based System for Rehabilitation and Healthcare . . . . .	515
<i>Arezki A. Chellal, José Lima, Florbela P. Fernandes, José Gonçalves, Maria F. Pacheco, and Fernando C. Monteiro</i>	
Understanding Health Care Access in Higher Education Students . . . . .	531
<i>Filipe J. A. Vaz, Clara B. Vaz, and Luís C. D. Cadinha</i>	

Using Natural Language Processing for Phishing Detection .....	540
<i>Richard Adolph Aires Jonker, Roshan Poudel, Tiago Pedrosa,     and Rui Pedro Lopes</i>	

## Data Analysis

A Panel Data Analysis of the Electric Mobility Deployment in the European Union .....	555
<i>Sarah B. Gruetzmacher, Clara B. Vaz, and Ângela P. Ferreira</i>	
Data Analysis of Workplace Accidents - A Case Study .....	571
<i>Inês P. Sena, João Braun, and Ana I. Pereira</i>	
Application of Benford's Law to the Tourism Demand: The Case of the Island of Sal, Cape Verde .....	587
<i>Gilberto A. Neves, Catarina S. Nunes, and Paula Odete Fernandes</i>	
Volunteering Motivations in Humanitarian Logistics: A Case Study in the Food Bank of Viana do Castelo .....	599
<i>Ana Rita Vasconcelos, Ângela Silva, and Helena Sofia Rodrigues</i>	
Occupational Behaviour Study in the Retail Sector .....	617
<i>Inês P. Sena, Florbela P. Fernandes, Maria F. Pacheco,     Abel A. C. Pires, Jaime P. Maia, and Ana I. Pereira</i>	
A Scalable, Real-Time Packet Capturing Solution .....	630
<i>Rafael Oliveira, João P. Almeida, Isabel Praça, Rui Pedro Lopes,     and Tiago Pedrosa</i>	

## Trends in Engineering Education

Assessing Gamification Effectiveness in Education Through Analytics .....	641
<i>Zornitsa Yordanova</i>	
Real Airplane Cockpit Development Applied to Engineering Education: A Project Based Learning Approach .....	649
<i>José Carvalho, André Mendes, Thadeu Brito, and José Lima</i>	
Azbot-1C: An Educational Robot Prototype for Learning Mathematical Concepts .....	657
<i>Francisco Pedro, José Cascalho, Paulo Medeiros, Paulo Novo,     Matthias Funk, Albeto Ramos, Armando Mendes, and José Lima</i>	

Towards Distance Teaching: A Remote Laboratory Approach for Modbus and IoT Experiencing .....	670
<i>José Carvalho, André Mendes, Thadeu Brito, and José Lima</i>	
Evaluation of Soft Skills Through Educational Testbed 4.0 .....	678
<i>Leonardo Breno Pessoa da Silva, Bernardo Perrota Barreto, Joseane Pontes, Fernanda Tavares Treinta, Luis Mauricio Martins de Resende, and Rui Tadashi Yoshino</i>	
Collaborative Learning Platform Using Learning Optimized Algorithms .....	691
<i>Beatriz Flamia Azevedo, Yahia Amoura, Gauhar Kantayeva, Maria F. Pacheco, Ana I. Pereira, and Florbela P. Fernandes</i>	
<b>Author Index .....</b>	<b>703</b>