Optimal DC link voltage stabilisation technique for a grid-connected PV system

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The utilisation of renewable energy (RES) powered microgrids has seen significant growth due to environmental concerns. These RES resources are often integrated with the grid through a DC link. Maintaining the DC link voltage at a specified level is of prime importance to ensure smooth and efficient supply in the presence of fluctuating RES. Therefore, this work presents a fractional order super twisting sliding mode control technique (FOSTSMC) to stabilise the voltage, reduce response time, and overshoot at the DC link of a grid connected microgrid. The microgrid under study is composed of a photovoltaic (PV) system with an incremental conductance and integral regulator-based maximum power point tracking (IC+IR MPPT) algorithm. Firstly, a conventional proportional-integral (PI) control-based voltage control technique is implemented, which is considered a benchmark technique for comparison and validation purposes. Secondly, the proposed control technique is implemented to control the DC link voltage to a reference voltage in constant and varying solar irradiance. Additionally, an Ant colony optimisation algorithm is used to optimally tune the coefficients of the FOSTSMC controller. The simulation results demonstrated the effectiveness of the ACO-FOSTSMC which exhibits 72% lower settling time, and no overshoot when compared with the benchmark technique. The results of the PI controller exhibit a longer settling time with a 23.6% overshoot, and 26% undershoot. The results indicated that the proposed control strategy can be effective in maintaining the DC link voltage to ensure a smooth power supply

Deep Spuds: Unearthing Blackleg Disease in Potatoes through Convolutional Neural Networks and Transfer Learning

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Introduction: Blackleg disease, caused by Pectobacterium atrosepticum, poses a significant threat to potato crops, particularly in Scotland. It affects 5-30% of fields and can result in a 20% yield loss and a 40% reduction in quality.

Methodology: This study employed Convolutional Neural Networks (CNNs) and Transfer Learning to identify blackleg disease in potato images from Kaggle. The model underwent a series of steps, including pre-processing, augmentation, and training with TensorFlow. It integrated advanced techniques such as convolutional layers, pooling, batch normalisation, and transfer learning with pre-trained models like ResNet and Inception.

Conclusion: The CNN model, a significant achievement of this research, showed outstanding performance with 92.14% accuracy, 92.22% precision, and an average F1 score of 95.68%. This groundbreaking method for early detection of crop diseases can potentially improve crop quality and substantially reduce economic losses.

Towards an initialisation of PSO task scheduling algorithm in edge-to-cloud computing

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Task scheduling produces a challenge in the edge-to-cloud computing setting. Efficient task scheduling plays a crucial role in achieving cost execution and maximising resource utilisation like computing units. This issue falls under the category of the polynomial time (NP) hard prompting researchers to look into nature-inspired metaheuristic algorithms. One notable aspect of these algorithms is their use of initialized search solutions. However, augmenting algorithms with prepared solutions can greatly enhance their effectiveness. particle swarm optimisation (PSO) using algorithms is suggested to address this issue. The initialisation process capitalises on energy parameters associated with tasks and devices along, with time considerations to configure the PSO setup. The proposed technique is assessed based on its capability to reduce makespan execution time and overall energy consumption. Furthermore, its performance is compared against that of task scheduling approaches.

Linguistically Communicating Uncertainty in Patient-Facing Risk Prediction Models

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This work addresses the unique challenges associated with uncertainty quantification in AI models when applied to patient-facing contexts within healthcare. Unlike traditional eXplainable Artificial Intelligence (XAI) methods tailored for model developers or domain experts, additional considerations of communicating in natural language, its presentation and evaluating understandability are necessary. I the poster, we identify the challenges in communication model performance, confidence, reasoning and unknown knowns using natural language in the context of risk prediction. We propose a design aimed at addressing these challenges, focusing on the specific application of in-vitro fertilisation outcome prediction.

Immersive Eco-Fashion Experience: A Virtual Reality Framework with Conversational Agent for Sustainable Fashion Engagement

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The textile industry has seen significant changes due to rapidly changing fashion trends and social influences, driving frequent, short-lived garment purchases. This has resulted in a surge of cheaper, lower-quality products, contributing to fast fashion's environmental challenges. The industry is now a major global polluter, consuming vast resources and generating tons of non-degradable textiles in landfills.

Addressing this, the study develops a systematic approach to create a VR experience with a conversational agent focused on sustainable fashion. It explores methodologies, algorithms, design principles, and architecture for the VR interaction. The project aims to engage, educate, and inspire consumers about traditional fashion, emphasizing heritage, value, and environmental impact. The evaluation includes pre- and post-intervention surveys and engagement metrics to measure the VR solution's effectiveness in promoting sustainable fashion practices.

A Zero-Shot Monolingual Dual Stage Information Retrieval System for Spanish Biomedical Systematic Literature Reviews

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Systematic Reviews (SRs) are foundational in healthcare for synthesising evidence to inform clinical practices. Traditionally skewed towards English-language databases, SRs often exclude significant research in other languages, leading to potential biases. This study addresses this gap by focusing on Spanish, a language notably underrepresented in SRs. We present a foundational zero-shot dual information retrieval (IR) baseline system, integrating traditional retrieval methods with pre-trained language models and cross-attention re-rankers for enhanced accuracy in Spanish biomedical literature retrieval. Utilising the LILACS database, known for its comprehensive coverage of Latin American and Caribbean biomedical literature, we evaluate the approach with three real-life case studies in Spanish SRs. The findings demonstrate the system's efficacy and underscore the importance of query formulation. This study contributes to the field of IR by promoting language inclusivity and supports the development of more comprehensive and globally representative healthcare guidelines.

Programming with Dyslexia

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This research is investigating the additional challenges Computing Science students with dyslexia face when learning to program. In recent years there have been numerous studies conducted researching how dyslexia affects children in general education, as well as research in developing tools to aid and detect dyslexia. Furthermore, there are many studies researching the challenges that non-dyslexic students face when learning to program.

However, the research is limited regarding the challenges that dyslexic students in higher and further education face when they are learning to code, which may have an impact on their motivation and future success.

To identify the challenges students with dyslexia face, an investigation of the previous literature was conducted. In addition, students with and without dyslexia were surveyed to compare their opinions of the challenges they face when learning to program. Further, research of the data should provide the tools and pedagogical approaches to benefit the students.

Does Supervision Improve the Availability of Microservice Applications?

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Microservices are a widespread software architecture used by companies such as Netflix and Uber. Kubernetes is a popular microservices platform that monitors container health through periodic probes. However, these probes may be slow to detect failures, and probing parameters must be carefully tuned for each application.

In contrast, in systems like Erlang, processes signal a supervisor upon failure, which then takes remedial action. We prototype supervision for Kubernetes microservices and compare it with conventional probes. Our initial work shows that supervision detects container failure faster than probes. In addition, the probes that detect failure the fastest are liable to incorrectly detect healthy containers as failed."

Cyber-Twin: Digital Twin-boosted Autonomous Attack Detection for Vehicular Ad-Hoc Networks

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My thesis topic is “AI-Enhanced Digital Twins Cybersecurity Framework for Autonomous Attack Detection”. This work focuses on the dynamic nature of VANETs, especially vehicle-to-infrastructure communications, which is part of my thesis. Roadside Units (RSUs) are vulnerable to dynamic cyberattacks like jamming and DDoS, posing significant risks to road safety. Existing methods struggle to detect these dynamic attacks in VANETs. We propose a novel framework combining digital twins and AI to enhance RSU security in VANETs, enabling real-time monitoring and efficient threat detection. Our solution improves computational efficiency, reduces data transmission delay, and optimizes resource management, outperforming existing methods. This work has been accepted to the IEEE International Conference on Communications (ICC) 2024, the flagship event of IEEE ComSoc, one of the largest societies in IEEE. With nearly 2400 submissions this year, only 800 were accepted, and our work is among these, highlighting its quality and significance in this prestigious conference.

Improving Factual Accuracy of Neural Table-to-Text Output by Addressing Input Problems in ToTTo

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Neural Table-to-Text models tend to hallucinate, producing texts that contain factual errors. We investigate whether such errors in the output can be traced back to problems with the input. We manually annotated 1,837 texts generated by multiple models in the politics domain of the ToTTo dataset. We identify the input problems that are responsible for many output errors and show that fixing these inputs reduces factual errors by between 52% and 76% (depending on the model). In addition, we observe that models struggle in processing tabular inputs that are structured in a non-standard way, particularly when the input lacks distinct row and column values or when the column headers are not correctly mapped to corresponding values.

Detection of Faecal Contamination (E. coli) in Water Using Image Processing

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Conventional detection methods for E. coli are often time-consuming, necessitating extended incubation periods and manual counting, which delays critical interventions. The Scottish Environment Protection Agency (SEPA) currently employs methods involving water sample collection and laboratory-based analyses. These traditional approaches can take 24-48 hours to yield results, thereby limiting the ability to respond swiftly to contamination events. In this project, we aim to develop a faster detection method using a camera and fluorescent microbeads of the same size as the bacteria, enabling more rapid and efficient identification of contamination

Fake News Detection and Labelling in the Era of Large Language Models

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The amount of fake news spread on the internet has a tangible impact on politics, financial markets and ultimately everybody's lives. Fake news detection relies on humans finding, identifying, and fact-checking articles which is a time-consuming process that can often end up too late to stop the spread. Automatic fake news detection is becoming a vital resource against fake news creators.

A warning label can be used to warn readers that an article could be considered fake news, based on "An Information Nutritional Label for Online Documents" by Fuhr et al.

Visualization of clinical pathways based on sepsis comorbidities

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Sepsis is a severe infectious syndrome that can lead to critical illness and death. As an important factor affecting the disease severity and clinical treatment of sepsis patients, sepsis comorbidities emerge as complex and variable characteristics within the clinical pathways. This research plans to use machine learning to extract similar comorbidity sub-groups of sepsis patients in electronic health records (EHR) and further combine them with advanced visualization to explore the clinical pathways of these comorbidity sub-groups. The study aims to help clinicians gain insights into the intricate relationship between sepsis and related comorbidities to develop more effective treatment and management strategies for patients.

Digital Competency & Online Safety Within Scottish Public Sector Organisations.

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This research investigates the evolving themes of digital competency and employees' attitudes toward privacy and security through the lens of digital literacy, employing a scientometric and taxonomic analytical approach. Scientific publications related to the subject area from 2020 to 2024 were extracted from the Web of Science database for data analysis. The VOSviewer software was utilised to examine the co-occurrence of keywords and documents from different sources. The study revealed a lack of sufficient consideration for the digital knowledge of remote and hybrid public sector employees. Consequently, further research is necessary to comprehensively explore the current state of digital competency and safety practices within Scottish public sector organisations."

MJ-TN: Pick-and-Place Towel Shaping from Crumpled States based on Transporter Net with Mask-Filtered Joint-Probability Action Inference

Halid Abdulrahim Kadi, University of St Andrews, ah390@st-andrews.ac.uk

Towel manipulation is a crucial step towards more general cloth manipulation. However, folding a towel from an arbitrary crumpled state and recovering from a failed folding step remain critical challenges in robotics. We propose mask-filtered joint-probability action inference MJ-TN, as a way to improve Transporter Net's operational efficiency. To our knowledge, this is the first single data-driven policy to achieve various types of folding from most crumpled states. We present three benchmark domains with a set of shaping tasks and the corresponding oracle policies to facilitate the further development of the field. We demonstrate MJ-TN's ability to plan directly on real camera images, demonstrating the method's applicability to real world tasks.

Structural aspects of the Student Project Allocation problem.

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The Student-Project Allocation problem with lecturer preferences over Students (SPA-S) involves the allocation of students to projects subject to student preferences over projects, lecturer preferences over students, and capacity constraints on each project and lecturer. The goal is to find a stable matching which guarantees that no student and lecturer would deviate from the matching by forming an alternative arrangement involving some project.

In this study, we explore the structural properties of SPA-S and characterise the set of stable matchings in any given SPA-S instance. Previous studies have established that the set of stable matchings in the classical Stable Marriage problem (SM) forms a distributive lattice, and that the man-optimal and woman-optimal matchings represents the minimum and maximum elements of the lattice. Similar results hold for the Hospital Residents problem (HR). We prove that the set of all stable matchings for a given instance of SPA-S forms a distributive lattice with the student-optimal and lecturer-optimal stable matchings representing the minimum and maximum elements of the lattice. This result, previously unexplored in SPA-S, could potentially lead to resolving the complexity as well as designing efficient algorithms for several other open problems relating to stable matchings in SPA-S.

Multimorbidity and Mental Health: Understanding Disease Trajectories and Social Determinants in Scotland using Process Mining and Machine Learning

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Multimorbidity is a growing global concern and is associated with higher risk of mortality, worse quality of life and substantial financial burden. Mental health is largely disregarded although physical and mental health conditions commonly co-exist. Moreover, current multimorbidity research takes a cross-sectional approach and does not provide evidence about the direction of relationships between diseases. This study uses data mining and machine learning to explore disease trajectories and uncover temporal pattern in multimorbid patients with both physical and mental conditions. The research can benefit clinical practice by informing the targeting of future individualised interventions aimed at reducing or delaying development of multimorbidity.

Digital Twin Enriched Green Topology Discovery for Next Generation Core Networks

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Topology discovery is the key function of core network management since it utilizes the perception of data and mapping network devices. Nevertheless, it holds operational and resource complexities. For example, traditional discovery cannot perform predictive analysis to learn the network behavior and periodically visits IP ports. This leads to high energy and resource consumption. To combat this, we propose a Digital Twin (DT) enriched Green Discovery Policy (DT-GDP) to serve a green discovery integrated with DT. DT-GDP jointly uses the outputs of two modules to calculate the total energy consumption. Energy module considers the service power, idle state power, and the cooling power of an IP port and derive a novel energy formula. Visit decision module uses Multilayer Perceptron (MLP) to classify the IP ports and recommend visit action. According to experimental results, we achieve a significant reduction in the visited ports by 53% and energy consumption by 66%.

Unity is Strength (or Not): Characterizing Teams and Collaboration in the Bug Bounty Ecosystem

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Bug bounty programmes and platforms (BBPs) create a frame-work by which security researchers are paid for discovering bugs in the vendors' systems. A unique bug bounty ecosystem has evolved in China, which allow groups of hackers to register together. However, little is known about the teams, or how team members collaborate. To address this gap, we conducted a mixed-methods study. The first phase involved scraping data from 85 BBPs. We show that team members are over twice as productive as solo hunters; 46% of users are registered as part of a team, highlighting the central role of teams in the Chinese hunter community. In the second phase, our semi-structured interviews (n = 18) reveal the multi-faceted natures of teams as study clubs, labor unions, and start-ups. We also examined why hackers choose to join or leave these teams, highlighting the motivations and challenges within hunter teams.

Investigating the Capabilities of Few-Shot Learning in Text Classification

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Few-shot learning aims to train models using only a handful of labelled examples. This approach contrasts with traditional methods that typically require vast amounts of data, making it particularly appealing for tasks where data is scarce or expensive to obtain. Our investigation focuses on identifying the specific scenarios where few-shot learning excels in text classification. This research contributes to the growing body of knowledge on few-shot learning, paving the way for more efficient and adaptable AI systems capable of achieving high performance with minimal data.

Enabling Robust Ensemble Explanation Experiences Through Realistic Quality Metrics

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Interpretability of AI systems is crucial for end-user trust and adoption. However, the black-box nature of common AI architectures limits transparency in decision-making. Feature attribution explainers like LIME and SHAP, part of eXplainable AI (XAI), quantify the influence of features on decisions. Without a standardised evaluation approach, end-users often rely on ensemble methods, leading to the ""Disagreement Problem"" where explainers offer conflicting insights, fostering scepticism. This work proposes a new framework to measure explainer stability and robustness in local explanations. Our method uses local neighbourhood information and the ""kernel trick"" to provide realistic perturbations as a testbed for robustness. We later demonstrate that robustness can serve as a quality indicator for explanation aggregation, showing that ensemble XAI enhances the faithfulness of explanations to the black-box model and tackles the disagreement problem. This results in increased transparency for AI decision-making and increases end-user trust.

Plausible Instance-based Causally Aware Counterfactuals for Human-Friendly Natural XAI

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PICACHU (Plausible Instance-based Causally Aware Counterfactuals for Human-Friendly Natural XAI) generates valid and plausible counterfactual explanations (cf-XAI) using actual data distributions. By leveraging Directed Acyclic Graphs (DAGs) and Individualised Treatment Effects (ITEs), it synthesizes causal knowledge to guide effective attribute adjustments. Integrating SHAP relevance weights addresses validity issues, forming a hybrid approach that combines causal and factual explainer weights. Evaluations on Heart, Diabetes, Credit, and Income datasets show PICACHU's high performance in sparsity, proximity, plausibility, and 100% validity. Additionally, a template-based natural language generation (NLG) strategy, informed by the Feature Actionability Taxonomy (FAT), enhances user trust. A user study with 176 participants confirmed significant trust improvements with the integration of causal knowledge.

Towards Reliable CXR Classification: Shortcuts, Generalisation and Lung-Pair Contrastive Learning

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Medical image modeling, particularly in chest X-ray (CXR) classification, often suffers from reliance on shortcuts and spurious correlations, impeding generalization to new samples. To address this, we propose a novel approach using supervised contrastive loss with split-lung pairs, which focuses learning on pathological indicators and minimizes confounding factors. This method aims to enhance model performance in unseen settings. Our approach is validated through cross-dataset evaluation using four source datasets from Node21. Additionally, we provide new labels and annotations for abnormal inorganic material in the Node21 dataset, aiding in the identification of potential model shortcuts. This complements existing nodule labels and offers deeper qualitative analysis of model performance. This work contributes to developing more reliable and generalizable CXR classification models.

Conversational Structure Learning for Assistive Speech-to-text

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With over 360 million people worldwide currently deaf or hard of hearing (DHH), and projections indicating this number will exceed 900 million by 2050, there is a pressing need for effective technological solutions to enhance communication for this population. Existing speech-to-text software, often repurposed from business applications, faces challenges in noisy environments, handling diverse accents, and managing multiple speakers. This research aims to develop advanced techniques for real-time understanding of conversational structure to improve assistive speech-to-text technology. The objectives are threefold: first, to annotate a diverse range of conversational data for structural analysis; second, to train models to identify dialogue acts and generate dialogue rules to capture nuances; and third, to integrate these models with automatic speech recognition systems to enhance transcription accuracy and speaker identification. Through this approach, our research aims to significantly improve the quality of life for the deaf and hard of hearing by providing more reliable and context-aware speech-to-text solutions.

Human-Centric Defence: Developing a Predictive Framework for Identifying Vulnerable Employees as Insider Threats

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Insider threats are increasingly common and damaging to organizations, with unintentional insider threats—where individuals unintentionally put organizations at risk—posing a significant challenge. Addressing these threats is difficult because they involve human actions that are not malicious. While recent studies have focused on insider threats, few have considered the human aspects of unintentional threats. Existing frameworks for these threats lack proper validation in real-world scenarios. This study aims to develop a theoretical framework to detect unintentional insider threats by examining risky actions and the human factors behind them. The framework is empirically validated through ethically designed experiments, resulting in a developed dataset. Ultimately, a machine learning model will be created to predict vulnerable unintentional insiders based on their risky actions and the underlying human factors.

Creating Authentic Historical Costumes to Augment Virtual Humans for Cultural Heritage

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Benefiting from the simulation of 3D technologies, the evolution of virtual humans allows them to have a realistic human-like appearance and behaviour, interacting with users and the environment. Today, the application of digital avatars has expanded to computer visualization exhibitions, movies, animations, game engines, etc. This poster investigates a methodology for applying virtual humans to support the digital reconstruction of cultural heritage in virtual reality applications, focusing on converting 2D design sketches of historical costumes into a tangible reality within an immersive VR environment. Creating authentic historical outfits enriched the authenticity of digital avatars, further expanding the interpretation and representation of cultural heritage for educational and cultural institutions. This research evaluated the impacts of avatars on enhancing learning and visiting experiences, which is beneficial for exploring how immersive VR technologies bring about equitable quality education and promote learning opportunities in cultural heritage.

Early-Stage Research: Study of Anti-Slip Control Using Soft Robotics for A Quadruped Robot

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To enhance the adaptability and robustness of quadruped robots on low-friction terrain, this study proposes an anti-slip toe design inspired by soft robotics. This design aims to integrate with the robot's control system to offer proactive solutions for challenging scenarios. By implementing this study, we anticipate a comprehensive improvement in the effectiveness and reliability of robots across diverse low-friction environments.

MJ-TN: Pick-and-Place Towel Shaping form Crumpled States based on Transporter Net with Mask-Filtered Joint-Probability Action Inference

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TBC

Towards Carbon-Aware Execution of Scientific Workflows

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TBC

Foundation Models to Analyse Glacier Dynamics

Steven Wallace, University of Aberdeen, s.wallace.23@abdn.ac.uk

TBC

Enhancing Agri-Food Transparent Sustainability

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Title

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TBC