

ALCOY TECH

ARTIFICIAL INTELLIGENCE & OPTIMIZATION CONGRESS

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Campus de Alcoy, Universitat Politècnica de València



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ALCOY TECH 2024 ARTIFICIAL INTELLIGENCE & OPTIMIZATION INTERNATIONAL WORKSHOP



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Committee

Alcoy Tech 2024 Artificial Intelligence & Optimization International Workshop

Universitat Politècnica de València, Campus d'Alcoi, October 1-2, 2024
<https://alcoytech.webs.upv.es/>

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Engineering Group



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Jorge Segura

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Onur Polat

Bilecik University

Sessions

1 Oct
9:50

A New ESG Scoring Methodology for SMEs

Renatas Kizys

University of Southampton

Governmental and international sustainability footprint targets have increasingly motivated companies to prioritize green products and investments. Consequently, assessing sustainability performance has become highly relevant for a variety of stakeholders. The existing literature predominantly focuses on evaluating sustainability using Environmental, Social, and Governance (ESG) scores for the largest, primarily listed companies. However, there is a notable gap in assessing the sustainability practices and policies of SMEs, despite their crucial role in economic growth, employment, resilience to shocks, and contributions to the environment and society. This study introduces a novel methodology for assessing the sustainability performance of SMEs through an ESG rating and scoring system. Focused on addressing the challenges specific to SMEs, particularly their voluntary disclosure practices and sector-specific nuances, the methodology leverages publicly available industry-specific firm-level information and optimization techniques. It employs the SASB framework to structure ESG indicators, emphasizing indicator selection, weighting, and aggregation into a composite index. Robust metrics are derived using mapping functions and multiple scoring methods, ensuring reliability in evaluating SMEs' sustainability efforts. The findings contribute to advancing methodologies for ESG scoring in SMEs and inform policy discussions on enhancing sustainability disclosures tailored to SMEs' operational contexts.

1 Oct
10:20

Multi-Criteria Optimization Approach for Car-Sharing Companies

Bartosz Sawik

AGH University of Krakow

This research consider multi-criteria optimization approach for the car-sharing transport system to reduce costs, carbon dioxide emissions, and unsatisfied demand. Input data set for computational experiments is from Polish and Spanish car-sharing companies. One located in Krakow, Poland and second one, located in Madrid, Spain. The problem analyses different demand scenarios, considering different population proportions in districts of Krakow and Madrid. Key

considerations include the capacity and cost of car-sharing points, the revenue from fulfilled demand, and cars carbon emission. The problem is solved using mathematical programming with use of GUROBI solver. The findings show the number of cars that the fleet must have and, gives some findings about the mathematical model results and the obtained results with consideration of data sets used to solve the research and business oriented problems. Research consists of the optimization of car-sharing companies in Poland and Spain with objective of maximizing the benefits for the enterprise and at the same time, minimizing the number of cars available. Research also includes the state of the art of car-sharing, defining and tracing its historical evolution, describing the profile of users in Krakow and Madrid and presenting the companies considered for optimization. It also compares car-sharing with bike-sharing, presenting the similarities and explaining the environmental labels used in Krakow and Madrid to classify vehicles according to their energy efficiency and environmental impact. Presented case studies show current situation of car sharing in Krakow and Madrid and the challenges faced both companies. Demand, distance matrices, capacity, costs, revenues and carbon emissions are evaluated, and the specific objectives of service optimization are defined. Presentation of mathematical problem is given, with detailed explanation of the data files, optimization model and obtained results, with details on variables, objective functions and constraints. Multi-criteria objective function considers minimization of cost, unsatisfied demand and carbon emission. Finally, the main conclusions and their implications for the improvement of the car-sharing service in Krakow, Poland and Madrid, Spain are presented.

Capabilities for the Future of Work

Cristina Genovés

FORVIA

1 Oct
10:40

Our competencies need to evolve to adapt to today's unpredictable and dynamic world, with increasingly complex environments and more agile organizations. We must train the necessary self-awareness, skills, knowledge, and behaviors to cope with this new reality.

1 Oct
11:00

Definition of digital process fingerprint applied in the aeronautical sector

Maidier Uranga
IDEKO

In modern manufacturing, ensuring the efficiency and quality of machining processes is crucial. This presentation introduces the concept of process fingerprint definition, a data-driven approach designed to monitor and optimize machining operations. The core objective of obtaining the process fingerprint is the detection of anomalies, prediction of incidents, and early identification of factors impacting workpiece quality. By implementing this methodology, manufacturers can proactively address potential issues, reduce scrap, and improve the management of cutting tools, ultimately enhancing production efficiency.

The presentation will also demonstrate the versatility of the process fingerprint methodology, showing how it can be applied across a wide range of machining processes. To illustrate its real-world benefits, three use cases will be presented, showcasing data from different machines and processes. These case studies will highlight how this approach leads to significant improvements in performance, predictive maintenance, and overall production quality.

1 Oct
11:50

AI for strategic decisions to create smart-home ecosystems

Patricia Rodríguez
ESADE

In the evolving landscape of corporate ecosystems, the role of the CEO has become increasingly strategic and central. This presentation explores how CEOs can leverage on artificial intelligence (AI) to orchestrate smart-home ecosystems, positioning their companies as leaders in the market and gaining unprecedented control over the customer experience.

AI-driven strategic decisions in smart-home ecosystems cover critical areas such as energy management, security, health monitoring, and user convenience. As the orchestrator, the CEO leverages AI to integrate and optimize these domains, creating a cohesive and intelligent home environment. By utilizing predictive analytics and real-time data, CEOs can ensure their products offer unparalleled efficiency and user satisfaction. During the presentation we will delve on the main industries and solutions that create that smart-home ecosystem.

Moreover, CEOs want to position their companies as pioneers in sustainable living and by orchestrating different industries, such as energy management and applying AI push the optimization of consumption patterns, leading to cost savings and environmental benefits.

This proactive approach not only serves the customer's needs but also builds brand loyalty and trust. User convenience is a key selling point in the smart-home market. CEOs can use AI to develop systems that learn and anticipate user preferences, automating routine tasks and creating a seamless living experience.

Finally, the presentation will delve into case studies and real-world applications, showcasing how CEOs have successfully implemented AI in smart-home ecosystems. It will also address the challenges faced, including ethical considerations and data privacy issues, emphasizing the importance of maintaining customer trust.

AI in Business Process Optimization

Eduardo Javier Celorio
Vivara Solutions, SL

1 Oct
12:10

It discusses the growing role of AI in streamlining business processes. It highlights how AI rapidly reshapes industries by increasing efficiency and improving decision-making. The talk also explored the impact of open-source and proprietary AI models, such as Llama and GPT4, which enable the creation of specialized agents capable of continuous learning. It also touches on AI's influence on the workforce and the potential for widespread adoption with examples of how AI-driven agents can personalize marketing customer interactions through data integration.

Agile Manufacturing as a Service through AI Autonomous Agents (MaaS AI)

Raúl Poler
UPV

1 Oct
12:30

The MaaS AI System is a comprehensive digital system to automate and facilitate interactions between suppliers of manufacturing systems (Providers) and manufacturing companies (Consumers) in a Manufacturing-as-a-Service (MaaS) ecosystem, in an agile, efficient and transparent manner. The MaaS AI System aims to revolutionise manufacturing and remanufacturing processes by facilitating access to flexible and decentralised capacities, through the MaaS business model, that extends the principles of the service-oriented economy to the manufacturing industry. The MaaS AI System aims to contribute to the reduction of the heavy investments that manufacturers have traditionally had to make to set up and maintain their operations. With an emphasis on production flexibility, agility and responsiveness, the MaaS AI System enables on-demand sustainable manufacturing, optimising resource utilisation, facilitating the transition towards circular facilities, and promoting better integration of the value chain. The MaaS AI System leverages on Explainable Artificial Intelligence (xAI) in autonomous agents to negotiate the use of manufacturing capacities between providers and consumers in a dynamic MaaS ecosystem. The incorporation of secure, and real-time data exchange between participating companies ensures fast response times and improves collaboration. The MaaS AI System represents a paradigm shift that enables manufacturers to access and utilise on-demand production capabilities, further increasing efficiency and lowering barriers to entry for SMEs.

1 Oct
12:50

Unlocking aerospace machining process data analytics

Anne Sanz Arrizabalaga
IDEKO

Composite machining requires aerospace manufacturers to combine complex precision manufacturing processes, high-precision machine tools and high-value-added workpieces. Successfully unlocking aerospace manufacturing data to optimize production requires combining different data sources: machining process data, machine tool condition data and part quality data. The data will enable the development of artificial intelligence applications that optimize production processes and machine condition.

The aerospace machining process will need a digital platform to manage data and software applications in an agile and efficient way, enabling lifecycle management of these applications. These platforms are capable of supporting the development, deployment, and scaling of data-driven applications. It leverages container technology to introduce new solutions in which application lifecycle management is moved to the on-premise cloud, while data processing remains on the machine, the edge computing.

This presentation will show the Edge computing platform solution, Danobat Box, for machine data acquisition and software application deployment. The “Process Fingerprint” application for anomaly detection during the machining process will be presented, together with “Quality Hallmark” application for quality reporting. Finally, the “Machine Fingerprint” application for the development of a predictive maintenance strategy based on machine condition will be proposed. Real industrial use cases will be exposed in the tutorial.

1 Oct
13:10

Preliminary study of requirements to incorporate AI agents into parametric

Guillermo Franco, Vanesa Juan
GuyCarpenter, MINTE

In this presentation, we introduce the problem of designing a parametric insurance policy with input from multiple stakeholders. Parametric insurance solutions, in contrast to traditional indemnity policies, are very technical products that provide coverage according to certain characteristics of a physical event, such as the magnitude of an earthquake or the category of a hurricane. The process to build these solutions is often iterative and subjected to multiple stages of feedback, adjustment, and internal/external inputs. We summarize the objectives of such a procedure and describe the inter-relations between all actors involved. This schematization of procedures and task force members is then used to suggest some preliminary thoughts on an alternative framework, in which a set of artificial intelligence agents assumes control or assists in some related tasks to increase the efficiency of the group.

An Agile Optimization Algorithm for the Non-Smooth Electric

1 Oct
15:00

Marc Escoto

Universitat Politècnica de València

This paper analyzes a non-smooth and realistic version of the vehicle routing problem in which a fleet of electric vehicles is employed in last-mile delivery. In order to better balance the load of the daily distribution task across the different time periods, a penalty cost is applied to vehicles for greater flexibility in the delivery times. These penalty costs, together with the driving-range limitations of the electric batteries, introduce some non-smooth components in the objective function. Since real-life instances of this problem need to be solved in short computing times –as new requests might arrive at the depot until a few minutes before starting the working day–, an ‘agile’ optimization algorithm is proposed as a solving approach. Computational experiments demonstrate the efficiency of our approach, illustrating its ability to produce high-quality solutions within practical time frames. This underscores the practical viability and robustness of our proposed algorithm in optimizing last-mile delivery operations using electric vehicles with delivery flexibility.

AI application for industrial purposes

1 Oct
15:20

Ramón Castelló

FORVIA

Use case of AI applied for vision control of defects in plastic injected parts.

An Optimization Algorithm for the Tourist Trip Design Problem with Type-Covering Constraints

1 Oct
15:40

Xabier A. Martin

Universitat Politècnica de València

The Tourist Trip Design Problem with Type-Covering Constraints (TTDP-TC) is a novel variant of the well-established Orienteering Problem (OP) designed to address the complex preferences of tourists planning multi-day trips. Unlike classical routing problems, which require visiting all points of interest (POIs), the TTDP-TC allows selective visitation based on perceived value, subject to a maximum travel time constraint. This variant introduces a type-covering requirement, ensuring that each trip includes at least one POI of every specified type, adding a layer of complexity to the optimization process. In this paper, an agile optimization algorithm to solve the TTDP-TC efficiently is proposed, which aims to maximize the total profit collected from visited POIs while ensuring compliance with type-covering requirements and travel time limits. The algorithm’s performance is validated through extensive computational

experiments, demonstrating its ability to generate high-quality solutions within short computational times. To further validate the competitiveness of our approach, an exact method to compare the results of our approach is also implemented. The proposed approach showcases significant potential for practical applications in tourist decision support systems, offering a flexible and robust solution for planning enriched and diverse tourist experiences.

1 Oct
16:00

Balancing Risk and Profit: Predicting the Performance of Potential New Customers in the Insurance

Celia Osorio

Universitat Politècnica de València

In the financial sector, insurance companies generate large volumes of data, including policy transactions, customer interactions, and risk assessments. These historical data on established customers provide opportunities to enhance decision-making processes and offer more customized services. However, data on potential new customers are often limited, due to a lack of historical records and to legal constraints on personal data collection. Despite these limitations, accurately predicting whether a potential new customer will generate benefits (high-performance) or incur losses (low-performance) is crucial for many service companies. This study used a real-world dataset of existing car insurance customers and introduced advanced machine learning models, to predict the performance of potential new customers for whom available data are limited. We developed and evaluated approaches based on traditional binary classification models and on more advanced boosting classification models. Our computational experiments show that accurately predicting the performance of potential new customers can significantly reduce operation costs and improve the customization of services for insurance companies.

1 Oct
16:20

A Learnheuristic Algorithm for a Max-Sum Capacitated Dispersion Problem with Dynamic Costs

Elnaz Ghorbani

Universitat Oberta de Catalunya

Effective project management in complex environments with shared resources and task dependencies presents significant challenges. This research project aims to address this issue by developing and testing an intelligent algorithm that optimizes the completion of multiple projects running in parallel, considering interdependencies among task and limited shared resources. The proposed algorithm leverages a combination of metaheuristic and reinforcement learning techniques to efficiently allocate resources, sequence tasks, and adapt to disruptions that may arise during project execution. By incorporating a disruption management component, the algorithm aims to minimize the total penalty cost associated with potential delays and resource conflicts.

Survival Analysis for cancellation risk assessment in auto insurance

1 Oct
16:40

Raquel Soriano

Universitat Politècnica de València

In the auto insurance sector, understanding and predicting customer behavior is crucial for effective management. Evaluating the risk of policy cancellation enables companies to enhance the insured's experience by tailoring their offerings to the specific needs of each client. This study employs survival analysis to estimate the probability and timing of policy cancellations, based on historical data on policy duration, cancellation history, and various customer behavior characteristics.

Using survival analysis models, we identify patterns in the data that allow us to predict the likelihood of a policyholder canceling their policy at different times.

Additionally, customers are clustered based on the expected duration of their relationship with the company, which facilitates the identification of segments with varying retention probabilities, depending on their behavior and specific characteristics. These insights enable the insurance company to adapt its retention strategies more effectively, thereby optimizing risk management and enhancing customer satisfaction.

Gender Equality – Uncovering new Research Directions and Opportunities in Analytics and Operational Research

2 Oct
9:30

Paula Carroll

University Collage Dublin

There is a lack of sex disaggregated data to allow Analytics and Operational Research communities de-bias their models and assess the implications of their model recommendations by sex.

Women are underrepresented in Science, Technology, Engineering and Mathematics (STEM) disciplines. This can lead to challenges for individual female researchers to maintain a successful career in the disciplines, but also results in fewer opportunities for female life experiences and perspectives to frame the business understanding and problem statements of Analytics and OR projects. This talk highlights opportunities to support female researchers through initiatives such as the EURO WISDOM Forum, and highlights opportunities for new research directions at the intersection of Gender and Analytics/OR.

2 Oct
10:00

Innovation and industry. A gentle vision on how AI is landing in industry

Alfredo Giménez
Factor S.L.

Digital tool implementation speed depends on human rate of adoption. Some examples of industrial competitive needs and how AI can help, and how slow it could come.

2 Oct
10:20

XR and metaverse technologies for industrial training, safety and social interaction

Josefa Mula
Universitat Politècnica de València

Industrial metaverse is an emerging concept based on extended reality (XR) technologies. The Social and Human Centered (SUN) XR project aims to develop and apply XR applications in healthcare and industrial pilots. Here, two proposals of industrial metaverse cases are presented to be addressed for the SUN XR project.

2 Oct
10:40

SUN Accessibility Pilot: Extended reality for people with serious mobility and verbal communication diseases

Vincenzo Croce
Engineering Group

In recent years, Extended Reality (XR) technology has emerged as a potent instrument, inducing transformative effects across various industries by providing immersive experiences and expanding accessibility for individuals encountering physical impediments. The merging of XR technology with hyper-realistic avatars and innovative interfaces exhibits significant potential in reshaping rehabilitation methodologies and elevating the quality of life for individuals afflicted with profound mobility and verbal communication diseases. Within this framework, the Social and hUmanceNtered XR (SUN) project is dedicated to investigating and advancing XR solutions that seamlessly integrate the physical and virtual worlds, with a specific emphasis on the human and social dimensions. The project endeavors to overcome challenges associated with hyper-realistic human avatar, constraints posed by end-user device resources, the incorporation of wearable haptic technologies to augment physical interactions and the exploration of gaze-based and gesture-based interaction modalities. This presentation describes the architecture of the pilot 3 of the SUN project, XR for people with serious mobility and verbal communication diseases, focusing on the implementation of the XR Environment.

Keywords: mobility and verbal communication diseases, virtual reality, sense of presence, social interaction, interaction.

Artificial Intelligence and Big Data in the Insurance industry: Opportunities, challenges and applications

2 Oct
11:00

Leocadio Ortega, Jorge Segura
Unión Alcoyana S.A.

We will talk about our vision implementing AI models and develop and data-driving culture in a insurance company. We will share considerations, common applications and other issues about data.

Forecasting U.S. Recessions Using Over 150 Years of Data: Stock-Market Moments versus Oil-Market Moments

2 Oct
11:50

Onur Polat
Bilecik University

Using monthly data from 1871 to 2024 and logistic models with shrinkage estimators, we compare the contribution of stock and oil-market moments (returns, volatility, skewness, and kurtosis) to the accuracy of out-of-sample forecasts of U.S. recessions at various forecast horizons, while controlling for various standard macroeconomic predictors and the total connectedness indexes of the moments. Adding stock-market moments to the potential predictors improves significantly the accuracy of out-of-sample forecasts at an intermediate forecast horizon, where the lagged recession dummy, the term spread, and stock returns are the top predictors of recessions. Oil-market moments and connectedness indexes do not contribute much to forecast accuracy.

Conversational AI and Consumer Choices: Insights from a Systematic Review and Cluster Analysis

2 Oct
12:10

David López
ESADE

This Research examines the impact of conversational artificial intelligence (AI) on consumer decision-making in digital marketing through a systematic review and cluster analysis. Using TF-IDF vectorization, K-means clustering, and silhouette analysis, we identify five key thematic clusters: Consumer Behavior and Engagement, Sentiment Analysis in E-Commerce, AI in Marketing, Trust and Technology Adoption, and Predictive Analytics. Our findings synthesize insights from 78 academic sources, highlighting trends, research gaps, and future directions for leveraging conversational AI in marketing strategies to improve consumer experiences.

2 Oct
12:30

Optimizing Maintenance of Energy Supply Systems in City Logistics with Heuristics and Reinforcement Learning

Antoni Guerrero
Baobab Soluciones

In urban logistics, effective maintenance is crucial for maintaining the reliability and efficiency of energy supply systems, impacting both asset performance and operational stability. This paper addresses the scheduling and routing plans for maintenance of power generation assets over a multi-period horizon. We model this problem as a multi-period team orienteering problem. To address this multi-period challenge, we propose a dual approach: a novel reinforcement learning (RL) framework and a biased-randomized heuristic algorithm. The RL-based method dynamically learns from real-time operational data and evolving asset conditions, adapting to changes in asset health and failure probabilities to optimize decision-making. In addition, we develop and apply a biased-randomized heuristic algorithm designed to provide effective solutions within practical computational limits. Our approach is validated through a series of computational experiments comparing the RL model and the heuristic algorithm. The results demonstrate that, when properly trained, the RL-based model is able to offer equivalent or even superior performance than the heuristic algorithm.

2 Oct
12:50

Using Data Analytics, Machine Learning, and KPIs for Urban Planning and Design

Veronika Tsertsvadze
Universitat Politècnica de València

With the increasing demand for sustainable urban development, smart cities have emerged as a promising solution for optimizing energy usage, reducing emissions, and enhancing the quality of life for citizens. In this context, the combined use of key performance indicators (KPIs) and data analytics has gained significant attention as a powerful tool for promoting energy efficiency and emissions reduction in urban areas. This paper presents a comprehensive conceptual framework in which a series of KPIs are proposed to serve as essential metrics for guiding, monitoring, and assessing energy efficiency and emissions reduction levels in smart cities. Some of the included KPIs in the analysis are ‘annual energy consumption per person’, ‘reduction in greenhouse gas emissions’, ‘public transport use’, and ‘adoption of renewable energy’. By incorporating these KPIs, city planners and policymakers can gain valuable insights into the effectiveness of sustainability initiatives. Furthermore, the paper explores how the integration of KPIs with data analytics can be used to monitoring and assessing the overall performance of the city in terms of energy efficiency, emissions reduction, and the enhancement of urban living conditions. Visualization tools, such as radar plots, and time series analysis forecasting methods allow to process data and identify patterns, enabling informed decision-making and efficient resource allocation.

Real-life case studies of ongoing smart city projects are presented in the paper, which also provides a KPI comparison among different European cities, as well as models to forecast the evolution of KPIs related to energy usage and emissions reduction in different European cities.

Experiences Integrating Python with Commercial Simulation Software

2 Oct
13:10

Mohammad Peyman

Universitat Politècnica de València

Simulation serves as an essential method for analyzing real-world systems that involve uncertainty, especially through discrete-event simulation (DES), which is used to model time-dependent and intricate systems. Both commercial (AnyLogic, Simul8, FlexSim) and non-commercial (SimPy, Salabim) DES software offer precise system modeling, but they often fall short in terms of advanced analytics and optimization functionalities. By integrating DES with external programming languages such as Python, these tools are significantly enhanced, enabling more robust analysis and providing greater flexibility in addressing complex challenges. In this paper, we review our experiences combining DES software with Python to solve optimization problems using simheuristics, a simulation-optimization methodology that addresses uncertainty by combining simulation with optimization. Specifically, we offer a review of simheuristics, detail the integration of Python with two DES platforms, and discuss their corresponding use cases. Finally, we explore potential future applications and highlight open challenges in the field of simulation tools.

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