OL2A INTERNATIONAL CONFERENCE 2021

OPTIMIZATION • LEARNING • ALGORITHMS • APPLICATIONS

International Conference on Optimization, Learning Algorithms and Applications

BOOK OF ABSTRACTS

Instituto Politécnico de Bragança
July 19-21, 2021

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International Conference on Optimization, Learning Algorithms and Applications

OL2A'2021

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Welcome

Welcome to OL2A 2021 - International Conference on Optimization, Learning Algorithms and Applications.

OL2A offers a forum for the research community on optimization and learning to get together and share the latest developments and techniques as well as develop new paths and collaborations.

OL2A provides a wide scope of presentations, covering many areas of optimization and learning and state of the art applications to multi-objective optimization, optimization for machine learning, machine learning for optimization, optimization and learning under uncertainty and 4th industrial revolution.

It is with great pleasure that the Organizing Committee welcomes you all to OL2A 2021!

The OL2A'2021 organization committee,

Ana Isabel Pereira, Florbela Fernandes, João Paulo Coelho, João Paulo Teixeira, Maria Pacheco, Paulo Alves and Rui Lopes

Contents

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Invited Plenary Lectures

On global optimization aspects of machine learning

Prof. Eligius M.T. Hendrix

Short Bio: Eligius M.T. Hendrix is a European scientist with more than 35 years of experience in mathematical modelling and optimization algorithms. His research focuses on exploiting mathematical structure of optimization problems in order to derive novel specific algorithms that can be implemented on modern computer platforms. Most of his work was related practical problems in environmental and food science. Among others he developed a new method on unmixing data from hyperspectral data and is interested in data selection of training sets for Deep learning on those data from the point of view of design of experiments. Moreover, his studies enhance logistics, inventory control, competitive location problems, production scheduling, traffic control, minimizing the size of search trees, fisheries quota determination, offshore wind farm maintenance, pooling, water control, food supply chains, coalition formation, deforestation, economic behaviour, design of experiments, permit trading, biomass production, fodder production, farm management and plague control. He published more than 85 journal articles and several books and organized international conferences. He is affiliated with the Universidad de Málaga.

Abstract: Machine Learning of predictive and classification models is considered by many researchers as optimization problems. Traditional gradient views implemented in learning algorithms may suffer from effective convergence pushing researchers to go for evolutionary algorithms. We focus on the characterization of the underlying optimization landscape and pose some questions on the effectiveness of algorithms. We look at parameter estimation, ill conditioning, parameter identification and symmetry leading to infinitely many parametrizations providing similar performance, also called over-parametrization in deep learning. We use several small instances to showcase the underlying difficulties.

AI's new clothes: challenges and needs

Prof. Ernesto Costa

Short Bio: Ernesto Costa is Full Professor at the Department of Informatics Engineering of the University of Coimbra. He received a 3rd Cycle Thesis in Computing Science from the University Pierre et Marie Curie (Paris, France) in 1981 and got a Ph.D. in Electronic Engineering (area of Computing Science) from the University of Coimbra (Coimbra, Portugal) in 1985. Over the years he assumed several leader roles at the University, e.g., president of the Department of Informatics Engineering, Director of CISUC's research centre, member of the General Council — a governing board of the university. Currently he is member of the Institute of Interdisciplinary Research of the University of Coimbra. His main research interests are in the areas of Evolutionary Computation, Artificial Life, Complex Systems, Machine Learning, Cognition and Computational Biology. In particular, we work in bio-inspired artificial intelligence, developing novel algorithms and applying them to design, optimization and learning problems, and promoting the cross-fertilization of Evolutionary Computation and Machine Learning. He was the founder and leader of the Artificial Intelligence Group and of the Evolutionary and Complex Systems Group, both within the CISUC research centre. He participated and is currently involved in several projects, national and international and got several best paper awards. He was the recipient of the 2009 EvoStar Award for Outstanding Contributions to the Field of Evolutionary Computation. He organized several international scientific events and had published over 200 peer reviewed works in books, journals and proceedings of conferences.

Abstract: Artificial Intelligence is again on the rise. A strong reason for that is the appearance of new machine learning approaches fueled by the emergence of huge amounts of data and powerful computers. In this talk, we will describe this new AI and will discuss some of the challenges that we face, without forgetting the technical and social problems raised by machine learning. In particular, we will explain how evolutionary computation may help to solve the major problems we face when we have to design a machine learning architecture. We will also discus the issue of designing ethical learning machines.

Special Sessions

TiEE – Trends in Engineering Education

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Description: The world is changing. Constant technological advances allow for different approaches to teaching. Since Science (e.g. Mathematics, Physics) is a core subject in engineering courses, we intend to highlight new approaches in its teaching for engineering students. Moreover, we also want to emphasize other teaching approaches that are somehow related to engineering. Technological advances and sometimes world problems (e.g. COVID-19 causing distance learning to be mandatory) induce us towards new methodologies and new trends, particularly in the area of education. Thus, this session focuses on learning algorithms applied to the field of education, e-learning platforms, blended learning, among others. Applications to mathematics and engineering education will also be considered.

Topics: Learning algorithms applied in education; intelligent systems for education.

OCSD - Optimization in Control Systems Design

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Description: Optimization is currently applied to a myriad of different knowledge areas that span from economic applications to social sciences. In the control engineering framework, optimization plays a fundamental role in several design strategies such as predictive, fuzzy, decentralised and optimum control among many, many more. Moreover, due to the increased tendency of integrating soft-computing techniques into control loops, and since those methods frequently rely on optimization algorithms in order to be able to learn, adapt and react, optimization is fundamentally ubiquitous in the control engineering realm. Since many researchers are working in this area, it is fundamental to provide a vehicle for them to present their results and to foster a place where discussion regarding the use of optimization techniques in control can take place. In this framework, OL2A includes this special session which can be used as a stage for researchers and engineers to present their work regarding new methods and practical applications of optimization in control engineering.

Topics: Control systems design; optimization.

MIoT - Measurements with the Internet of Things

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Description: In recent years, data acquisition and processing have become powerful tools for understanding the world around us. IoT plays and important topic in the digital transformation process to connect physical and digital worlds.

The different applications of the Internet of Things provide measurement resources to achieve this goal.

The objective of this special session is to open a discussion forum that allows experts and potential end-users of the IoT application to share recent developments, challenges and current and new research trends. The special session will provide the common ground in terms of what was brought by research in the last years and what are the challenges not only but also on IoT, WSN, acquisition modules and intelligent sensors.

In this context, this session will exhibit the newest advances in the area through the most several sensors combined learning and optimisations strategies.

Topics: Internet of Things (IoT); wireless sensors network (WSN); node/module sensors; smart/intelligent sensors; algorithms.

DVVR - Data Visualization and Virtual Reality

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Description: The search for simulated experiences that could be similar to or completely different from the real world have been a constant struggle of research and industry. Taking advantage of the stereoscopic vision that characterises humans, the possibility to project different scenarios in each eye allows the creation of environments that give the feeling of depth and space. The association with special sensors that give precise orientation and location of the head of the viewer allows to adapt the projection to follow the user's gaze, allowing free exploration of virtual scenarios with a feeling of reality. The assembly of these in a Head Mounted Display provides the main interface with a virtual reality, allowing the creation of both physical world simulations and otherwise inaccessible settings, such as the inside of a vulcano or the void of space. On the other hand, portable devices such as smartphones or tablets, together with an embedded camera, allows to superimpose virtual elements in a perspective of the real world, leading to an information augmented reality. These two technologies pave the way for uncountable applications, that range from the medical area to the education. Both virtual reality and augmented reality can bring new experiences and new tools that allows better training of professionals and better understanding of events. The Data Visualisation and Virtual Reality track of the OL2A builds on this, providing a context for discussion and advances in these areas.

Topics: Data visualization; virtual reality; 3D elements; interactive scenarios.

Abstracts

A Look-Ahead Based Meta-Heuristics for Optimizing Continuous Optimization Problems

Thomas Nordli and Noureddine Bouhmala

University of SouthEast Norway, Norway

In this paper, the famous kernighan-Lin algorithm used for the graph partitioning problem is adjusted and embedded into simulated annealing algorithm and genetic algorithm for continuous optimization problems. The performance of the different algorithms are evaluated using a set of well known optimization test functions.

Inverse Optimization for Warehouse Management

Hannu Rummukainen

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Day-to-day operations in industry are often planned in an ad-hoc manner by managers, instead of being automated with the aid of mathematical optimization. To develop operational optimization tools, it would be useful to automatically learn management policies from data about the actual decisions made in production. The goal of this study was to investigate the suitability of inverse optimization for automating warehouse management on the basis of demonstration data. The management decisions concerned the location assignment of incoming packages, considering transport mode, classification of goods, and congestion in warehouse stocking and picking activities. A mixed-integer optimization model and a column generation procedure were formulated, and an inverse optimization method was applied to estimate an objective function from demonstration data. The estimated objective function was used in a practical rolling horizon procedure. The method was implemented and tested on real-world data from an export goods warehouse of a container port. The computational experiments indicated that the inverse optimization method, combined with the rolling horizon procedure, was able to mimic the demonstrated policy at a coarse level on the training data set and on a separate test data set, but there were substantial differences in the details of the location assignment decisions.

Predicting Canine Hip Dysplasia in X-ray Images using Deep Learning

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

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Convolutional neural networks (CNN) and transfer learning are receiving a lot of attention because of the positive results achieved on image recognition and classification. Hip dysplasia is the most prevalent hereditary orthopedic disease in the dog. The definitive diagnosis is using the hip radiographic image. This article compares the results of the conventional canine hip dysplasia (CHD) classification by a radiologist using the Fédération Cynologique Internationale criteria and the computer image classification using the Inception-V3, Google's pre-trained CNN, combined with the transfer learning technique. The experiment's goal was to measure the accuracy of the model on classifying normal and abnormal images, using a small dataset to train the model. The results were satisfactory considering that, the developed model classified 75% of the analyzed images correctly. However, some improvements are desired and could be achieved in future works by developing a software to select areas of interest from the hip joints and evaluating each hip individually.

Optimization of wind turbines placement in offshore wind farms: Wake effects concerns

José Baptista, Filipe Lima and Adelaide Cerveira

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In the coming years, many countries are going to bet on the exploitation of offshore wind energy. This is the case of southern European countries, where there is great wind potential for offshore exploitation. Although the conditions for energy production are more advantageous, all the costs involved are substantially higher when compared to onshore. It is, therefore, crucial to maximize system efficiency. In this paper, an optimization model based on a Mixed-Integer Linear Programming model is proposed to find the best wind turbines location in offshore wind farms taking into account the wake effect.A case study, concerning the design of an offshore wind farm, were carried out and several performance indicators were calculated and compared. The results show that the placement of the wind turbines diagonally presents better results for all performance indicators and corresponds to a lower percentage of energy production losses.

Economic burden of personal protective strategies for dengue disease: an optimal control approach

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

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Dengue fever is a vector-borne disease that is widely spread. It has a vast impact on the economy of countries, especially where the disease is endemic. The associated costs with the disease comprise prevention and treatment. This study focus on the impact of adopting individual behaviors to reduce mosquito bites - avoiding the disease's transmission - and their associated costs. An epidemiological model is presented with human and mosquito compartments, modeling the interaction of dengue disease. The model assumed some self-protection measures, namely the use of repellent in human skin, wear treated clothes with repellent, and sleep with treated bed nets. The household costs for these protections are taking into account to study their use. We conclude that personal protection could have an impact on the reduction of the infected individuals and the outbreak duration. The costs associated with the personal protection could represent a burden to the household budget, and its purchase could influence the shape of the infected's curve.

Volunteering motivations in humanitarian logistics: a case study in the Food Bank of Viana do Castelo

Ana Rita Vasconcelos, Ângela Silva and Helena Sofia Rodrigues

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The importance of humanitarian logistics has been increasing over time, caused by economic or family crises. Volunteering has a fundamental role at the Food Bank of Viana do Castelo, contributing to the quality of life improvement of disadvantaged families. This way is necessary to understand the motivations that determine to be a volunteer in this kind of entity, to improve the experience and at the same time, increase the number of people that could be potential volunteers. A questionnaire was prepared to determine the motivations that this volunteer experience allows to achieve, namely, the impact that the volunteer experience has on each person´s life. The results obtained show the existence of a positive association between the different dimensions of personal development, establishing ties, collaboration among other volunteers, and also acquiring professional skills with the experience of volunteering.

On the performance of the OrthoMads algorithm on continuous and mixed-integer optimization problems

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OrthoMads is an instantiation of the Mesh Adaptive Direct Search (MADS) algorithm used in derivative-free and blackbox optimization. We investigate the performance of the variants of OrthoMads on the bbob and bbob-mixint, respectively continuous and mixed-integer, testbeds of the COmparing Continuous Optimizers (COCO) platform and compare the considered best variants with heuristic and non-heuristic techniques. The results show a favourable performance of OrthoMads on the low-dimensional continuous problems used and advantages on the considered mixed-integer problems. Besides, a generally faster convergence is observed on all types of problems when the search phase of OrthoMads is enabled.

Assessing gamification effectiveness in education through analytics

Zornitsa Yordanova

University of National and World Economy, Sofia, 8mi dekemvri, Bulgaria

The study aims at identifying indicators for assessing the application of gam-ification in education and training, as it often remains immeasurable and therefore the whole process is insufficiently effective. The paper seeks in-sight into the further development of a web-based software analytics solution based on the evaluation measures identified and accumulated in this study through literature and content analyses. The applied methodology is a critical selection of those indicators for measuring the effectiveness of gamification in education, which are relevant for a wide range of educational areas and could answer the simple question of whether a gamification practice is or is not effective for use. The aim is to gain a common understanding of indica-tors that can be measured across many different organizations and goals after using gamification with simple and adaptive data models. The study bases the results and conclusions of some real experiments with university students and interns in business organizations. The results of the research can serve as a prerequisite for further development and implementation of analytics tool as well as to contribute to build an artificial intelligence-based solution for rapid assessment of new serious games in education.

ERP business speed: a measuring framework

Zornitsa Yordanova

University of National and World Economy, Sofia, 8mi dekemvri, Bulgaria

A major business concern nowadays is how adequate and appropriate the ERP system used is for the growing business needs, the ever-changing com-plexity of the business environment, the growing global competition and as a result - the growing business speed. The purpose of this research is to make a benchmark for an ERP system business speed (performance from business point of view), i.e. how fast the business operations executed are with the used ERP. A literature analysis is conducted for framing and defining the concept of ERP business speed as an important and crucial factor for busi-ness success. Then a measurement framework for testing ERP systems in terms of business operations and ERP business performance is proposed and tested. Metrics for measuring ERP business speed are defined by conducting focused interviews with experts in ERP implementation and maintenance. The measurement framework has been empirically tested in 6 business or-ganizations, first to validate the selected KPIs and second to formulate some average business speed indications of the KPIs as part of the business speed of ERP. The research contributes by providing a framework measurement tool for testing business speed of ERP systems. The study can also serve as a benchmark in further measuring of ERP business speed. From theory per-spective, this study provides a definition and an explanation of the term ERP business speed for the first time in the literature.

Sensor Fusion for Mobile Robot Localization using Extended Kalman Filter, UWB ToF and ArUco Markers

Sílvia Faria, José Lima and Paulo Costa

Faculty of Engineering, University of Porto, Porto, and Research Centre of Digitalization and Intelligent Robotics, Instituto Politécnico de Bragança, Portugal

The ability to locate a robot is one of the main features to be truly autonomous. Different methodologies can be used to determine robots location as accurately as possible, however these methodologies present several problems in some circumstances. One of these problems is the existence of uncertainty in the sensing of the robot. To solve this problem, it is necessary to combine the uncertain information correctly. In this way, it is possible to have a system that allows a more robust localization of the robot, more tolerant to failures and disturbances. This paper evaluates an Extended Kalman Filter (EKF) that fuses odometry information with Ultra-WideBand Time-of-Flight (UWB ToF) measurements and camera measurements from the detection of ArUco markers in the environment. The proposed system is validated in a real environment with a differential robot developed for this purpose, and the achieved results are promising.

Multiple mobile robots scheduling based on Simulated Annealing algorithm

Diogo Matos, Pedro Costa, José Lima and António Valente

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Task Scheduling assumes an integral topic in the efficiency of multiple mobile robots systems and is a key part in most modern manufacturing systems. Advances in the field of combinatorial optimisation have allowed the implementation of algorithms capable of solving the different variants of the vehicle routing problem in relation to different objectives. However few of this approaches are capable of taking into account the nuances associated with the coordinated path planning in multi-AGV systems. This paper presents a new study about the implementation of the Simulated Annealing algorithm to minimise the time and distance cost of executing a tasks set while taking into account possible pathing conflicts that may occur during the execution of the referred tasks. This implementation uses an estimation of the planned paths for the robots, provided by the Time Enhanced A* (TEA*) to determine where possible pathing conflicts occur and uses the Simulated Annealing algorithm to optimise the attribution of tasks to each robot, in order to minimise the pathing conflicts. Results are presented that validate the efficiency of this algorithm and compare it to an approach that does not take into account the estimation of the robots paths.

Real Airplane Cockpit development applied to Engineering Education: A project based learning approach

José Carvalho, André Mendes, Thadeu Brito and José Lima

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Engineering education, the process of teaching knowledge and principles to the professional practice of engineering, can be done by resorting to several methodologies. Project Based Learning is a teaching method that allows students to get knowledge and skills by developing and solving complex problems or challenges, supported by a supervisor. In the presented work, a real airplane cockpit development is used as a case study for Mechanical, Mechatronics, Electrical, and Computer Science courses. Students are encouraged to develop modules to be applied in the cockpit and further integrated with other ones.

A simulation tool for optimizing a 3D Spray Painting System

João Casanova, José Lima and Paulo Costa

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The lack of general robotics purposed, accurate open source simulators is a major setback that limits the optimized trajectory generation research and general evolution of the robotics field. Spray painting is a particular case that has multiple advantages in using a simulator for exploring new algorithms, mainly the waste of materials and the dangers associated with a robotic manipulator. This paper demonstrates an implementation of spray painting on a previously existing simulator, SimTwo. Several metrics for optimization that evaluate the painted result are also proposed. In order to validate the implementation, we conducted a real world experiment that serves both as proof that the chosen spray distribution model translates to reality and as a way to calibrate the model parameters.

Deep Reinforcement Learning Applied to a Robotic Pick-and-Place Application

Natanael Magno Gomes, Felipe N. Martins, José Lima and Heinrich Wörtche

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Industrial robot manipulators are widely used for repetitive applications that require high precision, like pick-and-place. In many cases, the movements of industrial robot manipulators are hard-coded or manually defined, and need to be adjusted if the objects being manipulated change position. To increase flexibility, an industrial robot should be able to adjust its configuration in order to grasp objects in variable/unknown positions. This can be achieved by off-the-shelf vision-based solutions, but most require prior knowledge about each object to be manipulated. To address this issue, this work presents a ROS-based deep reinforcement learning solution to robotic grasping for a Collaborative Robot (Cobot) using a depth camera. The solution uses deep Q-learning to process the color and depth images and generate a ϵ-greedy policy used to define the robot action. The Q-values are estimated using Convolutional Neural Network (CNN) based on pre-trained models for feature extraction. Experiments were carried out in a simulated environment to compare the performance of four different pre-trained CNN models (RexNext, MobileNet, MNASNet and DenseNet). Results show that the best performance in our application was reached by MobileNet, with an average of 84% accuracy after training in simulated environment.

BELBIC based step-down controller design using PSO

João Paulo Coelho, Manuel Braz-César and José Gonçalves

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This article presents a comparison between a common type III controller and one based on a brain emotional learning paradigm (BELBIC) parameterized using a particle swarm optimization algorithm (PSO). Both strategies were evaluated regarding the set-point accuracy, disturbances rejection ability and control effort of a DC-DC buck converter. The simulation results suggests that, when compared to the common controller, the BELBIC leads to an increase in both set-point tracking and disturbances rejection ability while reducing the dynamics of the control signal.

Model-agnostic multi-objective approach for the evolutionary discovery of mathematical models

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In modern data science, it is often not enough to obtain only a data-driven model with a good prediction quality. On the contrary, it is more interesting to understand the properties of the model, which parts could be replaced to obtain better results. Such questions are unified under machine learning interpretability questions, which could be considered one of the area's raising topics. In the paper, we use multi-objective evolutionary optimization for composite data-driven model learning to obtain the algorithm's desired properties. It means that whereas one of the apparent objectives is precision, the other could be chosen as the complexity of the model, robustness, and many others. The method application is shown on examples of multi-objective learning of composite models, differential equations, and closed-form algebraic expressions are unified and form approach for model-agnostic learning of the interpretable models.

Human Detector Smart Sensor for Autonomous Disinfection Mobile Robot

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The COVID-19 virus outbreak led to the need of developing smart disinfection systems, not only to protect the people that usually frequent public spaces but also to protect those who have to subject themselves to the contaminated areas. In this paper it is developed a human detector smart sensor for autonomous disinfection mobile robot that use Ultra Violet C type light for the disinfection task and stops the disinfection system when a human is detected around the robot in all directions. UVC light is dangerous for humans and thus the need for a human detection system that will protect them by disabling the disinfection process, as soon as a person is detected. This system uses a Raspberry Pi Camera with a Single Shot Detector (SSD) Mobilenet neural network to identify and detect persons. It also has a FLIR 3.5 Thermal camera that measures temperatures that are used to detect humans when within a certain range of temperatures. The normal human skin temperature is the reference value for the range definition. The results show that the fusion of both sensors data improves the system performance, compared to when the sensors are used individually. One of the tests performed proves that the system is able to distinguish a person in a picture from a real person by fusing the thermal camera and the visible light camera data. The detection results validate the proposed system.

Multi AGV Industrial Supervisory System

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Automated guided vehicles (AGV) represent a key element in industries' intralogistics and the use of AGV fleets bring multiple advantages. Nevertheless, coordinating a fleet of AGV is already a complex task but when exposed to delays in the trajectory and communication faults it can represent a threat, compromising the safety, productivity and efficiency of these systems. Concerning this matter, trajectory planning algorithms allied with supervisory systems have been studied and developed. This article aims to, based on work developed previously, implement and test a Multi AGV Supervisory System on real robots and analyse how the system responds to the dynamic of a real environment, analysing its intervention, what influences it and how the execution time is affected.

Artificial Intelligence architecture based on planar LiDAR scan data to detect energy pylon structures in a UAV autonomous detailed inspection process

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The technological advances in Unmanned Aerial Vehicles (UAV) related to energy power structure inspection are gaining visibility in the past decade, due to the advantages of this technique compared with traditional inspection methods. In the particular case of power pylon structure and components, autonomous UAV inspection architectures are able to increase the efficacy and security of these tasks. This kind of application presents technical challenges that must be faced to build real-world solutions, especially the precise positioning and path following for the UAV during a mission. This paper aims to evaluate a novel architecture applied to a power line pylon inspection process, based on the machine learning techniques to process and identify the signal obtained from a UAV-embedded planar Light Detection and Ranging - LiDAR sensor. A simulated environment built on the GAZEBO software presents a first evaluation of the architecture. The results show an positive detection accuracy level superior to 97% using the vertical scan data and 70% using the horizontal scan data. This accuracy level indicates that the proposed architecture is proper for the development of positioning algorithms based on the LiDAR scan data of a power pylon.

Overview of Robotic Based System for Rehabilitation and Healthcare

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As in many other fields, robots are increasingly being used in the healthcare sector, particularly for hospital logistics support, surgery and rehabilitation. Rehabilitation is a concern for millions of people around the world, and because of this, there has been a constant progress over the last decade in the rehabilitation robotics field, with the use of new technologies aimed at overcoming the different challenges faced in this field. In this sense, this paper reviews the main applications developed in the last ten years of rehabilitation robotics, as well as the different challenges that still need to be addressed in order to achieve the design of a prototype that is easy to use, small, safe, less costly and brings real added value to this field. Much of the efforts of the researchers in this topics is focused on providing as many DOF and ROM as possible, and also on the designing of new robots control algorithms.

Robotic Welding Optimization using A* Parallel Path Planning

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The world of robotics is in constant evolution, trying to find new solutions to improve on top of the current technology and to overcome the current industrial pitfalls. To date, one of the key intelligent robotics components, path planning algorithms, lack exibility when considering dynamic constraints on the surrounding work cell. This is mainly related to the large amount of time required to generate safe collision-free paths for high redundancy systems. Furthermore, and despite the already known benefits, the adoption of CPU/GPU parallel solutions is still lacking in the robotic field. This work presents a software solution able of connecting the path planning algorithms with parallel computing tools, reducing the time needed to generate a safe path. The output of this work is the validation for the introduction of intelligent parallel solutions in the robotic sector.

Dual Coulomb Counting Extended Kalman Filter for Battery SOC Determination

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The importance of energy storage continues to grow, whether in power generation, consumer electronics, aviation, or other systems. Therefore, energy management in batteries is becoming an increasingly crucial aspect of optimizing the overall system and must be done properly. Very few works have been found in the literature proposing the implementation of algorithms such as Extended Kalman Filter (EKF) to predict the State of Charge (SOC) in small systems such as mobile robots, where in some applications the computational power is severely lacking. To this end, this work proposes an implementation of the two algorithms mainly reported in the literature for SOC estimation, in an ATMEGA328P microcontroller-based BMS. This embedded system is designed taking into consideration the criteria already defined for such a system and adding the aspect of flexibility and ease of implementation with an average error of 5 % and an energy efficiency of 94 %. One of the implemented algorithms performs the prediction while the other will be responsible for the monitoring.

Using Natural Language Processing for Phishing Detection

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We live in a world where computers are constantly changing the way we do things. People spend many hours on their phones or computers, whether it be for work or leisure purposes. The danger is that these unsuspecting users can be targeted for attacks at any time and can fall victim to many types of scams or phishing attacks. These attacks can be harmful to the user by getting valuable credentials, money or even installing malicious software on their devices, all while the user is unaware of what has just happened. In a business environment these can lead to mass data breeches which could end up costing a company millions of euros. Many users are not trained to recognize phishing texts, so an alternative solution is needed to help prevent users from falling into these traps. In this paper we will be investigating Natural Language Processing (NLP), a subsection of Machine Learning (ML) to try generate solutions to the problem of phishing. We will investigating different NLP solutions: Word2Vec, Doc2Vec and BERT, and different ML solutions: RNN, LSTM, CNN and TD-IDF. All of these different approaches provide good classification results ranging from f1-scores of 90.03 - 98.94.

An IoT approach for animals tracking

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Pastoral activities bring several benefits to the ecosystem and rural communities. These activities are already carried out daily with goats, cows and sheep in Portugal. Still, they could be better applied to take advantage of their benefits. Most of these pastoral ecosystem services are not remunerated, indicating a lack of making these activities more attractive to bring returns to shepherds, breeders and landowners. The monitoring of these activities provides data to value these services, besides being able to indicate directly to the shepherds' routes to drive their flocks and the respective return. There are devices in the market that perform this monitoring, but they are not adaptable to the circumstances and challenges required in the Northeast of Portugal. This work addresses a system to perform animals tracking, and the development of a test platform, through long-range technologies for transmission using LoRaWAN architecture. The results demonstrated the use of LoRaWAN in tracking services, allowing to conclude about the viability of the proposed methodology and the direction for future works.

Optimizing data transmission in a Wireless Sensor Network based on LoRaWAN protocol

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Internet of Things, IoT, is a promising methodology that has been increasing over the last years. It can be used to allow the connection and exchange data with other devices and systems over the Internet. One of the IoT connection protocols is the LoRaWAN, which has several advantages but has a low bandwidth and limited data transfer. There is a necessity of optimising the data transfer between devices. Some sensors have a 10 or 12 bits resolution, while LoRaWAN owns 8 bits or multiples slots of transmission remaining unused bits. This paper addresses a communication optimisation for wireless sensors resorting to encoding and decoding procedures. This approach is applied and validated on the real scenario of a wildfire detection system.

Application of Benford's Law to the Tourism Demand: the Case of the Island of Sal, Cape Verde

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This article presents Benford's Law applied for the first time to the tourism context, focusing on tourism demand. This law states that in sets of random numbers of natural events, the probability of the first digit of these numbers being 1 is approximately 30%, of being 2 is 18%, and so on, until reaching 9 with 4.6% probability. In this context, the objective is to verify if Benford's Law applies to the monthly numbers of overnight stays registered in the accommodation establishments of the Island of Sal, in the period between 2000 and 2018, to test the data reliability. This research focus on data provided by the National Statistics Institute of Cape Verde. The Chi-Square test (χ^2) was used to assess the discrepancy between the observed and expected relative frequencies. The results show that the observed χ^2 value is higher than the χ^2 critical value (5% significance level), meaning that the number of monthly overnight stays recorded in accommodation establishments on the Island of Sal does not follow Benford's Law. However, certain possible data disturbances must be considered, such as the occurrence of specific events during that time period. Other factors that could influence the results are the size of the data set and a sub notification in the data collection process. These circumstances may be the cause of the non-adaptation of the number of overnight stays to Benford's Law. The implication of this fact on the estimation of tourism demand is crucial for the development and optimization of prediction models.

Towards distance teaching: a remote laboratory approach for modbus and IoT experiencing

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Remote laboratories are of extraordinary importance for students that cannot attend classroom lessons. Once Automation and industrial networks are topics of electrical engineering that should be studied and experimented with by students in a practical way, this paper presents a developed tool that students can use to access the laboratory equipment from outside. It has as an advantage the capacity of handling several students simultaneously, and it is accessible 24 hours per day and 7 days per week. The proposed tool also allows students in the classroom to interact with the system. With this proposed tool, connections between Programmable Logic Controllers (PLC) with supervision and control of high-level systems such as LabVIEW IDE are possible to program and test. The hardware implementation in the laboratory can be accessed by students to control illumination, heating and window shutter, and sensors to acquire wind speed, temperature, humidity, and CO2, as examples.

Leaf-Based Species Recognition using Convolutional Neural Networks

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Identifying plant species is an important activity in specie control and preservation. The identification process is carried out mainly by botanists, consisting of a comparison of already known specimens or using the aid of books, manuals or identification keys. Artificial Neural Networks have been shown to perform well in classification problems and are a suitable approach for species identification. This work uses Convolutional Neural Networks to classify tree species by leaf images. In total, 29 species were collected. This work analyzed two network models, Darknet-19 and GoogLeNet (Inception-v3), presenting a comparison between them. The Darknet and GoogLeNet models achieved recognition rates of 86.2% and 90.3%, respectively.

Indoor Location Estimation Based on Diffused Beacon Network

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This work investigates the problem of location estimation in indoor Wireless Sensor Networks (WSN) where precise, discrete and low-cost independent self-location is a critical requirement. The indoor scenario makes explicit measurements based on specialised location hardware, such as the Global Navigation Satellite System (GNSS), difficult and not practical, because RF signals are subjected to many propagation issues (reflections, absorption, etc.). In this paper, we propose a low-cost effective WSN location solution. Its design uses received signal strength for ranging, lightweight distributed algorithms for location computation, and the collaborative approach to delivering accurate location estimations with a low number of nodes in predefined locations. Through real experiments, our proposal was evaluated and its performance compared with other related mechanisms from literature, which shows its suitability and its lower average location error almost of the time.

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

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The use of mechanisms based on artificial intelligence techniques to perform dynamic learning has received much attention recently and has been applied in solving many problems. However, the convergence analysis of these mechanisms does not always receive the same attention. In this paper, the convergence of the mechanism using reinforcement learning to determine the channel detection sequence in a multi-channel, multi-user radio network is discussed and, through simulations, recommendations are presented for the proper choice of the learning parameter set to improve the overall reward. Then, applying the related set of parameters to the problem, the mechanism is compared to other intuitive sorting mechanisms.

Azbot-1C: An educational robot prototype for learning mathematical concepts

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Nowadays, educational robotics is part of the learning activities in many K-12 schools. With the increasing interest in Computer Thinking education and acknowledging the importance of using tangible devices, many different educational robots for primary education have become available. With them, new research activities bring about new results concerning the use of robots in classes and how they can improve learning in STEAM areas. In this paper, a prototype of a new robot for primary school is presented. It has similar features to many other robots used in early school years (e.g. easy robot's interface and one or two sensors, motor actuators), but with the advantage of having a low cost, being a do-it-yourself (DIY) kit and including a participation strategy, clarifying some of the learning targets, addressing the concept of alignment in learning activities.

Optimization of Glottal Onset Peak Detection Algorithm For Accurate Jitter Measurement

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Jitter is an acoustic parameter used as input for intelligent systems for the diagnosis of speech related pathologies. This work has the objective to improve an algorithm that allows to extract vocal parameters, and thus improve the accuracy measurement of absolute jitter parameter. Some signals were analyzed, where signal to signal was compared in order to try to understand why the values are different in some signal between the original algorithm and the reference software. In this way, some problems were found that allowed to adjust the algorithm, and improve the measurement accuracy for those signals. Subsequently, a comparative analysis was performed between the values of the original algorithm, the adjusted algorithm and the Praat software (assumed as reference). By comparing the results, it was concluded that the adjusted algorithm allows the extraction of the absolute jitter with values closer to the reference values for several speech signals. For the analysis, sustained vowels of control and pathological subjects were used.

Deep Learning Recognition of a Large Number of Pollen Grain Types

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Pollen in honey reflects its botanical origin and melissopalynology is used to identify origin, type and quantities of pollen grains of the botanical species visited by bees. Automatic pollen counting and classification can alleviate the problems of manual categorisation such as subjectivity and time constraints. Despite the efforts made during the last decades, the manual classification process is still predominant. One of the reasons for that is the small number of types usually used in previous studies. In this paper, we present a large study to automatically identify pollen grains using nine state-of-the-art CNN techniques applied to the recently published POLEN73S image dataset. We observe that existing published approaches used original images without study the possible biased recognition due to pollen's background colour or using preprocessing techniques. Our proposal manages to classify up to 97.4% of the samples from the dataset with 73 different types of pollen. This result, which surpasses previous attempts in number and difficulty of pollen types under consideration, is an important step towards fully automatic pollen recognition, even with a large number of pollen grain types.

Evaluation of Soft Skills Through Educational Testbed 4.0

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Industry 4.0 is promoting changes in the labour market through the need for digitalization. As a result, new skills, new job profiles and training programs need to follow this transformation, as these technological trends are affecting the work profiles and skills required by the workforce for Industry 4.0. To develop the workforce of the future, specifically soft skills for industry 4.0, it is necessary to have innovative teaching methodologies for workforce training, which encourages the development of specific soft skills for industry 4.0 of the workforce. With this in mind, this work aims to evaluate the development of soft skills through the Educational Testbed 4.0 teaching methodology in bachelor students at a Brazilian university. The proposed model was illustrated that the development of teamwork, communication and creativity were developed, improved and enhanced from the training program, provided from course inserted in the university program. In addition to checking important issues for the students who attended the course, including teamwork, contact with the labour market, real problem solving, among other issues encoded using Software QSR Nvivo® version 10, 90% to 95% of the respondents agreed that teamwork and communication were the soft skills most developed and used during the course or training program.

Approaches to classify knee osteoarthritis using biomechanical data

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Knee osteoarthritis (KOA) is a degenerative disease that mainly affects the elderly. The development of this disease is associated with a complex set of factors that cause abnormalities in motor functions. The purpose of this review is to understand the composition of works that combine biomechanical data and machine learning techniques to classify KOA progress. This study was based on research articles found in the search engines Scopus and PubMed between January 2010 and April 2021. The results were divided into data acquisition, feature engineering, and algorithms to synthesize the discovered content. Several approaches have been found for KOA classification with significant accuracy, with an average of 86% overall and three papers reaching 100%; that is, they did not fail once in their tests. The acquisition of data proved to be the divergent task between the works, the most considerable correlation in this stage was the use of the ground reaction force (GRF) sensor. Although three studies reached 100% in the classification, two did not use a gradual evaluation scale, classifying between KOA or healthy individuals. Thus, we can get out of this work that machine learning techniques are promising for identifying KOA using biomechanical data. However, the classification of pathological stages is a complex problem to discuss, mainly due to the difficult access and lack of standardization in data acquisition.

A scalable, real-time packet capturing solution

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The evolution of technology and the increasing connectivity between devices lead to an increased risk of cyberattacks. Good protection systems,such as Intrusion Detection System (IDS) and Intrusion Prevention System (IPS), are essential in trying to prevent, detect and counter most of the attacks. However, the increasing creativity and type of attacks raise the need for more resources and processing power for the protection systems which, in turn, requires horizontal scalability to keep up with the massive companies' network infrastructure and with the complexity of attacks. Technologies like machine learning, show promising results and can be of added value in the detection and prevention of attacks in real-time. But good algorithms and tools are not enough. They require reliable and solid datasets to be able to effectively train the protection systems. The development of a good dataset requires horizontal-scalable, robust, modular and fault-tolerance systems, so that the analyses may be done also in real-time. This paper describes an architecture for horizontal-scaling capture architecture, able to collect packets from multiple sources and prepared for real-time analysis. It depends on multiple modular nodes with specific roles to support different algorithms and tools.

Analysis of the Middle and Long Latency ERP Components in Schizophrenia

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Schizophrenia is a complex and disabling mental disorder estimated to affect 21 million people worldwide. Electroencephalography (EEG) has proven to be an excellent tool to improve and aid the current diagnosis of mental dis-orders such as schizophrenia. The illness is comprised of various disabilities associated with sensory processing and perception. In this work, the first 10-200ms of brain activity after the self-generation via button presses (condition 1) and passive presentation (condition 2) of auditory stimuli was addressed. A time-domain analysis of the event-related potentials (ERPs), specifically the MLAEP, N1, and P2 components, was conducted on 49 schizophrenic patients (SZ) and 32 healthy controls (HC), provided by a public dataset. The amplitudes, latencies, and scalp distribution of the peaks were used to com-pare groups. Suppression, measured as the difference between both condi-tions' neural activity, was also evaluated. With the exception of the N1 peak during condition (1), patients exhibited significantly reduced amplitudes in all waveforms analyzed in both conditions. The SZ group also demonstrated a peak delay in the MLAEP during condition (2) and a modestly earlier P2 peak during condition (1). Furthermore, patients exhibited less and more N1 and P2 suppression, respectively. Finally, the spatial distribution of activity in the scalp during the MLAEP peak in both conditions, N1 peak in condition (1) and N1 suppression differed considerably between groups. These find-ings and measurements will be used with the finality of developing an intelligent system capable of accurately diagnosing schizophrenia.

Feature Selection Optimization for Breast Cancer Diagnosis

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Cancer is one of the leading causes of death in the world, which has increased over the past few years. This disease can be classified as benign or malignant. One of the first and most common cancers that appear in the human body is breast cancer, which, as the name implies, appears in the breast regardless of the person's gender. Machine learning has been widely used to assist in the diagnosis of breast cancer. In this work, feature selection and multi-objective optimization are applied to the Breast Cancer Wisconsin Diagnostic dataset. It is intended to identify the most relevant characteristics to classify whether the diagnosis is benign or malignant. Two classifiers will be used in the feature selection task, one based on neural networks and the other on support vector machine. The objective functions to be used in the optimization process are to maximize sensitivity and specificity, simultaneously. A comparison was made between the techniques used and there was a better performance by neural networks.

Optimal Sizing of a Hybrid Energy System Based on Renewable Energy Using Evolutionary Optimization Algorithms

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The current trend in energy sustainability and the energy growing demand have given emergence to distributed hybrid energy systems based on renewable energy sources. This study proposes a strategy for the optimal sizing of an autonomous hybrid energy system integrating a photovoltaic park, a wind energy conversion, a diesel group, and a storage system. The problem is formulated as a uni-objective function subjected to economical and technical constraints, combined with evolutionary approaches mainly particle swarm optimization algorithm and genetic algorithm to determine the number of installation elements for a reduced system cost. The computational results have revealed an optimal configuration for the hybrid energy system.

A Simple Clustering Algorithm Based on Weighted Expected Distances

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This paper contains a proposal to assign points to clusters, represented by their centers, based on weighted expected distances in a cluster analysis context. The proposed clustering algorithm has mechanisms to create new clusters, to merge two nearby clusters and remove very small clusters, and to identify points 'noise' when they are beyond a reasonable neighborhood of a center or belong to a cluster with very few points. The presented clustering algorithm is evaluated using four randomly generated and two well-known data sets. The obtained clustering is compared to other clustering algorithms through the visualization of the clustering, the value of the DB validity measure and the value of the sum of within-cluster distances. The preliminary comparison of results shows that the proposed clustering algorithm is very efficient and effective.

Cluster Analysis for Breast Cancer Patterns Identification

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Safety in patient decision-making is one of the major health care challenges. Computational support in establishing diagnoses and preventing errors will contribute to an enhancement in doctor-patient communication. This work performs a three-dimensional cluster analysis, using k-means algorithm, to identify patterns in a breast cancer database. The methodology proposed can be useful to identify patterns in the database that are normally difficult to be noted by classical methods, such as statistical methods. The three-dimensional cluster approach was explored combining three variables at once. The k-means algorithm is used to recognize the hidden patterns on the database. Sub-clusters are used to separate the benign and malignant tumors inside the global cluster. The results present effective analyses of three different clusters based on different combinations between variables. Thus, health professionals can obtain a better understanding of the properties of different types of tumor, identifying the mined abstract tumor features, through the cluster data analysis.

Searching the Optimal Parameters of a 3D scanner through Particle Swarm Optimization

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The recent growth in the use of 3D printers by independent users has contributed to a rise in interest in 3D scanners. Current 3D scanning solutions are commonly expensive due to the inherent complexity of the process. A previously proposed low-cost scanner disregarded uncertainties intrinsic to the system, associated with the measurements, such as angles and offsets. This work considers an approach to estimate these optimal values that minimize the error during the acquisition. The Particle Swarm Optimization algorithm was used to obtain the parameters to optimally fit the final point cloud to the surfaces. Three tests were performed where the Particle Swarm Optimization successfully converged to zero, generating the optimal parameters, validating the proposed methodology.

Collaborative Learning Platform using Learning Optimized Algorithms

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Aware that the lack of mathematical knowledge and skills is a major problem for the development of a modern, inclusive and informed society, the MathE partnership has developed a tool that is aimed at bridging the gap that moves students away from courses that rely on a mathematical core. The MathE collaborative learning platform offers higher education students a package of scientific and pedagogical resources that allow them to be active agents in their learning pathway, by self-managing their study. The MathE platform is currently being used by a significant number of users, from all over the world, as a tool to support and engage students, ensuring new and creative ways to encourage them to improve their mathematical skills and therefore increasing their confidence and capacities. In order to enhance this platform, a visual representation of the performance of the students is already implemented, based on the recorded performance historic data for each student. This paper contains a literature review about the implementation of data mining techniques in education, followed by a description of the features of the MathE learning system and suggestions of data parameters to support the improvement of the students' performance. Future work includes the application of optimization and learning algorithms so that the MathE platform will have a dynamical structure and act as a virtual tutor for the users.

Understanding health care access in higher education students

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This study aims to evaluate the accessibility to healthcare by the higher education students and its determinants. A cross-sectional study was conducted in April 2018 by applying a questionnaire to 2051 students of the Polytechnic Institute of Bragança. Logistic regression models were used to identify the determinants that affect or hinder access to health care services in the city of Bragança. Among the main outcomes, the female students enrolled 4 to 12 months ago and the students who have chronic illness for those enrolled 13 to 24 months ago were associated with a greater need for access to health care. The nationality was associated with greater need and difficulty in accessing to health care. The inequities found with regard to foreign students should be debated in order to find solutions.

A panel data analysis of the electric mobility deployment in the European Union

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Governments all over the world have been promoting electric mobility as an effort to reduce the transport sector's greenhouse emissions and fossil fuel dependency. This work analyses the deployment of electric vehicles in the European Union countries, between 2015 and 2019, and the variables that may influence it, using a panel data methodology. The present work focuses on the deployment of battery and plug-in hybrid electric vehicles, individually and jointly. Nine explanatory variables were included in the model: density of recharging points, gross domestic product per capita, cumulative number of policies on electromobility, share of renewable energy in transport, greenhouse gas emissions from fuel combustion in road transport per capita, tertiary education attainment, electricity price, employment rate and new registrations of passenger cars per capita. The results showed that the indicators influence differently the deployment of the different types of electric vehicles. The most significant factor driving the battery electric vehicles deployment was the density of recharging points, while for plug-in hybrid electric vehicles was the share of renewable energy. Policy makers should focus on adjusting actions to the demand for the different types of electric vehicles.

Dynamic Response Surface Method combined with Genetic Algorithm to Optimize Extraction Process Problem

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This study aims to find and develop an appropriate optimization approach to reduce the time and labor employed throughout a given chemical process and could be decisive for quality management. In this context, this work presents a comparative study of two optimization approaches using real experimental data from the chemical engineering area, reported in a previous study [4].The first approach is based on the traditional response surface method and the second approach combines the response surface method with genetic algorithm and data mining. The main objective is to optimize the surface function based on three variables using hybrid genetic algorithms combined with cluster analysis to reduce the number of experiments and to find the closest value to the optimum within the established restrictions. The proposed strategy has proven to be promising since the optimal value was achieved without going through derivability unlike conventional methods, and fewer experiments were required to find the optimal solution in comparison to the previous work using the traditional response surface method.

Machine Vision to Empower an Intelligent Personal Assistant for Assembly Tasks

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In the context of the fourth industrial revolution, the integration of human operators in emergent cyber-physical systems assumes a crucial relevance. In this context, humans and machines can not be considered in an isolated manner but instead regarded as a collaborative and symbiotic team. Methodologies based on the use of intelligent assistants that guide human operators during the execution of their operations, taking advantage of user friendly interfaces, artificial intelligence (AI) and virtual reality (VR) technologies, become an interesting approach to industrial systems. This is particularly helpful in the execution of customised and/or complex assembly and maintenance operations. This paper presents the development of an intelligent personal assistant that empowers operators to perform faster and more cost-effectively their assembly operations. The developed approach considers ICT technologies, and particularly machine vision and image processing, to guide operators during the execution of their tasks, and particularly to verify the correctness of performed operations, contributing to increase productivity and efficiency, mainly in the assembly of complex products.

Occupational Behaviour Study in the Retail Sector

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The health, safety, and well-being of employees, service providers, and customers are important priorities for retail companies. Based on this principle, an intelligent system that contributes to the reduction of accidents at work will be developed, monitoring risk control, preventing work-related illnesses, promoting a culture of zero accidents, and seeking to ensure the health of employees, customers, and stakeholders. In order to achieve such goals, it is necessary to determine the local and global variables (internal and external) that feed the system. This study comprises the first strategy applied to collect the local variables involved in the problem. To obtain this, a data analysis study in a retail store was performed. Data analysis procedures were performed namely clustering analysis with algorithm k-means, correlation procedures, like Pearson coefficient and matrix of correlation, and relationship analysis with parallel coordinate graphs. From the preliminary results, it is possible to indicate a set of local variables that have influence in the occupational behavior and accidents at work.

Towards a High-Performance Implementation of the MCSFilter Optimization Algorithm

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Multistart Coordinate Search Filter (MCSFilter) is an optimization method suitable to find all minimizers – both local and global – of a non convex problem, with simple bounds or more generic constraints. Like many other optimization algorithms, it may be used in industrial contexts, where execution time may be critical in order to keep a production process within safe and expected bounds. MCSFilter was first implemented in MATLAB and later in Java (which introduced a significant performance gain). In this work, a comparison is made between these two implementations and a novel one in C that aims at further performance improvements. For the comparison, the problems addressed are bound constraint, with small dimension (between 2 and 10) and multiple local and global solutions. It is possible to conclude that the average time execution for each problem is considerable smaller when using the Java and C implementations, and that the current C implementation, though not yet fully optimized, already exhibits a significant speedup.

SMACovid-19 – Autonomous Monitoring System for Covid-19

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The SMACovid-19 project aims to develop an innovative solution for users to monitor their health status, alerting health professionals to potential deviations from the normal pattern of each user. For that, data is collected, from wearable devices and through manual input, to be processed by predictive and analytical algorithms, in order to forecast their temporal evolution and identify possible deviations, predicting, for instance, the potential worsening of the clinical situation of the patient.

Data Analysis of Workplace Accidents - A Case Study

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The welfare and safety of the employees of an enterprise is a great concern and priority in a responsible and successful organization. The identification of patterns of work-related accidents is important to reduce and prevent further mishaps and injuries. To improve the safety of the work environment, accidents related data must be analyzed to identify the possible risk factors and their effects on the type of accident and its level of severity. Thus, data related to workplace accidents in fishmonger stores were collected from a Portuguese retail company where it was analyzed with statistical, clustering, and classification techniques to identify potential underlying correlation and patterns between the data, and in this way, collecting important information to prevent future accident or lesions.

Smart River Platform - River Quality Monitoring and Environmental Awareness

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In the technology communication era, the use of the Internet of Things (IoT) has become popular among other digital solutions, since it offers the integration of information from several organisms and at several sources. By means of this, we can access data from distant locations and at any time. In the specific case of water monitoring, the conventional outdated measurement methods can lead to low efficiency and complexity issues. Hence, Smart systems rise as a solution for a broad of cases. Smart River is a smart system platform developed to optimize the resources and monitoring the quality of water parameters of the Fervença river. The central solution is based at *Centro Ciência Viva de Bragança* (CCVB), one of the 21 science centers in Portugal that aims to promote the preservation and environmental awareness for the population. By using the IoT technologies, the system allows real-time data collection with low cost and low energy consumption, being a complement of existing projects that are being developed to promote natural resources. This paper covers sensor module selection for data collection inside the river and data storage. The parameters of the river are visualized using a program developed in Unity engine to present data averages and comparison between weeks, months, and years.

VR@School Project

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In today's digital world, teachers are struggling to find new ways to engage students. When home technologies such as mobile phones, tablets and games consoles are highly advanced, widely available and hugely popular with young children, finding educational engagement with technology in the classroom can be even harder, especially if the technology deployed there is less engaging than that of the technology children use at home. VR@School is a ground-breaking project offering a student-teacher friendly interface, practical resources and guidelines, embedded educational resources and user-friendly VR lessons designed to help raise engagement and increase students knowledge retention.

Sponsors

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CeDRI stands for "Research Centre in Digitalization and Intelligent Robotic" and its mission is to contribute to the development, application and transfer of scientific knowledge related to robotics, intelligent systems, and information and communication technologies, in the scope of the digitalization and automation of industrial systems, strengthening the scientific and technological system.

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Author Index