PROGRAM

19-21 June, 2023

Ponta Delgada, Azores (Portugal)

Julio Ortega Lopera

More than a friend of IWANN's friends

IN MEMORIAM

IWANN 2023 Short Program

Monday, June 19th, 2023		
8:30-9:00	**REGISTRATION DESK** ***(start at 8:30h but it is opened during all the conference)***	
9:00-10:45	**Session A.1: Real World Applications of BCI Systems**	**Session B.1: Interaction with Neural Systems in Both Health and Disease.**
10:45-11:30	**COFFEE BREAK**	
11:30-12:30	**OPENING PLENARY LECTURE**	
12:30-14:00	**Session A.2: Deep Learning Applied to Computer Vision and Robotics (Part I)**	**Session B.2: Neural Networks in Chemistry and Material Characterization**
14:00-16:00	**LUNCH**	
16:00-17:10	**Session A.3: ANN HW-Accelerators**	**Session B.3: Ordinal Classification**
17:10-17:40	**COFFEE BREAK**	
17:40-18:45	**Session A.4: Deep Learning and Time Series Forecasting: Methods and Applications**	**Session B.4: Deep Learning and Applications (Part I)**
18:45-19:45	**Session A/B-5. Poster Session/ Demo Session**	
20:15	**Welcome cocktail**	

NOTE: Session A and **B** are face-to-face oral presentations. Presentations are 15 minutes plus three minutes of questions. **Posters** can occupy a maximum surface of A0 format: 119 cm (height) x 84 cm (width).

Tuesday, June 20th, 2023			
8:30-9:00	**REGISTRATION DESK** *(start at 8:30h but it is opened during all the conference)*		
9:00-10:45	**Session A.6: Deep Learning Applied to Computer Vision and Robotics (Part II)**	**Session B.6: Deep Learning and Applications (Part. II)**	
10:45-11:30	**COFFEE BREAK**		
11:30-12:30	**PLENARY LECTURE**		
12:30-14:00	**Session A.7: Advanced Topics in Computational Intelligence**	**Session B.7: Applications of Machine Learning in Time Series Analysis**	**Online Session C1. Advances in Artificial Neural Networks. (Part I)**
14:00-16:00	**LUNCH**		
16:00-17:10	**Session A.8: General Applications of AI. (Part I)**	**Session B. 8 Spiking Neural Networks: Applications and Algorithms**	
17:10-17:40	**COFFEE BREAK**		
17:40-18:45	**Session A.9: Applications of Machine Learning in Biomedicine and Healthcare**	**Session B.9: Machine Learning for 4.0 Industry Solutions**	**(16:00-19:45) Online Session C2. Advances in Artificial Neural Networks. (Part II)**
18:45-19:45	**Session A/B-10. Poster Session/ Demo Session**		
20:15	**Gala Dinner**		

NOTE: Wednesday will be held the **Tutorial**: From deep learning to deep understanding: Hands-on introduction to Deep Learning interpretability. The tutorial will include a practical session. More information in the web page of IWANN.

Wednesday, June 21th, 2023		
8:30-9:00	**REGISTRATION DESK** ***(start at 8:30h but it is opened during all the conference)***	
9:00-10:45	**Session A.11: General Applications of AI. (Part II)**	**Tutorial: From deep learning to deep understanding: Hands-on introduction to Deep Learning interpretability**
10:45-11:30	**COFFEE BREAK**	
11:30-12:30	**GENERATIVE AI ROUND TABLE**	

To be determined (around 12:35)

Sete Cidades visit

This visit will be organized by IWANN: A small bus will pick up IWANN participants after the end of Generative AI Round Table, visiting the miradouro da Boca do Inferno and the miradouro do Vista do Rei, picnic in the gardens close to the Lagoa Azul and afternoon bath in the natural swimming pools of Mosteiros

IWANN 2023.
Preface.

We are proud to present the set of abstract for the 17th International Work-Conference on Artificial Neural Networks (IWANN-2023), which will take place in June, 19th-21th, 2023 in Ponta Delgada (Sao Miguel, Azores Islands, Portugal).

This gathering will bring people physically together again after 4 years in the one of the most beautiful Atlantic's islands, conducive to creativity and inspiration.

We will continue with the structure of previous editions (Plenary Sessions, Special Sessions, Tutorials on relevant topics and Open Discussion forum), favouring the connection/interaction among attendees to facilitate the debate.

IWANN is a biennial conference that seeks to provide a discussion forum for scientists, engineers, educators, and students about the latest ideas and realizations in the foundations, theory, models, and applications of hybrid systems inspired by nature as well as in emerging areas related to these topics. As in previous editions of IWANN, this year's conference aimed to create a friendly environment that could lead to the establishment of scientific collaborations and exchanges among attendees. As in previous editions, we strongly emphasize the wide range of topics comprised under the umbrella of IWANN2023 and, in particular, we focus on trending topics such as Deep Learning and Ethics in AI. It's confirmed one tutorial about "From Deep Learning to Deep Understanding".

Since the first edition in Granada (LNCS 540, 1991), the conference has evolved and matured. The list of topics in the successive Call for Papers has also evolved, resulting in the following list for the present edition:

1. **Mathematical and theoretical methods in computational intelligence**. Mathematics for neural networks. RBF structures. Self-organizing networks and methods. Support vector machines and kernel methods. Fuzzy logic. Evolutionary and genetic algorithms.
2. **Deep Learning**. Deep Learning applied to Computer Vision. Deep Learning and Time Series Forecasting. Deep Learning and Biomedicine. New advances in Deep Learning.
3. **Neurocomputational formulations**. Single-neuron modelling. Perceptual modelling. System-level neural modelling. Spiking neurons. Models of biological learning.
4. **Learning and adaptation**. Adaptive systems. Imitation learning. Reconfigurable systems. Supervised, non-supervised, reinforcement, and statistical algorithms.
5. **Emulation of cognitive functions**. Decision-making. Multi-agent systems. Sensor mesh. Natural language. Pattern recognition. Perceptual and motor functions (visual, auditory, tactile, virtual reality, etc.). Robotics. Planning motor control.
6. **Bio-inspired systems and neuro-engineering**. Embedded intelligent systems. Evolvable computing. Evolving hardware. Microelectronics for neural, fuzzy, and bioinspired systems. Neural prostheses. Retinomorphic systems. Brain-computer interfaces (BCI), Nanosystems. Nanocognitive systems.
7. **Advanced topics in computational intelligence**. Intelligent networks. Knowledge-intensive problem-solving techniques. Multi-sensor data fusion using computational intelligence. Search and meta-heuristics. Soft computing. Neuro-fuzzy systems. Neuro-evolutionary systems. Neuro-swarm. Hybridization with novel computing paradigms.
8. **Applications**. Expert systems. Image and signal processing. Ambient intelligence. Biomimetic applications. System identification, process control, and manufacturing. Computational biology and bioinformatics. Parallel and distributed computing. Human computer interaction, Internet modeling, Communication and networking. Intelligent systems in education. Human-robot interaction. Multi-agent systems. Time series analysis and prediction. Data mining and knowledge discovery. Machine Learning for 4.0 industry solutions.

During IWANN 2021, several special sessions were held. Special sessions are a very useful tool for complementing the regular program with new and emerging topics of particular interest for the participating community. Special sessions that emphasize multi-disciplinary and transversal aspects, as well as cutting-edge topics are especially encouraged and welcome, and in this edition of IWANN 2019 comprised the following:

- SS01: Ordinal Classification.
  Organized by Victor M. Vargas, David Guijo-Rubio and Pedro A. Gutiérrez
- SS02: Machine Learning in Mental Health.
  Organized by: Pepijn van de Ven
- SS03: Interaction with neural systems in both health and disease.
  Organized by Pablo Martínez Cañada and Jesus Minguillón Campos
- SS04: Deep Learning applied to Computer Vision and Robotics.
  Organized by: Enrique Dominguez, José García-Rodríguez and Ramon Moreno Jiménez
- SS05: Applications of Machine Learning in Biomedicine and Healthcare.
  Organized by Miri Weiss Cohen, Daniele Regazzoni and Catalin Stoean
- SS06: Neural Networks in Chemistry and Material Characterization.
  Organized by Ruxandra Stoean, Patricio García Báez and Carmen Paz Suárez Araujo
- SS07: Real World Applications of BCI Systems.
  Organized by Ivan Volosyak
- SS08: Spiking Neuron Networks: Applications and Algorithms.
  Organized by Elisa Guerrero Vázquez and Fernando M. Quintana Velázquez
- SS09: Deep Learning and Time Series Forecasting: Methods and Applications.
  Organized by Francisco Martínez Álvarez, Verónica Bolón-Canedo and David Camacho
- SS10: ANN HW-Accelerators.
  Organized by Mario Porrmann and Ulrich Rückert

The 17th edition of the IWANN conference was organized by the University of Granada, the University of Malaga, and the Technical University of Catalonia.

We would also like to express our gratitude to the members of the different committees for their support, collaboration and good work. We specially thank to our Steering Committee (Davide Anguita, Andreu Catala¡, Marie Cottrell, Gonzalo Joya, Kurosh Madani, Madalina Olteanu, Ignacio Rojas, and Ulrich Rueckert), the Technical Assistant Committee (Miguel Atencia, Francisco García-Lagos, Luis Javier Herrera, and Fernando Rojas), the Program Committee, the reviewers, invited speakers, and special session organizers. Finally, we want to thank Springer and especially Ronan Nugent, and Anna Kramer for their continuous support and cooperation.

June 2023

Ignacio Rojas
Gonzalo Joya
Andreu Catala

IWANN 2023 PROGRAM

Monday, June 19th 2023

(9:00-10:45) Session A.1: Real World Applications of BCI Systems

Chairman: Dr. Ivan Volosyak

Effects of stimulus sequences on brain-computer interfaces using code-modulated visual evoked potentials: an offline simulation **(Ref: *1076*)**
Jordy Thielen

Frequency, space and time tensor decomposition of motor imagery EEG in BCI applied to post-stroke neurorehabilitation **(Ref: *1102*)**
Roman Rosipal, Zuzana Rošťáková, Natália Porubcová and Leonardo J. Trejo

Evaluation of visual parameters to control a visual ERP-BCI under single-trial classification **(Ref: *2340*)**
Álvaro Fernández-Rodríguez, Ricardo Ron-Angevin, Francisco Velasco-Alvarez, Jaime Diaz-Pineda, Théodore Letouzé and Jean-Marc André

Toward Early Stopping Detection for Non-Binary c-VEP-based BCIs: A Pilot Study **(Ref: *3904*)**
Víctor Martínez-Cagigal, Eduardo Santamaría-Vázquez and Roberto Hornero

Gender Influence on cVEP-based BCI Performance **(Ref: *6929*)**
Ivan Volosyak, Foluke Adepoju, Piotr Stawicki, Paul Rulffs, Atilla Cantürk and Lisa Henke

Bit-wise reconstruction of non-binary visual stimulation patterns from EEG using deep learning: a promising alternative for user-friendly high-speed c-VEP-based BCIs **(Ref: *8278*)**
Eduardo Santamaría-Vázquez, Víctor Martínez-Cagigal and Roberto Hornero

(9:00-10:45) Session B.1: Interaction with Neural Systems in Both Health and Disease.

Chairman: Dr. Jesus Minguillón, Dr. Pablo Martínez and Dr. David Gil

Machine Learning Models for Depression Detection using the Concept of Perceived Control **(Ref: *375*)**

Prosper Azaglo, Pepijn van de Ven, Rachel Msetfi and John Nelson

ECG Hearbeat Classification Based on Multi-Scale Convolutional Neural Networks **(Ref: *4876*)**

Ondrej Rozinek and Petr Dolezel

On macroscopic observations about COVID-19 mortality in Israel **(Ref: *7864*)**

Manuel Graña and Goizalde Badiola

On stability assessment using the WalkIT smart rollator **(Ref: *8220*)**

Manuel Fernandez-Carmona, Joaquin Ballesteros, Jesus Manuel Gomez-De-Gabriel and Cristina Urdiales

Fast Convolutional Analysis of Task-based fMRI Data for ADHD Detection **(Ref: *7078*)**

Federica Colonnese, Francesco Di Luzio, Antonello Rosato and Massimo Panella

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(11:30-12:30) Plenary Talk: Prof. Alberto Bosio

Full Professor the INL – Ecole Centrale de Lyon, France.

Title of the presentation: Reliable and Efficient hardware for Trustworthy Deep Neural Networks

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(12:30-14:00) Session A.2: Deep Learning Applied to Computer Vision and Robotics (Part I)

Chairman: Dr. Enrique Dominguez, Dr. José García-Rodríguez and Dr. Ramon Moreno Jiménez

Phenotype Discrimination based on pressure signals by transfer learning approaches **(Ref: *3407*)**

Marina Aguilar-Moreno and Manuel Graña

AATiENDe: Automatic ATtention Evaluation on a Non-invasive Device **(Ref: *5957*)**
Felix Escalona, Francisco Gomez-Donoso, Francisco Morillas-Espejo, Monica Pina-Navarro, Luis Marquez-Carpintero and Miguel Cazorla

(12:30-14:00) Session B.2: Neural Networks in Chemistry and Material Characterization

Chairman: Dr. Ruxandra Stoean, Dr. Patricio García Báez and Dr. Carmen Paz Suárez Araujo

Automatic Control of Class Weights in the Semantic Segmentation of Corrosion Compounds on Archaeological Artefacts **(Ref: *833*)**
Ruxandra Stoean, Patricio Garcia Baez, Carmen Paz Suarez Araujo, Nebojsa Bacanin, Miguel Atencia and Catalin Stoean

Study on Semantic Inpainting Deep Learning Models for Artefacts with Traditional Motifs **(Ref: *930*)**
Catalin Stoean, Nebojsa Bacanin, Zeev Volkovich, Leonard Ionescu and Ruxandra Stoean

A Novel Approach to Jominy Profile Prediction Based on 1D Convolutional Neural Networks and Autoencoders that Supports Transfer Learning. **(Ref: *1136*)**
Marco Vannucci and Valentina Colla

Simulation of HREM crystalline nanoparticles images using Conditional Generative Adversarial Network **(Ref: *5362*)**
Rubén Muñoz García, Guillermo Bárcena-González, Juan Carlos De la Torre Macías, Arturo Ponce Pedraza and Pedro Luis Galindo Riaño

Enhancing Efficiency at BAMline: Employing Data Science and Machine Learning for X-Ray Research **(Ref: *7688*)**
Martin Radtke, Cafer Tufan Cakir and Ana Guilherme Buzanich

(16:00-17:10) Session A.3: ANN HW-Accelerators

Chairman: Dr. Mario Porrmann and Dr. Ulrich Rückert

Reconfigurable Accelerators for Heterogenous Computing in AIoT **(Ref: *1639*)**
Marco Tassemeier, Mario Porrmann, Rene Griessl, Jens Hagemeyer and Pedro Petersen Moura Trancoso

A Scalable Binary Neural Associative Memory on FPGA **(Ref: *6652*)**
Marius Kortekamp, Sarah Pilz, Jens Hagemeyer and Ulrich Rückert

STANN – Synthesis Templates for Artificial Neural Network Inference and Training **(Ref: *8827*)**

Marc Rothmann and Mario Porrmann

Digit Recognition using Spiking Neural networks on FPGAs **(Ref: *8877*)**

Shamini Koravuna, Sanaullah, Thorsten Jungeblut and Ulrich Rückert

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(16:00-17:10) Session B.3: Ordinal Classification

Chairman: Dr. Victor M. Vargas, Dr. David Guijo-Rubio and Dr. Pedro A. Gutiérrez

Gramian Angular and Markov Transition Fields applied to Time Series Ordinal Classification **(Ref: *1396*)**

Víctor Manuel Vargas, Rafael Ayllón-Gavilán, Antonio Manuel Durán-Rosal, Pedro Antonio Gutiérrez, César Hervás-Martínez and David Guijo-Rubio

Ordinal classification approach for donor-recipient matching in liver transplantation with circulatory death donors **(Ref: *2409*)**

Marcos Rivera-Gavilán, Víctor Manuel Vargas, Pedro Antonio Gutierrez, Javier Briceño, César Hervás-Martínez and David Guijo-Rubio

Evaluating the Performance of Explanation Methods on Ordinal Regression CNN Models **(Ref: *4521*)**

Javier Barbero Gómez, Ricardo Cruz, Jaime dos Santos Cardoso, Pedro Antonio Gutiérrez and César Hervas

A Dictionary-based approach to Time Series Ordinal Classification **(Ref: *9711*)**

Rafael Ayllón, David Guijo-Rubio, Pedro Antonio Gutierrez and César Hervás-Martínez

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(17:40-18:45) Session A.4: Deep Learning and Time Series Forecasting: Methods and Applications

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Chairman: Dr. Francisco Martínez Álvarez and Dr. David Camacho

Forecasting passenger demand in competitive railway markets: an approach based on Temporal Fusion Transformer (TFT) **(Ref: *415*)**

Enrique Adrian Villarrubia-Martin, David Muñoz-Valero, Luis Jimenez-Linares and Luis Rodriguez-Benitez

Predicting Wildfires in the Caribbean Using Multi-Source Satellite Data and Deep Learning **(Ref: *1867*)**
José Francisco Torres Maldonado, Santiago Valencia, Francisco Martínez-Álvarez and Natalia Hoyos

Interpretability of autoencoder latent space for passengers demand-sensitive planning on high-speed railways **(Ref: *5099*)**
David Muñoz-Valero, Enrique Adrian Villarrubia-Martin, Julio Alberto López-Gómez and Juan Moreno-Garcia

Embedded temporal feature selection for time series forecasting using deep learning **(Ref: *7009*)**
Manuel Jesús Jiménez Navarro, María Martínez Ballesteros, Francisco Martínez-Álvarez and Gualberto Asencio-Cortés

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(17:40-18:45) Session B.4: Deep Learning and Applications (Part I)

Chairman: Dr. Petr Hurtik and Dr. Gregorio Díaz

CauSim: A Causal Learning Framework for Fine-grained Image Similarity **(Ref: *2477*)**
Hichem Debbi

NOSpcimen: A first approach to unsupervised discarding of empty photo trap images **(Ref: *4415*)**
David de la Rosa, Francisco Charte, María J. del Jesus, Antón Álvarez, Ramón Pérez, Germán Garrote and Antonio J. Rivera

Efficient Transformer for Video Summarization **(Ref: *5171*)**
Tatiana Kolmakova and Ilya Makarov

Driver's Condition Detection System Using Multimodal Imaging and Machine Learning Algorithms **(Ref: *7755*)**
Paulina Leszczełowska, Maria Bollin, Karol Lempkowski, Mateusz Żak and Jacek Rumiński

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(18:45-19:45) Session A-B. 5: Poster Session

Chairman: Dr. Miguel Atencia and Dr. Ignacio Rojas

Automatic recording and processing of saccadic electrooculograms **(Ref: *6744*)**
Roberto Antonio Becerra García, Gonzalo Joya, Rodolfo García-Bermúdez and Francisco Garcia-Lagos

Artificial Vision Technique to Detect and Classify Cocoa Beans **(Ref: *309*)**
Luis Zhinin-Vera, Jonathan Zhiminaicela-Cabrera, Elena Pretel, Pamela Suarez, Oscar Chang and Francesc Antón Castro

Time Series Classification of Electroencephalography Data **(Ref: *446*)**
Aiden Rushbrooke, Tony Bagnall, Saber Sami and Jordan Tsigarides

Unsupervised Learning for the Segmentation of SmallCrystalline Particles at the Atomic Level **(Ref: *556*)**
Guillermo Bárcena-González, Hernández-Robles Andrei, Alvaro Mayoral, Lidia Martinez Orellana, Yves Huttel, Pedro Luis Galindo Riaño and Ponce Arturo

Efficient Blind Image Super-Resolution **(Ref: *689*)**
Olga Vais and Ilya Makarov

Acid Sulfate Soils Classification and Prediction from Environmental Covariates using Extreme Learning Machines **(Ref: *757*)**
Tamirat Atsemegiorgis, Leonardo Espinosa-Leal, Amaury Lendasse, Stefan Mattbäck, Kaj-Mikael Björk and Anton Akusok

Chemistry-wise augmentations for molecule graph self-supervised representation learning **(Ref: *1016*)**
Evgeniia Ondar and Ilya Makarov

Fairness-enhancing Ensemble Classification in Water Distribution Networks **(Ref: *1885*)**
Janine Strotherm and Barbara Hammer

Identification of Benign Tumor Masses Using Deep Learning Techniques Based on Semantic Segmentation **(Ref: *2092*)**
Mohamed El-Khatib, Oana Mihaela Teodor, Dan Popescu and Loretta Ichim

Texture Detection with Tactile Sensors based on the Goertzel Algorithm **(Ref: *2166*)**
Raúl Lora-Rivera, Óscar Oballe-Peinado and Fernando Vidal-Verdú

FUME: An air quality decision support system for cities based on CEP technology and fuzzy logic **(Ref: *2389*)**
Enrique Brazález Segovia, Hermenegilda Macià, Gregorio Díaz, María Teresa Baeza Romero, Edelmira Valero and Valentin Valero

LSTM time series classification use case: sleep apnea detection **(Ref: *2521*)**
Angela del Robledo Troncoso García, María Martínez Ballesteros, Francisco Martínez Álvarez and Alicia Troncoso Lora

Fast Image Super-Resolution **(Ref: *2706*)**
Aleksei Pokoev and Ilya Makarov

A generalized deep learning model for multi-disease Chest X-Ray diagnostics **(Ref: *3226*)**
Nabit Bajwa, Kedar Bajwa, Muhammad Faique Shakeel, Atif Rana, Kashif Haqqi and Suleiman Khan

Towards the Identification of Multiclass Lung Cancer Related Genes: An Evolutionary and Intelligent Procedure **(Ref: *3507*)**
Juan Carlos Gómez López, Daniel Castillo Secilla, Jesús González Peñalver, Luis Javier Herrera Maldonado and Ignacio Rojas Ruiz

Prediction of blood glucose levels in patients with type 1 diabetes via LSTM neural networks **(Ref: *3732*)**
Ciro Rodriguez, Oresti Banos, Oscar Fernandez Mora, Alex Martinez Bedmar, Fernando Rufo Jimenez and Claudia Villalonga

A Quantum Computing Artificial Neuron **(Ref: *3894*)**
Hernán I. de la Cruz, Jesús A. Fernández, Jose J. Paulet, Fernando Cuartero and Fernando López Pelayo

Bio-plausible digital implementation of a reward modulated STDP synapse **(Ref: *4106*)**
Fernando M. Quintana, Fernando Perez-Peña and Pedro L. Galindo

Measuring fairness with biased data: A case study on the effects of unsupervised data in fairness evaluation **(Ref: *4154*)**
Sarah Schröder, Alexander Schulz, Ivan Tarakanov, Robert Feldhans and Barbara Hammer

PITS: An Intelligent Transportation System in pandemic times **(Ref: *4495*)**
Enrique Brazález Segovia, Hermenegilda Macià, Gregorio Díaz, Valentín Valero and Juan Boubeta-Puig

On-line authenticity verification of a biometric signature using dynamic time warping method and neural networks. **(Ref: *4894*)**
Krzysztof Walentukiewicz, Albert Masiak, Aleksandra Gałka, Justyna Jelińska and Michał Lech

Tuesday, June 20th, 2023

(9:00-10:45) Session A.6: Deep Learning Applied to Computer Vision and Robotics (Part II)

Chairman: Dr. Enrique Dominguez, Dr. José García-Rodríguez and Dr. Ramon Moreno Jiménez

Implementation of a Neural Network for the Recognition of Emotional States by Social Robots, Using 'OhBot' **(Ref: *4624*)**

Natalia Bartosiak, Adam Gałuszka and Martyna Wojnar

Deep Learning Algorithms For Diagnosis of Coffee Plants Disease **(Ref: *4836*)**

Nameer Baht and Enrique Domínguez

Towards a voxelized semantic representation of the workspace of mobile robots **(Ref: *5995*)**

Antonio Jesús Pérez Bazuelo, José Raúl Ruiz Sarmiento, Gregorio Ambrosio Cestero and Javier Gonzalez-Jimenez

Effective black box adversarial attack with handcrafted kernels **(Ref: *245*)**

Petr Dvořáček, Petr Hurtik and Petra Števuliáková

Intersection over Union with smoothing for bounding box regression **(Ref: *9108*)**

Petra Stevuliakova and Petr Hurtik

(9:00-10:45) Session B.6: Deep Learning and Applications (Part II)

Chairman: Dr. Ricardo Ron-Angevin and Dr. Marcos Faundez-Zanuy

SlideGCN: slightly deep graph convolutional network for multilingual sentiment analysis **(Ref: *2274*)**

El Mahdi Mercha, Houda Benbrahim and Mohammed Erradi

Toward Machine's Artificial Aesthetic Perception: Could Machines Appreciate the Beauty? **(Ref: *3735*)**

Mohand Tahar Soualah, Fatemeh Saveh and Kurosh Madani

Detection and visualization of user facial expressions **(Ref: *5456*)**

Martyna Wojnar, Tomasz Grzejszczak and Natalia Bartosiak

Offline substitution Machine Learning model for the prediction of fitness of GA-ARM. **(Ref: *7192*)**
Leila Hamdad, Cylia Laoufi, Rima Amirat, Karima Benatchba and Souhila Sadeg

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(11:30-12:30) Plenary Talk: Prof. Amaury Lendasse

Department Chair Information and Logistics Technology Faculty, University of Houston.

Title of the presentation: Metric Learning with Missing Data

(12:30-14:00) Session A.7: Advanced Topics in Computational Intelligence

Chairman: Dr. Manuel Graña and Dr. Andreu Catala

Energy Complexity of Fully-Connected Layers **(Ref: *2294*)**
Jiri Sima and Jérémie Cabessa

Low-dimensional Space Modeling-based Differential Evolution: A scalability perspective on bbob-largescale suite **(Ref: *5535*)**
Thiago Henrique Fonseca, Silvia Nassar, Alexandre César de Oliveira and Bruno Agard

Fair Empirical Risk Minimization Revised **(Ref: *5638*)**
Danilo Franco, Luca Oneto and Davide Anguita

Scalable Convolutional Neural Networks for Decoding of Terminated Convolutional Codes **(Ref: *8418*)**
Werner Teich and Weikun Pan

(12:30-14:00) Session B.7: Applications of Machine Learning in Time Series Analysis

Chairman: Dr. Grzegorz Dudek and Dr. Tomasz Grzejszczak

Developing deep learning approaches for solar radiation prediction according to prediction horizons and data acquisition frequencies **(Ref: *1585*)**
Carlos M. Travieso-González and Alejandro Piñan

Random Forests Model for HVAC System Fault Detection in Hotel Buildings **(Ref: *6564*)**
Iva Matetić, Ivan Štajduhar, Igor Wolf, Darko Palaić and Sandi Ljubic

Time Series forecasting with Quantum Neural Networks **(Ref: *8069*)**
Manuel P. Cuéllar, María del Carmen Pegalajar, Luis Gonzaga Baca Ruiz and Carlos Cano-Gutierrez

Intra- and all-day PV power forecasting using expansion PDE models composed of the L-transform components in nodes of step-by-step evolved polynomial binary-nets **(Ref: *8129*)**
Ladislav Zjavka and Václav Snášel

Ensemble of Randomized Neural Networks with STD decomposition for Forecasting Time Series with Complex Seasonality **(Ref: *8457*)**
Grzegorz Dudek

(12:30-14:00) Session C.1 (Online): Advances in Artificial Neural Networks. (Part I)

Chairman: Dr. Ignacio Rojas and Dr. Miguel Atencia

Observe Locally, Classify Globally: Using GNNs to Identify Sparse Matrix Structure **(Ref: *353*)**
Khaled Abdelaal and Richard Veras

Unsupervised Topic Modeling with BERTopic for Coarse and Fine-Grained News Classification **(Ref: *1032*)**
Mohamad Al Sayed, Adrian M.P. Brasoveanu, Lyndon J.B. Nixxon and Arno Scharl

Double Transfer Learning to detect Lithium-Ion batteries on X-Ray images **(Ref: *1977*)**
David Rohrschneider, Nermeen Abou Baker and Uwe Handmann

Temporal Dynamics of Drowsiness Detection Using LSTM-Based Models **(Ref: *5981*)**
Rafael Silva, Lourenço Abrunhosa Rodrigues, André Lourenço and Hugo Plácido da Silva

MLFEN:Multi-scale Long-distance Feature Extraction Network **(Ref: *2063*)**
Yuhua Wang and Yuhao Lian

Comparison of Fourier Bases and Asymmetric Network Bases in the Bio-inspired Networks **(Ref: *3105*)**
Naohiro Ishii, Kazunori Iwata, Yuji Iwahori and Tokuro Matsuo

Fine-Tuned SqueezeNet Lightweight Model for Classifying Surface Defects in Hot-Rolled Steel **(Ref: *7860*)**

Francisco López de la Rosa, José Luis Gómez-Sirvent, Lidia María Belmonte Moreno, Rafael Morales Herrera and Antonio Fernández-Caballero

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(16:00-17:10) Session A.8: General Applications of AI. (Part I)

Chairman: Dr. Manuel Fernandez-Carmona and Dr.Zeev Volkovich

Designing a Fault Detection System for Wind Turbine Control Monitoring Using CEP **(Ref: *2108*)**

Enrique Brazález Segovia, Gregorio Díaz, Hermenegilda Macià and Valentín Valero

Coordination of Autonomous Mobile Robot Teams with Anticipatory Networks **(Ref: *3142*)**

Andrzej M.J. Skulimowski

What are the ethical paradoxes of using artificial intelligence in online communities? **(Ref: *3337*)**

Cristina Fernandes and Pedro Veiga

On the use of artificial neural networks for automatic heliostat aiming **(Ref: *8922*)**

J.A. Carballo, N.C. Cruz, J. Bonilla, J.D. Álvarez and M. Berenguel

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(16:00-17:10) Session B.8: Spiking Neural Networks: Applications and Algorithms

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Chairman: Dr. Elisa Guerrero Vázquez and Dr. Fernando M. Quintana Velázquez

Event-based classification of defects in civil infrastructures with Artificial and Spiking Neural Networks **(Ref: *4390*)**

Udayanga K.N.G.W. Gamage, Silvia Tolu, Matteo Fumagalli, Cesar Dario Cadena and Luca Zanatta

TM-SNN: Threshold Modulated Spiking Neural Network for Multi-task Learning **(Ref: *7376*)**

Paolo Gabriel Cachi Delgado, Sebastián Ventura and Krzysztof Cios

Event-based Regression with Spiking Networks **(Ref: *3942*)**

Elisa Guerrero, Fernando M. Quintana and Maria P. Guerrero-Lebrero

SpikeBALL: Neuromorphic dataset for object tracking **(Ref: *5752*)**

Maria P Guerrero-Lebrero, F.M. Quintana and E. Guerrero

(17:40-18:45) Session A.9: Applications of Machine Learning in Biomedicine and Healthcare

Chairman: Dr. Miri Weiss Cohen, Dr. Daniele Regazzoni and Dr. Catalin Stoean

Brain Tumor Segmentation using Ensemble Deep Neural Networks with MRI Images **(Ref: *1604*)**

Miri Weiss Cohen, Ilan Meikler and Idan Bar

Denoising low-dose CT images using Noise2Noise hyperparameter optimization **(Ref: *2189*)**

Or Man and Miri Weiss Cohen

SIA-SMOTE: A SMOTE-based Oversampling Method with Better Interpolation on High Dimensional Data by Using a Siamese Network **(Ref: *2199*)**

Rahmat Izwan Heroza, John Q. Gan and Haider Raza

(17:40-18:45) Session B.9: Machine Learning for 4.0 Industry Solutions

Chairman: Dr. Marina Aguilar-Moreno and Dr. Sarah Pilz

Prediction of transportation orders in logistics based on LSTM: Cargo taxi **(Ref: *2523*)**

Tomasz Grzejszczak, Adam Galuszka, Jarosław Śmieja, Marek Harasny and Maciej Zalwert

X-ELM: A Fast Explainability Approach for Extreme Learning Machines **(Ref: *2883*)**

Brandon Warner, Edward Ratner and Amaury Lendasse

Replacing goniophotometer with camera and U-Net with Hypercolumn rescale block **(Ref: *2945*)**

Marek Vajgl and Petr Hurtik

Unsupervised Clustering at the Service of Automatic Anomaly Detection in Industry 4.0 **(Ref: *6268*)**

Dylan Molinié, Kurosh Madani and Véronique Amarger

Adversarial Attacks on Leakage Detectors in Water Distribution Networks **(Ref: *8483*)**
Paul Stahlhofen, André Artelt, Luca Hermes and Barbara Hammer

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(16:00-19:45) Session C.2 (Online): Advances in Artificial Neural Networks. (Part II)

Chairman: Dr. Ignacio Rojas and Dr. Miguel Atencia

Deep learning recommendation system for stock market investments **(Ref: *3461*)**
Stanislaw Osowski and Michal Parzyszek

Minimal Optimal Region Generation for Enhanced Object Detection in Aerial Images using Super-Resolution and Convolutional Neural Networks **(Ref: *5370*)**
Iván García Aguilar, Lipika Deka, Rafael Marcos Luque Baena, Enrique Domínguez Merino and Ezequiel López Rubio

Long-Term Hail Risk Assessment with Deep Neural Networks **(Ref: *5627*)**
Mikhail Mozikov, Ivan Lukyanenko, Yury Maximov and Ilya Makarov

A model for classifying emergency events based on social media multimodal data **(Ref: *6779*)**
Zhenhua Wu, Liangyu Chen and Yuantao Song

Classification of subjectively evaluated images with Self-Enforcing Networks using reference types, and a cue validity factor **(Ref: *7878*)**
Christina Kluever and Jürgen Klüver

On Comparing Early and Late Fusion Methods **(Ref: *9342*)**
Luis Manuel Pereira, Addisson Salazar and Luis Vergara

3D Human Body Models: Parametric and Generative Methods Review **(Ref: *962*)**
Nahuel Emiliano García D'Urso, Jorge Azorín-López, Andres Fuster-Guillo and Pablo Ramon Guevara

Advanced architecture of a home-based patient monitoring system for diabetes. Initial experiences in a real environment. **(Ref: *8027*)**
David Díaz Jiménez, José Luis López Ruiz, Alicia Montoro Lendínez, Jesús González Lama and Macarena Espinilla Estévez

Shot Boundary Detection with Augmented Annotations **(Ref: *745*)**
Miguel Esteve Brotons, Jorge Carmona Blanco, Francisco Javier Lucendo and Jose Garcia-Rodriguez

Video Scene Segmentation based on Triple Loss Ranking **(Ref: *5921*)**
Miguel Esteve Brotons, Jorge Carmona Blanco, Francisco Javier Lucendo and Jose Garcia-Rodriguez

A Performance Evaluation of Lightweight Deep Learning Approaches for Bird Recognition **(Ref: *7177*)**
Dmitrij Teterja, Jorge Azorin-Lopez, Jose Garcia-Rodriguez and Esther Sebastian-Gonzalez

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(18:45-19:45) Session A-B. 10: Poster Session

Chairman: Dr. Andreu Catala

Data Analysis and Generation in the ENVELLINT longitudinal study to determine loss of functionality in elderly people **(Ref: *718*)**
John Nelson, Jordi Ollé, Xavier Parra, Carlos Pérez-López, Oscar Macho-Pérez, Marta Arroyo-Huidobro and Andreu Català

Optimizing an IDS (Intrusion Detection System) by means of Advanced Metaheuristics **(Ref: *6156*)**
Antonio Mora, Maribel García-Arenas, Andrés Romero Horno and Pedro Castillo

On the use of first and second derivative approximations for biometric online signature recognition **(Ref: *6181*)**
Marcos Faundez-Zanuy and Moises Diaz-Cabrera

A deep transfer learning approach to support opportunistic wearable activity recognition **(Ref: *6680*)**
Oresti Banos, David Gil, Javier Medina, Adrian Sanchez and Claudia Villalonga

Halyomorpha Halys Detection in Orchard from UAV Images Using Convolutional Neural Networks **(Ref: *6803*)**
Alexandru Dinca, Dan Popescu, Cristina Maria Pinotti, Loretta Ichim, Lorenzo Palazzetti and Nicoleta Angelescu

CPMC: A multi-level controllable music generation model with fine-grained control **(Ref: *7054*)**
Weipeng Wang, Ziqiang Hu, Xiaobing Li, Yun Tie and Qi Lin

Neonatal Incubator Modeling and Adaptive Neural Control Using the SIMSCAPE Object-Oriented Approach **(Ref: *7299*)**
Javier Fernandez de Canete and Inmaculada Garcia Moral

Random ensemble of extended CNN structures for medical image recognition **(Ref: *7372*)**
Stanislaw Osowski, Bartosz Swiderski, Jaroslaw Kurek and Cezary Chudobinski

Pilot Program to Attract Talented Students in STEM, with a Focus on Girls **(Ref: *7443*)**
Marta Musté, Marta Díaz, Xavier Parra and Andreu Català

Iterative Graph Embedding and Clustering **(Ref: *8169*)**
Artem Oborevich and Ilya Makarov

Analysis of the effect of the time interval between samples on the solar forecasting **(Ref: *8315*)**
Carlos M. Travieso-González and Alejandro Piñan

An Efficient Parallel Multi-population Wrapper for Solving Feature Selection Problems in High-dimensional Space **(Ref: *9051*)**
Juan Carlos Gómez López, Daniel Castillo Secilla, Dragi Kimoviski and Jesús González Peñalver

Bioinspired Reinforcement Learning Control for a Biomimetic Artificial Muscle Pair **(Ref: *9088*)**
Michele Foggetti and Silvia Tolu

Extending Drift Detection Methods to Identify When Exactly the Change Happened **(Ref: *9480*)**
Markus Vieth, Alexander Schulz and Barbara Hammer

A Deep Neural Network for RNA G-quadruplexes Binding Proteins Classification **(Ref: *9664*)**
Francesco Di Luzio, Alessandro Paiardini, Federica Colonnese, Antonello Rosato and Massimo Panella

Pedestrian Multi-Object Tracking Algorithm Based on Attention Feature Fusion **(Ref: *9676*)**
Yan Zhou, Zhennan Du and Dongli Wang

Photovoltaic energy prediction using machine learning techniques **(Ref: *5027*)**
Gonzalo Surribas-Sayago, Jose David Fernandez-Rodriguez and Enrique Dominguez

Energy-aware KNN for EEG Classification: A Case Study in Heterogeneous Platforms **(Ref: *9564*)**
Juan José Escobar Pérez, Francisco Rodríguez, Rukiye Savran Kızıltepe, Beatriz Prieto, Dragi Kimovski, Andrés Ortiz, Alberto Prieto and Miguel Damas

Wednesday, June 21th, 2023

(9:00-10:45) Session A.11: General Applications of AI. (Part II)

Chairman: Dr. Cristina Fernandes

Global Feature Importance in Dynamic Environments **(Ref: *4191*)**
Fabian Fumagalli, Maximilian Muschalik, Eyke Hüllermeier and Barbara Hammer

Comparison of ANN and SVR for State of Charge Regression evaluating EIS spectra **(Ref: *5089*)**
Andre Loechte, Jan-Ole Thranow, Felix Winters, Andreas Heller and Peter Gloesekoetter

Fall Detection in Smart Environments: A Comparative Study between Thermal Cameras and IMU-based Devices **(Ref: *6469*)**
Marcos Lupión Lorente, Luz López, Vicente González-Ruiz, Juan Francisco Sanjuan Estrada and Pilar M. Ortigosa

An approach to predicting social events via dailies tracking **(Ref: *7493*)**
Zeev Volkovich, Renata Avros, Dan Lemberg and Elena Ravve

Data Fusion for Prediction of Variations in Students Grades **(Ref: *8817*)**
Renata Teixeira, Bruno Veloso, Francisco Marcondes, Dalila Duraes and Paulo Novais

Adaptive Surrogate Modelling in Continuous Black-Box Optimization **(Ref: *9860*)**
Jiří Tumpach, Jan Koza and Martin Holeňa

(12:15-13:10) Generative AI Round Table

Round Table.

The enormous growing of the use of ChatGpt and other Generative AI platforms in many sensitive fields like education, medicine, justice, social communication or political requires a deep debate around the ethics of AI, the potential for bias and the implication in intellectual property rights, just to mention a few considerations. The present technology is relatively new but still no clear regulations apply. When and where to use it needs some deliberation.

[245] *Effective black box adversarial attack with handcrafted kernels*

Petr Dvořáček (University of Ostrava), Petr Hurtik (University of Ostrava) and Petra Števuliáková (University of Ostrava).

We propose a new, simple framework for crafting adversarial examples for black box attacks. The idea is to simulate the substitution model with a non-trainable model compounded of just one layer of handcrafted convolutional kernels and then train the generator neural network to maximize the distance of the outputs for the original and generated adversarial image. We show that fooling the prediction of the first layer causes the whole network to be fooled and decreases its accuracy on adversarial inputs. Moreover, we do not train the neural network to obtain the first convolutional layer kernels, but we create them using the technique of F-transform. Therefore, our method is very time and resource effective.

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[309] *Artificial Vision Technique to Detect and Classify Cocoa Beans*

Luis Zhinin-Vera (University of Castilla-La Mancha), Jonathan Zhiminaicela-Cabrera (Universidad Técnica de Machala), Elena Pretel (University of Castilla-La Mancha), Pamela Suarez (Yachay Tech University), Oscar Chang (Yachay Tech University) and Francesc Antón Castro (Yachay Tech University).

This article discusses the use of Artificial Intelligence (AI) to classify cocoa beans as healthy or diseased based on established classification criteria, given the challenges faced by the cocoa industry due to the impact of diseased beans on quality and grading. The proposed method uses YOLOv5 and achieved an 94.5% accuracy rate. The article also outlines the development of an affordable and easy-to-implement prototype system that cocoa farmers can use to grade and assure bean quality. The results suggest that the proposed system is successful, and increasing the amount of data improves its reliability, which could help farmers improve their competitiveness in the market.

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[353] *Observe Locally, Classify Globally: Using GNNs to Identify Sparse Matrix Structure*

Khaled Abdelaal (University of Oklahoma) and Richard Veras (University of Oklahoma).

The performance of sparse matrix computation highly depends on the matching of the matrix format with the underlying structure of the data being computed on. Different sparse matrix formats are suitable for different structures of data. Therefore, the first challenge is identifying the matrix structure before the computation to match it with an appropriate data format. The second challenge is to avoid reading the entire dataset before classifying it. This can be done by identifying the matrix structure through samples and their features. Yet, it is possible that global features cannot be determined from a sampling set and must instead be inferred from local features. To address these challenges, we develop a framework that generates sparse matrix structure classifiers using graph convolutional networks. The framework can also be extended to other matrix structures using user-provided generators. The approach achieves 97\% classification accuracy on a set of representative sparse matrix shapes.

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[375] *Machine Learning Models for Depression Detection using the Concept of Perceived Control*

Prosper Azaglo (University of Limerick), Pepijn van de Ven (University of Limerick), Rachel Msetfi (University of Limerick) and John Nelson (University of Limerick).

In this paper, machine learning techniques are used to detect and predict the mental health status of individuals based on the concept of Perceived Control using a mobile app. In the proposed method, an individual's measure of perceived control is solicited by allowing them to download and install an android app called the Judgement App. The users then participate in an experiment, where they perform a number of trials and make a judgement after 8 trials. The data is labelled by the subject's Beck Depressive Inventory (BDI-II) score. Due to the imbalanced nature of the data available, Synthetic Minority Oversampling Technique(SMOTE) and some of its variants were used to process the training data before being used to train ML algorithms. The evaluation was completed by analyzing 274 samples from 140 participants. Out of the 274 samples, 54 were labelled as mildly depressed and 220 as non-depressed.

[415] *Forecasting passenger demand in competitive railway markets: an approach based on Temporal Fusion Transformer (TFT)*

Enrique Adrian Villarrubia-Martin (Universidad de Castilla-La Mancha), David Muñoz-Valero (Universidad de Castilla-La Mancha), Luis Jimenez-Linares (Universidad de Castilla-La Mancha) and Luis Rodriguez-Benitez (Universidad de Castilla-La Mancha).

The liberalization of the railway market in the European Union and especially in Spain has led to international competition in the markets that require new and adaptive planning methodologies to respond to demand changes as quickly as possible. In this paper, we present an interpretable competitive passenger rail services demand forecasting model using Temporal Fusion Transformer (TFT). It can predict with promising results the distribution of tickets sold, which can be used to adjust the rail services to maximize the economic benefits while being environmentally sustainable by modifying the ticket prices, the number of different seat classes (e.g. tourist and business class), schedule and frequency of services, among others variables. In addition, expert domain knowledge has been included in the TFT model, such as the location of the stations, meteorological warnings, and their severity, as well as, local, regional, and national holidays that can impact the demand for rail services.

[446] *Time Series Classification of Electroencephalography Data*

Aiden Rushbrooke (University of East Anglia), Tony Bagnall (University of East Anglia), Saber Sami (University of East Anglia) and Jordan Tsigarides (University of East Anglia).

Electroencephalography (EEG) is a non-invasive technique used to record the electrical activity of the brain using electrodes placed on the scalp. EEG data is commonly used for classification problems. However, many of the current classification techniques are dataset specific and cannot be applied to EEG data problems as a whole. We propose the use of multivariate time series classification (MTSC) algorithms as an alternative. Our experiments show comparable accuracy to results from standard approaches on EEG datasets on the UCR time series classification archive without needing to perform any dataset-specific feature selection. We also demonstrate MTSC on a new problem, classifying those with the medical condition Fibromyalgia Syndrome (FMS) against those without. We utilise a short-time Fast-Fourier transform method to extract each individual EEG frequency band, finding that the theta and alpha bands may contain discriminatory data between those with FMS compared to those without.

[556] *Unsupervised Learning for the Segmentation of SmallCrystalline Particles at the Atomic Level*

Guillermo Bárcena-González (University of Cádiz), Hernández-Robles Andrei (University of Texas at San Antonio), Alvaro Mayoral (University of Zaragoza), Lidia Martinez Orellana (Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC)), Yves Huttel (Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC)), Pedro Luis Galindo Riaño (University of Cádiz) and Ponce Arturo (University of Texas at San Antonio).

Electron backscattering diffraction provides the analysis of crystalline phasesat large scales (microns) while precession electron diffraction may be used toget 4D-STEM data to elucidate structure at nanometric resolution. Both are limited by the probe size and also exhibit some difficulties for the generation of large datasets, given the inherent complexity of image acquisition. The latter appoints the application of advanced machine learning techniques, suchas deep learning adapted for several tasks, including pattern matching, image segmentation, etc. This research aims to show how Gabor filters provide anappropriate feature extraction technique for electron microscopy images that could prevent the need of large volumes of data to train deep learning models. The work presented here in combines an algorithm based on Gabor filters for feature extraction and an unsupervised learning method to perform particle segmentation of polyhedral metallic nanoparticles and crystal orientation mapping at atomic scale.

[689] *Efficient Blind Image Super-Resolution*

Olga Vais (HSE University) and Ilya Makarov (AIRI).

A hybrid method to Single Image Super-resolution is proposed. We used zero-shot super-resolution method to reconstruct high-resolution image from low-resolution one based on the degradation trained on unpaired high-resolution and low-resolution samples. This approach gives the benefits of internal networks, such as extracting features from a particular picture, as well as external methods working with high-resolution and low-resolution image distributions. The proposed scheme would be of high-interest for super-resolution of single images from a specific devices with the same degradations.

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[718] *Data Analysis and Generation in the ENVELLINT longitudinal study to determine loss of functionality in elderly people*

John Nelson (University of Limerick), Jordi Ollé (Conceptos Claros), Xavier Parra (UPC), Carlos Pérez-López (Consorci sanitari de l'Alt Penedès i el Garraf), Oscar Macho-Pérez (Consorci sanitari de l'Alt Penedès i el Garraf), Marta Arroyo-Huidobro (Consorci sanitari de l'Alt Penedès i el Garraf) and Andreu Català (UPC).

This paper presents the initial data analysis and modelling for detecting health changes from data gathered on a low-cost smartphone used during normal daily activities. The work is part of the ENVELLINT project, where one of the main objectives is to explore if it is possible to evaluate the functional aspects of frailty indices automatically using smartphones. The project involves both cross-sectional and longitudinal trials involving elder participants. A core aspect, given the expense and limited number of participants in the longitudinal study, is to explore synthetic data generation leveraging both the longitudinal and cross-sectional trials. Generative Adversarial Network and Gaussian Copula models have been investigated to create a larger representative dataset of participants. Initial results and insights show generated synthetic data that closely mirrors the real data, especially using Gaussian Copula.

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[745] *Shot Boundary Detection with Augmented Annotations*

Miguel Esteve Brotons (Telefonica I+D), Jorge Carmona Blanco (Telefonica I+D), Francisco Javier Lucendo (Telefonica I+D) and Jose Garcia-Rodriguez (University of Alicante).

In recent years, deep learning approaches have been considered to provide state-of-the-art results in shot boundary detection. These approaches revolve around the need for large annotated datasets. The quality of the annotations is crucial to the robustness of the algorithm. Having graphical tools to verify the correct annotation of the original datasets, as well as the correct generation of synthetic datasets is a must. In this paper we propose a framework that allow the visual inspection of the datasets, incorporating the option of editing the annotations manually, as well as annotations from other algorithms, generating a set of augmented annotations. In addition, we benchmark the performance of TransNet V2 in three scenarios, 1) using the datasets with their original annotations, 2) using automatically generated annotations, and 3) using the combination of the previous annotations, as augmented annotations. We conclude that the usage of augmented annotations significantly improves the network results.

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[757] *Acid Sulfate Soils Classification and Prediction from Environmental Covariates using Extreme Learning Machines*

Tamirat Atsemegiorgis (Arcada UAS), Leonardo Espinosa-Leal (Arcada UAS), Amaury Lendasse (University of Houston), Stefan Mattbäck (Geological Survey of Finland), Kaj-Mikael Björk (Arcada UAS) and Anton Akusok (Arcada UAS).

This paper explores the performance of the Extreme Learning Machine (ELM) in an acid sulfate soil classification task. ELM is an Artificial Neuron Network (ANN) with a new learning method. The dataset comes from Finland's west coast region, containing point observations and environmental covariates datasets. The experimental results show similar overall accuracy of ELM and Random Forest models. However, ELM implementation is easy, fast, and requires minimal human intervention compared to conventional ML methods like Random Forest.

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[833] *Automatic Control of Class Weights in the Semantic Segmentation of Corrosion Compounds on Archaeological Artefacts*

Ruxandra Stoean (University of Craiova), Patricio Garcia Baez (Universidad de La Laguna), Carmen Paz Suarez Araujo (Universidad de Las Palmas de Gran Canaria), Nebojsa Bacanin (Singidunum University, Belgrade, Serbia), Miguel Atencia (Universidad de Málaga) and Catalin Stoean (University of Craiova).

The semantic segmentation for irregularly and not uniformly disposed patterns becomes even more difficult when the occurrence of categories is imbalanced within the images. One example is represented by heavily corroded artefacts in archaeological digs. The current study therefore proposes a weighted loss function within a deep learning architecture for semantic segmentation of corrosion compounds from microscopy images of archaeological objects, where the values for the class weights are generated via genetic algorithms. The fitness evaluation of individuals is the estimation that a surrogate of the deep learner gives concerning the segmentation accuracy. The obtained class weight values are compared to a random search through the space of potential configurations and another automated means to compute them, in terms of resulting model accuracy.

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[930] *Study on Semantic Inpainting Deep Learning Models for Artefacts with Traditional Motifs*

Catalin Stoean (University of Craiova), Nebojsa Bacanin (Singidunum university), Zeev Volkovich (ORT Braude College, Karmiel), Leonard Ionescu (Restoration and Conservation Lab, Oltenia Museum, Craiova, Romania) and Ruxandra Stoean (University of Craiova).

This paper proposes the use of pre-trained semantic inpainting deep learning architectures to reach a high-fidelity, visually plausible filling content suggestion for the restoration of museum textile objects with traditional motifs. Two state-of-the-art models are selected and their reconstructions are additionally given to an autoencoder trained on a specific collection of textiles. The results show some potential of the tandem and the viability of an automatic support for artefact restoration.

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[962] *3D Human Body Models: Parametric and Generative Methods Review*

Nahuel Emiliano García D'Urso (Universidad de Alicante), Jorge Azorín-López (University of Alicante), Andres Fuster-Guillo (Universidad de Alicante) and Pablo Ramon Guevara (Universidad de Alicante).

The paper provides an overview of the current status of 3D human body model estimation, reconstruction, and generation in computer vision. The focus is on the commonly used parametric and generative methods and their applications in various fields, such as medicine, film, video games, and clothing. Parametric models use parameters to represent body shape and pose, and they are commonly used to reconstruct 3D human bodies. These models have different features, including those that focus on body deformations, shape, and pose optimization, and the separation of body shape into identity-specific and pose-dependent components. Generative methods, such as Variational Autoencoder and Generative Adversarial Networks, have been developed to generate 3D models of the human body by learning the data distribution. These advancements have improved the accuracy and stability of representing human body shapes and poses.

[1016] *Chemistry-wise augmentations for molecule graph self-supervised representation learning*

Evgeniia Ondar (MIPT) and Ilya Makarov (AIRI).

In this work, we propose chemistry-wise augmentations for a contrastive learning framework. Two augmentations were implemented: (1) toxicophore subgraph removal, and (2) toxicophore subgraph saving. This approach does not violate chemical principles while pushing the model to learn the toxicity-dependent parts of a molecule.

[1032] *Unsupervised Topic Modeling with BERTopic for Coarse and Fine-Grained News Classification*

Mohamad Al Sayed (Modul Technology GmbH), Adrian M.P. Brasoveanu (Modul University Vienna GmbH), Lyndon J.B. Nixxon (Modul University Vienna GmbH) and Arno Scharl (webLyzard Technology GmbH).

Transformer models have achieved state-of-the-art results for news classification tasks, but it is still difficult to modify them to output the desired probabilities for each class in a multi-class setting. Using a neural topic model helps with generating these class probabilities. BERTopic, the selected model, leverages embedding models to create dense clusters of topics. It is used as a preprocessor to eliminate samples mapped to "topic -1", documents which do not belong to any distinct cluster or topic. When the resulting clustered embeddings are used together with a Sentence Transformer fine-tuned with SetFit, we obtain a prompt-free framework that demonstrates competitive performance even with few-shot labeled data. Our findings show that incorporating BERTopic in the preprocessing stage leads to a notable improvement in the classification accuracy of news documents. Furthermore, our method outperforms hybrid approaches that combine text and images for news document classification.

[1076] *Effects of stimulus sequences on brain-computer interfaces using code-modulated visual evoked potentials: an offline simulation*

Jordy Thielen (Radboud).

Brain-computer interfaces (BCIs) translate brain activity into computer commands. BCIs require substantial amounts of recorded training data to calibrate their algorithms. This not only prevents immediate use but also hinders exploration and optimization of stimulus parameters that could substantially enhance the BCI's performance. To address this issue, a simulation framework was developed that eliminates the need for recording calibration data. Using simulated data, this offline study systematically compared five stimulus conditions: almost perfect autocorrelation sequence, Golay sequence, de Bruijn sequence, Gold code, and m-sequence. The results showed that the classification accuracy between these stimulus conditions was not statistically different. However, the accuracy did significantly improve when the stimulus sequence was optimized for individuals. Overall, this is the first step towards optimizing stimulus parameters for BCIs using simulated data. This approach could significantly speed up the development and optimization of BCIs, leading to more effective BCIs tailored to the individual.

[1102] *Frequency, space and time tensor decomposition of motor imagery EEG in BCI applied to post-stroke neurorehabilitation*

Roman Rosipal (Institute of Measurement Science, Slovak Academy of Sciences), Zuzana Rošťáková (Institute of Measurement Science, Slovak Academy of Sciences), Natália Porubcová (Institute of Measurement Science, Slovak Academy of Sciences) and Leonardo J. Trejo (Pacific Development and Technology, LLC).

We present a novel method of tensor decomposition of EEG for precise measurement and real-time tracking of narrowband brain oscillations (NBO) for brain-computer interfaces (BCI). To determine NBOs associated with specific limb movements, we used mirror-box therapy, in which users view mirror images of one limb moving to alter the NBO associated with the movement of the contralateral limb. Unlike purely imaginary motion, mirror-box imagery is specific and easy for users to control. Tensor decomposition is an algorithm that separates the NBOs present in a multi-channel EEG and provides a spectral-spatial signature of each NBO. We can track NBO’s activity in real-time by back-projecting its signature on a live EEG recording. This enables continuous monitoring of the synchronization and desynchronization of selected NBOs and the construction of an elegant BCI protocol. We applied this approach to rehabilitating post-stroke patients using the BCI control of a robotic splint and avatar hand.

[1136] *A Novel Approach to Jominy Profile Prediction Based on 1D Convolutional Neural Networks and Autoencoders that Supports Transfer Learning.*

Marco Vannucci (Scuola Superiore S. Anna) and Valentina Colla (Scuola Superiore S. Anna).

This paper introduces a novel method for the estimation the Jominy profile of steel based on its composition, by combining autoencoders and 1-D Convolutional Neural Networks . The approach has two goals: firstly, to enhance the accuracy of hardenability prediction by exploiting the capability of the 1-D CNN to learn how the chemical composition of steel affects the shape of the Jominy profile; secondly, to use transfer learning to apply the knowledge gained from training on a specific dataset to new types of production with less available data or data with different characteristics as it

often occurs in the industrial context. The proposed approach was tested on two industrial datasets aiming to assess the effectiveness of the methods on the two goals achieving satisfactory results.

[1396] *Gramian Angular and Markov Transition Fields applied to Time Series Ordinal Classification*

Víctor Manuel Vargas (Department of Computer Sciences, Universidad de Córdoba), Rafael Ayllón-Gavilán (Department of Computer Sciences, Universidad de Córdoba), Antonio Manuel Durán-Rosal (Universidad Loyola Andalucía), Pedro Antonio Gutiérrez (Department of Computer Sciences, Universidad de Córdoba), César Hervás-Martínez (Department of Computer Sciences, Universidad de Córdoba) and David Guijo-Rubio (Department of Computer Sciences, Universidad de Córdoba and School of Computing Sciences, University of East Anglia).

This work presents a novel ordinal Deep Learning (DL) approach to Time Series Ordinal Classification (TSOC) field. TSOC consists in classifying time series with labels showing a natural order between them. This particular property of the output variable should be exploited to boost the performance for a given problem. This paper presents a novel DL approach in which time series are encoded as 3-channels images using Gramian Angular Field and Markov Transition Field. A soft labelling approach, which considers the probabilities generated by a unimodal distribution for obtaining soft labels that replace crisp labels in the loss function, is applied to a ResNet18 model. Specifically, beta and triangular distributions have been applied. They have been compared against three state-of-the-art deep learners in the Time Series Classification (TSC) field using 13 univariate and multivariate time series datasets. The approach considering the triangular distribution (O-GAMTFT) outperforms all the techniques benchmarked.

[1585] *Deep learning for the analysis of solar radiation prediction with different time horizons and data acquisition frequencies*

Carlos M. Travieso-González (University of Las Palmas de Gran Canaria (ULPGC)) and Alejandro Piñan (Investigator).

This study aims to develop and compare different AI systems for predicting so-lar radiation and evaluate their performance across different prediction horizons. Predicting solar radiation is of crucial importance for harnessing renewable en-ergy sources. The models were designed to predict radiation over 6-hour and 15-minute horizons with the lowest possible error. The impact of prediction horizon and data acquisition frequency on prediction accuracy is discussed, emphasizing the need to consider the number of parameters and training time when comparing models. To improve the accuracy of short-term solar radiation predictions, five deep learning models, including classical, convolutional, and recurrent neural networks, were analyzed. The accuracy of the predictions was compared using two error metrics: root mean square error and mean absolute error.

[1604] *Brain Tumor Segmentation using Ensemble Deep Neural Networks with MRI Images*

Miri Weiss Cohen (Braude College of Engineering), Ilan Meikler (Braude College of Engineering) and Idan Bar (Braude College of Engineering).

The work proposes an automated segmentation method for brain tumors using MRI scans and a convolutional neural network (CNN) ensemble. The method accurately identifies the tumor's size and location, crucial for treatment planning and monitoring disease progression. The method uses the YOLOv5 object detection algorithm to identify the tumor region in the MRI scan and then applies the U-Net architecture to segment the tumor into the whole tumor, tumor core, and enhanced tumor core. The study employs a multi-class loss function to handle class imbalance in the dataset and evaluates different MRI modalities to optimize the U-Net training process. The results indicate high accuracy in identifying no tumor, necrotic tumor core (NCR), peritumoral edematous/invaded tissue, and enhancing tumor (ET). This proposed method can potentially reduce human errors and assist radiologists in accurately detecting brain tumors.

[1639] *Reconfigurable Accelerators for Heterogenous Computing in AIoT*

Marco Tassemeier (Osnabrück University), Mario Porrmann (Osnabrück University), Rene Griessl (Bielefeld University), Jens Hagemeyer (Bielefeld University) and Pedro Petersen Moura Trancoso (Chalmers University of Technology).

Efficient processing in the realm of Artificial Intelligence of Things (AIoT) necessitates highly scalable approaches that encompass the entire spectrum of cognitive computing, ranging from embedded devices through the edge to the cloud. This study presents findings related to deep learning accelerators utilizing reconfigurable computing within the H2020 VEDLIoT project. The project emphasizes the significance of Machine Learning (ML), particularly Deep Learning (DL), in IoT, leading to demanding computational and memory needs while maintaining a low energy consumption. The cognitive IoT hardware platform employed in VEDLIoT, known as RECS, is founded on a modular microserver architecture that allows for scalable and heterogeneous computing across the cognitive computing continuum.

[1867] *Predicting Wildfires in the Caribbean Using Multi-Source Satellite Data and Deep Learning*

José Francisco Torres Maldonado (Pablo de Olavide University), Santiago Valencia (Facultad de Ingeniería, Universidad de Antioquia, Medellín, Colombia), Francisco Martínez-Álvarez (Universidad Pablo de Olavide) and Natalia Hoyos (Departamento de Historia y Ciencias Sociales, Universidad del Norte, Colombia.).

Wildfires pose a significant threat to the environment and local communities, and predicting their occurrence is crucial for effective management and prevention. The Caribbean region is particularly susceptible to wildfires. We propose a comprehensive methodology that combines data from multi-source satellite data and applies several predictive models. The results demonstrate the potential of deep learning techniques for identifying high-risk areas and developing fire management strategies. They also highlight the importance of continued research and investment in this area to improve the accuracy of predictive models and ultimately ensure the safety of communities and the environment. The findings have important implications for policymakers and stakeholders in the Caribbean region, who can use this information to develop more effective fire management strategies to minimize the impact of wildfires on the environment and local communities. By identifying high-risk areas, preventative measures such as controlled burns and improved fire management strategies can be implemented.

[1885] *Fairness-enhancing Ensemble Classification in Water Distribution Networks*

Janine Strotherm (University Bielefeld) and Barbara Hammer (University Bielefeld).

As relevant negative examples such as the future criminal detection software show, fairness of AI-based and social domain affecting decision support tools constitutes an important area of research. In this contribution, we investigate the applications of AI to socioeconomically relevant infrastructures such as those of water distribution networks (WDNs), where fairness issues have yet to gain a foothold. To establish the notion of fairness in this domain, we propose an appropriate definition of protected groups and group fairness in WDNs as an extension of existing definitions. We demonstrate that typical methods for the detection of leakages in WDNs are unfair in this sense. Further, we therefore propose a remedy to increase the fairness which can be applied even to non-differentiable ensemble classification methods as used in this context.

[1977] *Double Transfer Learning to detect Lithium-Ion batteries on X-Ray images*

David Rohrschneider (Ruhr West University of Applied Sciences), Nermeen Abou Baker (Ruhr West University of Applied Sciences) and Uwe Handmann (Ruhr West University of Applied Sciences).

Due to the increasing use of electronic mobile devices, Lithium-Ion Batteries (LIB) have grown dramatically. This study was motivated by the growing need for automated recognition of batteries in applications such as electrical and electronic waste recycling facilities and baggage security inspections at airports. Eventually, it promotes reducing the health risks of battery recycling, sorting with higher precision and fewer human interventions. In this paper, eight state-of-the-art object detectors were used for the recognition and classification of electronic mobile devices (EMD) as well as the batteries contained therein on X-Ray images using double transfer learning.

[2063] *MLFEN:Multi-scale Long-distance Feature Extraction Network*

Yuhua Wang (Chongqing University of Posts and Telecommunications) and Yuhao Lian (Chongqing University of Posts and Telecommunications).

Hyperspectral image fusion frequently leverages panchromatic and multispectral images. Although remote sensing images exhibit multi-scale features, prior research has predominantly focused on local feature extraction using convolutional approaches, thereby neglecting long-range dependencies among image elements. To overcome this limitation, we introduce a network for multi-scale long-distance feature extraction that incorporates an encoder-decoder structure with skip connections and a multi-layer perceptron block with attention mechanisms. By capturing features from multiple scales and distant locations within the image, the proposed network improves the performance of image fusion. Our experimental findings demonstrate that the proposed network achieves state-of-the-art performance in image fusion tasks.

[2092] *Identification of Benign Tumor Masses Using Deep Learning Techniques Based on Semantic Segmentation*

Mohamed El-Khatib (University Politehnica of Bucharest), Oana Mihaela Teodor (University Politehnica of Bucharest), Dan Popescu (University Politehnica of Bucharest) and Loretta Ichim (University Politehnica of Bucharest).

Ovarian tumors affect women of all ages and the main challenge for optimal therapeutic management is to determine whether there is a benign or malig-nant tumor. The main imagistic tool for the evaluation of ovarian tumors is pelvic ultrasonography. To support the diagnosis of clinicians several artifi-cial intelligence applications and ultrasound computer-aided diagnosis sys-tems are emerging in recent years. This paper covers a comparative study be-tween different convolutional neural networks based on semantic segmenta-tion, implemented, and proposed for the identification of four benign ovarian tumor masses (chocolate cyst, mucinous cystadenoma, teratoma, and simple cyst). The semantic segmentation networks used in our comparative study are based on DeepLab-V3+ networks with 5 different encoders and a fully convolutional network. The scope of this study is to present the performanc-es of each network for each of the covered benign classes and to illustrate the ones with the best performances.

[2108] *Designing a Fault Detection System for Wind Turbine Control Monitoring Using CEP*

Enrique Brazález Segovia (University of Castilla - La Mancha), Gregorio Díaz (University of Castilla - La Mancha), Hermenegilda Macià (University of Castilla-La Mancha) and Valentín Valero (University of Castilla-La Mancha).

Renewal energies are key to face the challenges of climate change. The power generation using Wind Turbines (WT) shows a high growth during the last year. The Operation and Maintenance of WT using condition-monitoring (CM) to minimize failures determine the cost of the produced energy and therefore its efficiency. We present the design of a Fault Detection System for WTCM using Complex Event Processing (CEP) technology to analyze the data streams of a wind farm in real-time. Data streams are provided by the sensors and the SCADA system installed in the WT farms. This information is analyzed to determine failures using the stability in the produced power. Changes in this stability are detected by CEP patterns. A real case scenario is used to illustrate this design. It consists of 30 WTs operated by a private company and shows how this approach can help to plan operation and maintenance actions.

[2166] *Texture Detection with Tactile Sensors based on the Goertzel Algorithm*

Raúl Lora-Rivera (University of Málaga), Óscar Oballe-Peinado (University of Málaga) and Fernando Vidal-Verdú (University of Málaga).

This paper focuses on the detection of the texture of an object with smart tactile sensors. To ease the implementation on the embedded electronics of these sensors, the Goertzel algorithm instead of the fast Fourier Transform is considered. Twelve different textures are explored through active touch. A k-means classifier is trained with the output of the Goertzel algorithm for eight frequencies and a classification accuracy of 85.4% is achieved.

[2189] *Denoising low-dose CT images using Noise2Noise hyperparameter optimization*

Or Man (Braude College of Engineering) and Miri Weiss Cohen (Braude College of Engineering).

In Computed Tomography (CT), the quality of the image is directly related to the exposure of the patient during the scan. A reduction in exposure reduces the health risks for patients, however, an increase in noise compromises the image quality. This work examines the Noise2Noise framework, which requires only noisy image pairs for network training in order to minimize the noise in CT images. This study examines the effects of varying learning rates, batch sizes, epochs, and encoder-decoder network depths on a variety of loss functions and their parameters. According to the results of the study, we are able to demonstrate an improvement in the current denoising values.

[2199] *SIA-SMOTE: A SMOTE-based Oversampling Method with Better Interpolation on High Dimensional Data by Using a Siamese Network*

Rahmat Izwan Heroza (University of Essex), John Q. Gan (University of Essex) and Haider Raza (University of Essex).

SMOTE is an effective method for balancing imbalanced datasets by interpolating between existing samples in the minority class. However, if the synthetic samples generated through interpolation are based on noisy data points, then they may also be noisy and can lead to overfitting and reduced performance on unseen data. This paper proposes a new method SIA-SMOTE, which uses SMOTE for oversampling the minority class and a siamese network for synthetic image selection. SIA-SMOTE also explores the decision boundary to better capture data distribution of the minority class. The proposed method has been compared to random oversampling, SMOTE, and ASN-SMOTE on MNIST, FMNIST and two medical image datasets. The results show that SIA-SMOTE achieved the best overalll performance in terms of three evaluation metrics.

[2274] *SlideGCN: slightly deep graph convolutional network for multilingual sentiment analysis*

El Mahdi Mercha (ENSIAS, Mohammed V University, Rabat, Morocco), Houda Benbrahim (ENSIAS, Mohammed V University, Rabat, Morocco) and Mohammed Erradi (ENSIAS, Mohammed V University, Rabat, Morocco).

Multilingual sentiment analysis refers to the process of sentiment scoring while gathering insights from data in different languages. Many research studies have been conducted to perform multilingual sentiment analysis. However, most of these studies focus on the short-distance semantics which consists in modeling local consecutive word sequences. In this work, we consider the global word co-occurrence in the whole corpus, which capture both short- and long-distance semantics, to convey more meaningful insights for the analysis. We propose a framework called MSA-GCN (Multilingual Sentiment Analysis based on Graph Convolutional Network) while supporting both short- and long-distance semantics. We build a single heterogeneous text graph for a multilingual corpus based on sequential, semantic, and statistical information. Then, a slightly deep graph convolutional network learns embeddings for all nodes in a semi-supervised manner. Extensive experiments are carried out on various datasets, and the results demonstrate the effectiveness of the proposed framework.

[2294] *Energy Complexity of Fully-Connected Layers*

Jiri Sima (Institute of Computer Science of the Czech Academy of Sciences) and Jérémie Cabessa (DAVID Laboratory, University of Versailles Saint-Quentin-en-Yvelines).

The energy efficiency of processing convolutional neural networks (CNNs) is crucial for their deployment on low-power mobile devices. In our previous work, a simplified theoretical hardware-independent model of energy complexity for CNNs has been introduced. This model has been experimentally shown to asymptotically fit the power consumption estimates of CNN hardware implementations on different platforms. Here, we pursue the study of this model from a theoretically perspective in the context of fully-connected layers. We present two dataflows and compute their associated energy costs to obtain upper bounds on the optimal energy. Using the weak duality theorem, we further prove a matching lower bound when the buffer memory is divided into two fixed parts for inputs and outputs. The optimal energy complexity for fully-connected layers in the case of partitioned buffer ensues. These results are intended to be generalized to the case of convolutional layers.

[2340] *Evaluation of visual parameters to control a visual ERP-BCI under single-trial classification*

Álvaro Fernández-Rodríguez (University of Málaga), Ricardo Ron-Angevin (University of Málaga), Francisco Velasco-Alvarez (University of Málaga), Jaime Diaz-Pineda (Thales Avionics France), Théodore Letouzé (INP Bordeaux-ENSC) and Jean-Marc André (INP Bordeaux-ENSC).

A brain-computer interface (BCIs) based on event-related potentials (ERPs) could be used to assist and facilitate decision making in applications such as an air traffic controller (ATC). This work attempts to be an approximation to determine whether it is possible to detect the stimulus through a single presentation of a stimulus (single-trial classification) This experiment has involved six participants in four experimental conditions. Two conditions varied in the type of stimulus used, faces versus radar planes; and two conditions varied in the prior knowledge of where the stimulus would appear. The results suggest that the use of single-trial classification could be adequate to correctly detect the desired stimulus using and ERP-BCI. In addition, it seems that radar planes may be as suitable stimuli as faces and that not knowing the location of the target stimulus is not a significant problem, at least in a standard BCI scenario without distracting stimuli.

[2389] *FUME: An air quality decision support system for cities based on CEP technology and fuzzy logic*

Enrique Brazález Segovia (University of Castilla - La Mancha), Hermenegilda Macià (University of Castilla-La Mancha), Gregorio Díaz (University of Castilla - La Mancha), María Teresa Baeza Romero (Universidad de Castilla - La Mancha), Edelmira Valero (Universidad de Castilla - La Mancha) and Valentin Valero (University of Castilla-La Mancha).

Air pollution has become one of the most important problems in urban areas, and governments are applying regulations in an attempt to fulfill the recommendations of Air Quality (AQ) standards to reduce the pollution. In this paper, we present FUME, a decision support system to process heterogeneous and real-time data to propose daily recommendations following an action protocol based on AQ standards. This approach considers past, current and future environmental situations (AQ and atmospheric stability). FUME is implemented by combining Fuzzy Logic (FL) and Complex Event Processing (CEP) technology. We propose a Fuzzy Inference System (FIS) to improve the decision-making process by recommending the actions for four different sources of pollution: traffic, industry, domestic and agriculture. The FUME approach is applied to a specific case study: the city of Puertollano (Ciudad Real, Spain), where the pollution levels of PM10 are, on numerous occasions, above the World Health Organization recommendations.

[2409] *Ordinal classification approach for donor-recipient matching in liver transplantation with circulatory death donors*

Marcos Rivera-Gavilán (Department of Computer Sciences, Universidad de Córdoba), Víctor Manuel Vargas (Universidad de Córdoba), Pedro Antonio Gutierrez (Universidad de Cordoba), Javier Briceño (Hospital Universitario Reina Sofía, Córdoba), César Hervás-Martínez (Department of Computer Sciences, Universidad de Córdoba) and David Guijo-Rubio (Department of Computer Sciences, Universidad de Córdoba).

This paper tackles the Donor-Recipient (D-R) matching for Liver Transplantation (LT). Typically, D-R matching is performed following the knowledge of a team of experts guided by the use of a prioritisation system. One of the most extended, the Model for End-stage Liver Disease (MELD), aims to decrease the mortality in the waiting list. However, it does not take into account the result of the transplant. In this sense, with the aim of developing a system able to bear in mind the survival benefit, we propose to treat the problem as an ordinal classification one. The organ survival will be predicted at four different thresholds. The results achieved demonstrate that ordinal classifiers are capable of outperforming nominal approaches in the state-of-the-art. Finally, this methodology can help experts to make more informed decisions about the appropriateness of assigning a recipient for a specific donor, maximising the probability of post-transplant survival in LT.

[2477] *CauSim: A Causal Learning Framework for Fine-grained Image Similarity*

Hichem Debbi (University of M'sila).

Learning image similarity is useful in many computer vision applications. In fine-grained visual classification (FGVC), learning image similarity is more challenging due to the subtle inter-class differences. This paper proposes CauSim: a framework for deep learning image similarity based on causality. CauSim applies counterfactual reasoning on Convolution Neural Networks (CNNs) to identify significant filters responding to important regions, then it measures the similarity distance based on the counterfactual information learned with respect to each filter. We have verified the effectiveness of the method on the ImageNet dataset, in addition to four fine-grained datasets. Moreover, comprehensive experiments conducted on fine-grained datasets showed that CauSim can enhance the accuracy of existing FGVC architectures. The results can be reproduced using the code available in the GitHub repository https://github.com/HichemDebbi/CauSim_Upload.

[2521] *LSTM time series classification use case: sleep apnea detection*

Angela del Robledo Troncoso García (Data Science and Big Data Lab, Pablo de Olavide University (Spain)), María Martínez Ballesteros (University of Seville), Francisco Martínez Álvarez (Data Science and Big Data Lab, Pablo de Olavide University (Spain)) and Alicia Troncoso Lora (Data Science and Big Data Lab, Pablo de Olavide University (Spain)).

This paper explores the use of deep learning techniques for detecting sleep apnea. Sleep apnea is a common sleep disorder characterized by abnormal breathing pauses or infrequent breathing during sleep. The current standard for diagnosing sleep apnea involves overnight polysomnography, which is expensive and requires specialized equipment and personnel. The proposed method utilizes a Long-Short Term Memory neural network to analyze physiological signals, such as heart rate and respiratory patterns, that are recorded during sleep. The neural network is trained on a dataset of PSG recordings to identify patterns that are indicative of sleep apnea. The results compare the use of different physiological signals to detect sleep apnea. Nasal airflow seems to have the most accurate results and high specificity, whereas EEG and ECG have higher levels of sensitivity and specificity. This approach has the potential to provide automatic sleep apnea detection, being an accessible solution for diagnosing sleep apnea.

[2523] *Prediction of transportation orders in logistics based on LSTM: Cargo taxi*

Tomasz Grzejszczak (Silesian University of Technology), Adam Galuszka (Silesian University of Technology), Jarosław Śmieja (Silesian University of Technology), Marek Harasny (Giełda Papierów Wartościowych w Warszawie (GPW)) and Maciej Zalwert (Giełda Papierów Wartościowych w Warszawie (GPW)).

This work presents the application of LSTM neural network in prediction of transportation orders. In case of logistic transport, the empty return routs can be minimized by matching new orders in the vicinity of drop off of actual order. This is a similar approach to taxi, thus the approach is named cargo-taxi. To find the new orders in the vicinity of carrier, an LSTM network is used to predict the next towns that the carrier would visit basing on his actual route and archival routs that the network was trained on. This research focus on proof of concept, the way of constructing the training data, and the research of parameters influence on time of training and prediction.

[2706] *Fast Image Super-Resolution*

Aleksei Pokoev (HSE University) and Ilya Makarov (AIRI).

Single image super-resolution is important part of computer vision open problems. Recently, deep neural networks have demonstrated excellent performance in this problem. In this work, several cutting edge methods for super-resolution problem using deep neural networks will be considered. Comparison of their effectiveness and evaluation of neural networks architectures with respect to different metrics is one of our main goals for this research. Modern deep learning methods often require large computational cost and load a lot of computer memory, which affects the ease of use of neural networks and the time of generation super-resolution results. In addition to the existing models, we propose a new architecture of neural networks based on best properties of considered architectures and designed to eliminate their shortcomings. Furthermore, we compare the quality of all considered deep learning methods with baseline method of bicubic interpolation.

[2883] *X-ELM: A Fast Explainability Approach for Extreme Learning Machines*

Brandon Warner (Verseon Corp), Edward Ratner (Verseon Corp) and Amaury Lendasse (University of Houston).

Explainable Artificial Intelligence (XAI) has emerged as one of the key specializations in Machine Learning (ML) research. This has led to the rediscovery of Shapley values, a method originally applied to coalitional game theory to optimally distribute the “payout” (i.e., importance) of the “players” (i.e., features) of a model. More recently, Lundberg and Lee developed a sophisticated methodology to approximate Shapley values by computing SHAP (SHapley Additive exPlanations) values. Calculating global SHAP values is, however, computationally quite expensive. We propose eXplainable Extreme Learning Machine (X-ELM) values, which can be computed using coefficients of ELM parameters to wholistically evaluate the global importance of each feature in a dataset using a single ELM en-semble model. We compare the extracted ELM coefficients to values extracted using SHAP methods to show that our approach yields values comparable to the state-of-the-art (SOTA) game theoretic approaches at a dramatically lower computational cost

[2945] *Replacing goniophotometer with camera and U-Net with Hypercolumn rescale block*

Marek Vajgl (University Of Ostrava) and Petr Hurtik (IRAFM).

We deal with replacing a costly and slow goniophotometer device with a standard, inexpensive, and fast camera in the task of evaluating an illuminated area by a car headlamp. This solution is novel, has not yet been solved, and has the potential to speed up the process of prototyping headlamps. The difficulties lie in the significantly different resolutions of the two devices and in the disparity between intensities captured by the camera and goniophotometer due to the nonlinear behavior of the light. We propose to capture images by a camera with various exposure times and handle them as a multispectral image. The image is processed by U-Net architecture where we replaced the standard decoder with a Hypercolumn rescale block. The proposed scheme produces a mean absolute percentage difference between the real goniophotometer and our solution of less than 0.5%.

[3105] *Comparison of Fourier Bases and Asymmetric Network Bases in the Bio-inspired Networks*

Naohiro Ishii (Advanced Institute of Industrial Technology), Kazunori Iwata (Aichi University), Yuji Iwahori (Chubu University) and Tokuro Matsuo (Advanced Institute of Industrial Technology).

Machine learning, deep learning, and neural networks are extensively developed. Neural network architectures have shown a variety of applications. However, there is a need for explainable fundamentals in complex neural networks. In this paper, it is shown that bio-inspired networks are useful for the explanation of network functions. First, the asymmetric network is created based on the bio-inspired retinal network. They have orthogonal bases which correspond to the Fourier bases. Second, the classification performance of the asymmetric network is compared to the conventional symmetric network. Further, the asymmetric network is extended to the layered networks, which generate higher dimensional orthogonal bases. Their replacement operation is shown to be useful in the classification. Finally, it is shown that the sparse codes made of the higher dimensional bases are applied to the classification of real-world data.

[3142] *Coordination of Autonomous Mobile Robot Teams with Anticipatory Networks*

Andrzej M.J. Skulimowski (Dept. of Decision Sciences, AGH University of Science and Technology, Kraków).

The aim of this paper is to present a new approach to robot team coordination based on anticipatory networks. A related key notion is the virtual formation which explores arbitrary relations linking robots in a team. Both concepts serve to define a bi-level multicriteria optimization problem, where the optimization criteria at the higher level refer to the overall team performance. At the lower level each robot optimizes its individual criteria such as energy consumption or damage avoidance. This problem is solved with a heuristic anytime combinatorial nondominated subset selection algorithm and the reference-set-based robot preference model. The above approach has been applied to design a team of anticipatory fruit harvesting robots within a recent research project. We will point out the relations of this problem to the theory of cooperative systems. General anticipatory coordination principles have been also implemented in a digital twin model of autonomous robots in covered crops.

[3226] ***A generalized deep learning model for multi-disease Chest X-Ray diagnostics***

Nabit Bajwa (George Mason University), Kedar Bajwa (Shifa International Hospital), Muhammad Faique Shakeel (Shifa International Hospital), Atif Rana (Shifa International Hospital), Kashif Haqqi (Shifa International Hospital) and Suleiman Khan (Institute for Molecular Medicine, Finland).

We investigate the generalizability of deep convolutional neural network (CNN) on the task of disease classification from chest x-rays collected over multiple sites. We systematically train the model using datasets from three independent sites with different patient populations: National Institute of Health (NIH), Stanford University Medical Centre (CheXpert), and Shifa International Hospital (SIH). We formulate a sequential training approach and demonstrate that the model produces generalized prediction performance using held out test sets from the three sites. Our model generalizes better when trained on multiple datasets, with the CheXpert-Shifa-NET model performing significantly better (p-values < 0.05) than the models trained on individual datasets for 3 out of the 4 distinct disease classes.

[3337] ***What are the ethical paradoxes of using artificial intelligence in online communities?***

Cristina Fernandes (University of Beira Interior) and Pedro Veiga (University of Beira Interior).

This study, through undertaking a systematic review, seeks to map the research on ethics and the dark side of online communities in order to grasp where the literature has come from and where it is going and, consequently, providing opportunities for future research. This study applied a bibliometric approach based on analysis of the bibliographic coupling with the manual coding of documents to examine the literature on the ethics and the dark side of online communities to set out a holistic framework of its different facets. The content and the thematic analysis of 53 studies resulted in identifying four thematic groups. The findings of this study also highlight the various still existing shortcomings in the literature on the ethics and dark side of online communities and lead to some research questions that justify future academic research.

[3407] ***Phenotype Discrimination based on pressure signals by transfer learning approaches***

Marina Aguilar-Moreno (Universidad del País Vasco) and Manuel Graña (University of the Basque Country).

In this work we will analyse the data recorded with a multisensor system composed of a top video camera and a a piezoelectric pressure sensor that records the movement of animals. Specifically, this work aims to answer the research question of whether it is possible to differentiate phenotype of an model using transfer learning over the pressure signal alone. To do this, the piezoelectric signal will be analysed in the frequency domain by computing its spectrogram, and we segment the chunks corresponding to the locomotion events, previously detected. Convolutional neural models previously trained are used for classification by applying a transfer learning approach. The results show that an accuracy of more than 96% is obtained and confirmation that it is possible to classify phenotypes with the data obtained pressure sensors.

[3461] ***Deep learning recommendation system for stock market investments***

Stanislaw Osowski (Warsaw University of Technology) and Michal Parzyszek (Warsaw University of Technology).

The paper proposes and compares two models for creating a recommendation system in the stock market, based on convolutional neural networks (CNN). The first model encodes values of time series of the stock exchange quotations into multiple technical indicators incorporating them in the form of an image. The second model introduces some modifications of the previous approach by changing the definitions of the technical indicators. Both models are generated from the one-dimensional stock market data and saved as images. The CNN neural network uses these images in the training and testing phases. The numerical experiments aimed at maximizing profit from investments have been performed on the stock data of the six largest companies listed on the Warsaw Stock Exchange. The recommendations for companies were classified in the form of three classes (Buy, Sell, Hold). The numerical results for the proposed methods are presented and compared with other investment methods.

[3507] *Towards the Identification of Multiclass Lung Cancer Related Genes: An Evolutionary and Intelligent Procedure*

Juan Carlos Gómez López (University of Granada), Daniel Castillo Secilla (Fujitsu Technology Solutions S.A.), Jesús González Peñalver (University of Granada), Luis Javier Herrera Maldonado (University of Granada) and Ignacio Rojas Ruiz (University of Granada).

The amount of available transcriptomic data has rapidly increased. Besides, with the advances in Machine Learning and high performance computing, the computing efforts for analyzing those data is being reduced, leading to the design of CDSS for the precision medicine paradigm. As a result, the use of evolutionary methods for the study of cancer diseases has been successfully proposed. The main goal is the identification of set of genes which have the capability of discerning among ACC, SCC and healthy lung cancer. A DEGs analysis was performed by using RNA-seq data. After the first filter and, with the aim of finding the optimal combinations among DEGS candidates, an optimized evolutionary procedure was developed. Our custom method has the capability of maximizing the multiclass lung cancer recognition while minimizing the number of selected DEGs, getting an outstanding classification rate with a very reduced number of DEGs, biologically related to lung cancer.

[3732] *Prediction of blood glucose levels in patients with type 1 diabetes via LSTM neural networks*

Ciro Rodriguez (University of Granada), Oresti Banos (University of Granada), Oscar Fernandez Mora (Universidad Internacional de La Rioja), Alex Martinez Bedmar (Universidad Internacional de La Rioja), Fernando Rufo Jimenez (Universidad Internacional de La Rioja) and Claudia Villalonga (University of Granada).

Diabetes is one of the most prevalent diseases of the 21st century, with more than 500 million people affected. Having tools to estimate blood glucose levels is critical for these patients in their management of the disease. In this work, we present a comparison of three neural network architectures based on long short-term memory (LSTM). Their predictive ability has been evaluated against a longitudinal dataset with continuous glucose level measurements of patients with type 1 diabetes. All models, trained for different prediction horizons of 30, 60, 90 and 180 minutes, have generally yielded good prediction results. These results are further validated using clinical standards resulting in more than 95% of accurate blood glucose level predictions, mostly leading to correct treatments.

[3735] *Toward Machine's Artificial Aesthetic Perception: Could Machines Appreciate the Beauty?*

Mohand Tahar Soualah (Université Paris-Est Créteil, LISSI Laboratory EA 3956), Fatemeh Saveh (Université Paris-Est, LISSI Laboratory EA 3956) and Kurosh Madani (Université Paris-Est, LISSI Laboratory EA 3956).

To make cohabit humans and robots in the same living space, robots have not only develop rational awareness but also acquire emotional awareness regarding their surroundings. Investigating Emotional Machine-Awareness we tend to contribute in answering the following question: "likewise to human's emotional awareness, could the machine acquire Artificial Aesthetic Perception (AAP) proffering it kind of emotional esteem of the beauty of its environment?" In this paper we present a computational model of AAP, founded on art-philosophy's and psychology's basements. This allows us, on the one hand, to develop a model based on human being's intellectual mechanisms, and on the other hand, makes the model comprehensive regard the subjectivity inherent in the notion of "beauty". Experimental results obtained using two experimental data sets of various art-works (Wiki-Art and a home-made human's eye-fixation based dataset) show the pertinence of the investigated model firming up cognitive nature of the presented computational approach.

[3894] *A Quantum Computing Artificial Neuron*

Hernán I. de la Cruz (Universidad de Castilla-La Mancha), Jesús A. Fernández (Universidad de Castilla-La Mancha), Jose J. Paulet (University of Castilla-La Mancha), Fernando Cuartero (Universidad de Castilla-La Mancha) and Fernando López Pelayo (Universidad de Castilla-La Mancha).

This piece of research presents the first quantum computing implementation of an artificial neuron over continuous domain.

[3904] *Toward Early Stopping Detection for Non-Binary c-VEP-based BCIs: A Pilot Study*

Víctor Martínez-Cagigal (Biomedical Engineering Group (GIB), University of Valladolid), Eduardo Santamaría-Vázquez (Biomedical Engineering Group (GIB), University of Valladolid) and Roberto Hornero (Biomedical Engineering Group (GIB), University of Valladolid).

Code-modulated visual evoked potentials (c-VEPs) have potential as a reliable and non-invasive control signal for brain-computer interfaces (BCIs). However, these systems need to become more user-friendly. Non-binary codes have been proposed to reduce visual fatigue, but there is still a lack of adaptive methods to shorten trial durations. To address this, we propose a nonparametric early stopping algorithm for the non-binary circular shifting paradigm. The algorithm analyzes unattended commands' correlations and stops stimulation when the most probable correlation is an outlier. This proposal was evaluated with 15 healthy participants using maximal length sequences encoded with shades of gray. Results showed that the algorithm could stop stimulation in under two seconds for all sequences, achieving accuracies over 92%. The highest accuracy was achieved by the base 5, attaining 98.1% accuracy with an ITR of 122.9 bpm. The proposed algorithm reduces required cycles without compromising accuracy for c-VEP-based BCI systems.

[3942] *Event-based Regression with Spiking Networks*

Elisa Guerrero (Universidad de Cadiz), Fernando M. Quintana (Universidad de Cádiz) and Maria P. Guerrero-Lebrero (University of Cadiz).

Spiking Neuron Networks (SNNs), also known as the third generation of neural networks, are inspired from natural computing in the brain and recent advances in neurosciences. SNNs can overcome the computational power of neural networks made of threshold or sigmoidal units. Recent advances on event-based devices along with their great power, considering the time factor, make SNNs a cutting-edge priority research objective. In the literature, SNNs have been used mainly for classi cation problems, but their application to regression tasks remains challenging due to the complexity of training with continuous output data. This work deals with the analysis of the behavior of SNNs as pre- dictors of multivariable continuous values, for which a data set based on events has been generated from a bouncing ball, where the objective is to predict the next position of the ball over time.

[4106] *Bio-plausible digital implementation of a reward modulated STDP synapse*

Fernando M. Quintana (Universidad de Cádiz), Fernando Perez-Peña (Universidad de Cádiz) and Pedro L. Galindo (Universidad de Cádiz).

Reward-modulated Spike-Timing-Dependent Plasticity (R-STDP) is a learning method for Spiking Neural Network (SNN) that makes use of an external learning signal to modulate the synaptic plasticity produced by Spike-Timing-Dependent Plasticity (STDP). Combining the advantages of reinforcement learning and the biological plausibility of STDP, online learning on SNN in real-world scenarios can be applied. This paper presents a fully digital architecture, implemented on an Field-Programmable Gate Array (FPGA), including the R-STDP learning mechanism in a SNN. The hardware results obtained are comparable to the software simulations results using the Brian2 simulator. The maximum error is of 0.083 when a 14-bits fix-point precision is used in realtime. The presented architecture shows an accuracy of 95% when tested in an obstacle avoidance problem on mobile robotics with a minimum use of resources.

[4154] *Measuring fairness with biased data: A case study on the effects of unsupervised data in fairness evaluation*

Sarah Schröder (Bielefeld University), Alexander Schulz (Bielefeld University), Ivan Tarakanov (Bielefeld University), Robert Feldhans (Bielefeld University) and Barbara Hammer (Bielefeld University).

Evaluating fairness in language models has become an important topic, including different types of measurements for specific models, but also fundamental questions such as the impact of pre-training biases in finetuned models.

Ultimately, many rely on a data based evaluation using one of the few larger datasets for this purpose. We investigate one of them, the BIOS dataset \cite{biosbias}, that has been employed in several studies. It is an entirely unsupervised dataset, in the sense that it is scraped from the web and automatically labeled. We investigate this dataset in depth and expose a variety of flaws such as out-of-domain samples or falsely labeled samples, which particularly affect the biases measured on this dataset. We consider a subset that we review, relabel and clean, then reproduce fairness experiments from the literature both on the original and cleaned subset and demonstrate, that biases are strongly affected by the mentioned problems.

[4191] *Global Feature Importance in Dynamic Environments*

Fabian Fumagalli (Bielefeld University), Maximilian Muschalik (LMU Munich), Eyke Hüllermeier (LMU Munich) and Barbara Hammer (Bielefeld University).

Explainable artificial intelligence (XAI) recently emerged to enhance the interpretability of black-box machine learning models, where global feature importance (FI) is a popular method to understand a model's reasoning for a whole dataset or task. So far, XAI has primarily considered static learning scenarios, where underlying data distributions are stationary. In this work, we are interested in global FI scores for dynamic environments, which are computed incrementally over time and react to changing models and data distributions due to concept drift. We introduce a novel mathematical framework that directly extends removal-based explanations, introduced by Covert et al. (2021), to global FI in dynamic environments. We describe and address the challenges associated with efficient incremental global FI scores in dynamic environments with concept drift.

[4390] *Event-based classification of defects in civil infrastructures with Artificial and Spiking Neural Networks*

Udayanga K.N.G.W. Gamage (Department of Electrical and Photonics Engineering, Technical University of Denmark), Silvia Tolu (Department of Electrical and Photonics Engineering, Technical University of Denmark), Matteo Fumagalli (Department of Electrical and Photonics Engineering, Technical University of Denmark), Cesar Dario Cadena (Autonomous Systems Lab, ETH Zurich) and Luca Zanatta (DEI Department, University of Bologna, Bologna).

Small Multirotor Autonomous Vehicles (MAVs) can be used to inspect civil infrastructure at height, improving safety and cost savings. However, there are challenges to be addressed, such as accurate visual inspection in high-contrast lighting and power efficiency for longer deployment times. Event cameras and Spiking Neural Networks (SNNs) can help solve these challenges, as event cameras are more robust to varying lighting conditions, and SNNs promise to be more power efficient on neuromorphic hardware. This work presents an initial investigation of the benefits of combining event cameras and SNNs for the onboard and real-time classification of civil structural defects. Results showed that event cameras allow higher defect classification accuracy than image-based methods under dynamic lighting conditions. Moreover, SNNs deployed into neuromorphic boards are 65-135 times more energy efficient than Artificial Neural Networks (ANNs) deployed into traditional hardware accelerators. This approach shows promise for reliable long-lasting drone-based visual inspections.

[4415] *NOSpcimen: A first approach to unsupervised discarding of empty photo trap images*

David de la Rosa (Dept. of Computer Science, University of Jaén. Spain), Francisco Charte (Dept. of Computer Science, University of Jaén. Spain), María J. del Jesus (Dept. of Computer Science, University of Jaén. Spain), Antón Álvarez (WWF Spain. Spain), Ramón Pérez (WWF Spain. Spain), Germán Garrote (Consejería de Medio Ambiente y Agua. Junta de Andalucía. España) and Antonio J. Rivera (Dept. of Computer Science, University of Jaén. Spain).

A key tool in wildlife conservation is the observation and monitoring of wildlife using photo-trapping cameras. Every year, thousands of cameras around the world take millions of images. A large proportion of these are empty – they do not show any animals. Sorting out these blank images requires considerable effort from biologists, who spend hours on the task. It is therefore of particular interest to automate this task. So far, systems have been proposed which are based on the use of supervised learning models. In order to learn, these systems require the annotation of images to indicate where animals are located within them. NOSpcimen (NOn-SuPervised disCardIng of eMpty images based on

autoENcoders) system takes a different approach. It relies on unsupervised learning mechanisms. Thus, no prior annotation work is required to automate the process of discarding empty images.

[4495] *PITS: An Intelligent Transportation System in pandemic times*

Enrique Brazález Segovia (University of Castilla - La Mancha), Hermenegilda Macià (University of Castilla-La Mancha), Gregorio Díaz (University of Castilla - La Mancha), Valentín Valero (University of Castilla-La Mancha) and Juan Boubeta-Puig (University of Cádiz).

The control of a pandemic is a challenge for governments all around the globe. To manage this situation, countries have adopted a bundle of measures, including restrictions to mobility. As a consequence, drivers face with the problem of obtaining fast routes to reach their destinations. In this context, some recent works combine ITS with big data processing technologies taking the traffic information into account. However, there are no proposals able to gather COVID-19 health information, assist in the decision-making process, and compute fast routes in an all-in-one solution. We propose a Pandemic Intelligent Transportation System (PITS) based on CEP, Fuzzy Logic and CPNs. CEP is used to process the COVID-19 health indicators and Fuzzy Logic to provide recommendations about city areas that should not be crossed. CPNs are then used to create map models of health areas with the mobility restriction information and obtain fast routes to reach their destinations.

[4521] *Evaluating the Performance of Explanation Methods on Ordinal Regression CNN Models*

Javier Barbero Gómez (Universidad de Córdoba), Ricardo Cruz (Universidade do Porto), Jaime dos Santos Cardoso (Universidade do Porto), Pedro Antonio Gutiérrez (Universidad de Córdoba) and César Hervas (Universidad de Córdoba).

This paper introduces an evaluation procedure to validate the efficacy of explanation methods for CNN models in ordinal regression tasks. Two ordinal methods are contrasted against a baseline using cross-entropy, across four datasets. A statistical analysis demonstrates that attribution methods, such as Grad-CAM and IBA, perform significantly better when used with ordinal regression CNN models compared to a baseline approach in most ordinal and nominal metrics. The study suggests that incorporating ordinal information into the attribution map construction process may improve the explanations further.

[4624] *Implementation of a Neural Network for the Recognition of Emotional States by Social Robots, Using 'OhBot'*

Natalia Bartosiak (Silesian University of Technology), Adam Gałuszka (Silesian University of Technology) and Martyna Wojnar (Silesian University of Technology).

Convolutional Neural Networks are a popular approach for image classification problem. This article presents an overview of opensource facial expression datasets and performance comparison of CNN models. Evaluated model trained to detect seven basic emotions, on combined set of datasets offers 86, 7% of accuracy on a validation set and 97, 2% on a training set. In this work a system of automated appropriate response to human emotion expression and set of layers that ensure high performance are proposed. The system combines real-time CNN with robotic head OhBot. The information about current emotional state of a person based on its facial expression is the input signal for the subsystem controlling the robotic head, whose task is to react appropriate to the situation.

[4836] *Deep Learning Algorithms For Diagnosis of Coffee Plants Disease*

Nameer Baht (university of Malaga) and Enrique Domínguez (university of Malaga).

Coffee production faces a variety of difficulties, including the prevalence of coffee diseases that cause significant losses in production in terms of quantity and quality. The article aim to identify that artificial neural networks, specifically CNN, are one of the most important algorithms that work effectively in disease detection and image classification compared to other algorithms. this study helps researchers to use deep learning techniques to solve the current problem and classify

the most essential and common diseases that affect coffee plants. Based on the Arabica dataset (JMuBEN1) CNN achieved an overall 95% accuracy in diagnosing coffee leaf disease.

[4876] *ECG Hearbeat Classification Based on Multi-Scale Convolutional Neural Networks*

Ondrej Rozinek (University of Pardubice, Faculty of Electrical Engineering and Informatics) and Petr Dolezel (University of Pardubice, Faculty of Electrical Engineering and Informatics).

Clinical applications require automating ECG signal process- ing and classification. This paper investigates the impact of multiscale input filtering techniques and feature map blocks on the performance of CNN models for ECG classification. We conducted an ablation study using the AbnormalHeartbeat dataset, with 606 instances of ECG time series divided into five classes. We compared five multiscale input filtering techniques and four multiscale feature map blocks against a base model and non-multiscale input. Results showed that the combination of mean filter for multiscale input and residual connections for multiscale block achieved the highest accuracy of 64.47%. Residual connections were con- sistently effective across different filtering techniques, highlighting their potential to enhance CNN model performance for ECG classification. These findings can guide the design of future CNN models for ECG clas- sification tasks, with further experimentation needed for optimal combi- nations in specific applications.

[4894] *On-line authenticity verification of a biometric signature using dynamic time warping method and neural networks.*

Krzysztof Walentukiewicz (Gdańsk University of Technology), Albert Masiak (Gdańsk University of Technology), Aleksandra Gałka (Gdańsk University of Technology), Justyna Jelińska (Gdańsk University of Technology) and Michał Lech (Gdańsk University of Technology).

To ensure proper authentication, e.g. in banking systems, multimodal verification are becoming more prevalent. In this paper an on-line signature based on dynamic time warping (DTW) coupled with neural networks has been proposed. The goal of this research was to test if combining neural networks with DTW improves the effectiveness of verification of a handwritten signature, compared to the classifier based on fixed thresholds. The DTW algorithm was used as a feature extraction method and a similarity measure. Two neural network architectures were tested: multilayer perceptron (MLP) and one with convolutional neural network (CNN). A dataset containing model, verification and forged signatures gathered from a research group using a biometric pen has been created. The research has proved that the DTW coupled with neural networks perform significantly better than the baseline method - DTW model based on constant thresholds. The results are presented and discussed in this paper.

[5027] *Photovoltaic energy prediction using machine learning techniques*

Gonzalo Surribas-Sayago (Universidad de Malaga), Jose David Fernandez-Rodriguez (Universidad de Malaga) and Enrique Dominguez (Universidad de Malaga).

Solar energy is becoming one of the most promising power sources in residential, commercial, and industrial applications. Solar photovoltaic (PV) facilities use PV cells that convert solar irradiation into electric power. PV cells can be used in either standalone or grid-connected systems to supply power for home appliances, lighting, and commercial and industrial equipment. Managing uncertainty and fluctuations in energy production is a key challenge in integrating PV systems into power grids and using them as steady, standalone power sources. For this reason, it is very important to forecast solar energy power output. In this paper, we analyze and compare various methods to predict the production of photovoltaic energy for individual installations and network areas around the world, using statistical methods for time series and different machine learning techniques.

[5089] *Comparison of ANN and SVR for State of Charge Regression evaluating EIS spectra*

Andre Loechte (FH Muenster University of Applied Sciences), Jan-Ole Thranow (FH Muenster University of Applied Sciences), Felix Winters (FH Muenster University of Applied Sciences), Andreas Heller (FH Muenster University of Applied Sciences) and Peter Gloesekoetter (FH Muenster University of Applied Sciences).

The demand for energy storage is increasing massively due to the electrification of transport and the expansion of renewable energies. Current battery technologies cannot satisfy this growing demand because they are difficult to recycle and the energy density is insufficient. Metal-air batteries offer a high energy density because there is only one active mass inside the cell and the cathodic reaction uses oxygen from the ambient air. Typical characteristics are flat charge and discharge curves. Thus, the state determination of the system becomes more complex, since the voltage level is not sufficient to determine the state of the battery. In this context, electrochemical impedance spectroscopy is a promising candidate. Therefore, in this publication, electrochemical impedance spectroscopy is combined with multiple machine learning techniques to determine the state of charge during charging of the cell at non fixed charging currents.

[5099] *Interpretability of autoencoder latent space for passengers demand-sensitive planning on high-speed railways*

David Muñoz-Valero (Universidad de Castilla-La Mancha), Enrique Adrian Villarrubia-Martin (Universidad de Castilla-La Mancha), Julio Alberto López-Gómez (Universidad de Castilla-La Mancha) and Juan Moreno-Garcia (Universidad de Castilla-La Mancha).

The liberalization of the High-Speed Railway (HSR) passenger market in Spain presents challenges related to infrastructure management and competition among operators. This study proposes a demand-sensitive planning approach using autoencoders (AEs) in order to analyze and represent the underlying characteristics of demand in the latent space. The interpretability of the latent space allows to obtain valuable information from demand which can be used to generate railway services tailored to the needs of consumers.

[5171] *Efficient Transformer for Video Summarization*

Tatiana Kolmakova (HSE University) and Ilya Makarov (AIRI).

The amount of user-generated content is increasing daily. That is especially true for video content that became popular with social media like TikTok. Other internet sources keep up and easier the way for video sharing. That is why automatic tools for finding core information of content but decreasing its volume are essential. Video summarization is aimed to help with it. In this work, we propose a transformer-based approach to supervised video summarization. Previous works that used attention architectures either used lighter versions or loaded models with RNN modules, that slower computations. Our proposed framework uses all advantages of transformers. Extensive evaluation on two benchmark datasets showed that the introduced model outperform existed approaches on the SumMe dataset by 3% and shows comparable results on the TVSum dataset.

[5362] *Simulation of HREM crystalline nanoparticles images using Conditional Generative Adversarial Network*

Rubén Muñoz García (University of Cádiz), Guillermo Bárcena-González (University of Cádiz), Juan Carlos De la Torre Macías (University of Cádiz), Arturo Ponce Pedraza (University of Texas at San Antonio) and Pedro Luis Galindo Riaño (University of Cádiz).

In the electron microscopy field, sample preparation and the acquisition of images is a complex and expensive task. This exploratory work affords the task of simulating High Resolution Electron Microscopy (HREM) images using a Conditional Generative Adversarial Neural Network (CGAN) for the simula-tion of nanoparticles. The results obtained are promising and open the way to the generation of large electron microscopy image datasets for deep learning applications.

[5370] *Minimal Optimal Region Generation for Enhanced Object Detection in Aerial Images using Super-Resolution and Convolutional Neural Networks*

Iván García Aguilar (University of Malaga), Lipika Deka (The De Montfort University, United Kingdom), Rafael Marcos Luque Baena (University of Málaga, Spain), Enrique Domínguez Merino (University of Málaga, Spain) and Ezequiel López Rubio (University of Málaga, Spain).

In recent years, object detection has experienced impressive progress in several fields. However, identifying objects in aerial images remains a complex undertaking due to specific challenges, including the presence of small objects or tightly clustered objects. This paper proposes a novel methodology for enhancing object detection in aerial imagery by combining super-resolution and convolutional neural networks (CNNs). We begin by binarizing the grey zone of the image to detect roads and other regions of interest using the You Only Look Once (YOLO) model. Next, we generate minimal optimal regions. For every one of them, we apply Super-resolution (SR) to improve the number of pixels, generating a new image on which to re-infer. We then apply a CNN to these regions to detect objects more accurately. Our results show that the proposed methodology increases mean average precision in the Unmanned Aerial Vehicle Benchmark Object Detection and Tracking Dataset (UAVDT).

[5456] *Detection and visualization of user facial expressions*

Martyna Wojnar (Silesian University of Technology, Gliwice, Poland), Tomasz Grzejszczak (Silesian University of Technology, Gliwice, Poland) and Natalia Bartosiak (Silesian University of Technology).

The work covers topics in face detection, prediction of the position of the face landmarks as well as control of the graphical model. The purpose of the work is to create a vision system that detects the user's facial expressions and visualizes them on the created computer model. The scope of work includes detection of the face and face landmarks, creation of a graphic model of a character whose facial expressions can be modified, and control of the created model using data obtained from the camera image. The main objectives of the project are easy accessibility, simplicity of use and low cost of the tools used

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[5535] *Low-dimensional Space Modeling-based Differential Evolution: A scalability perspective on bbob-largescale suite*

Thiago Henrique Fonseca (Universidade Federal de Santa Catarina), Silvia Nassar (Universidade Federal de Santa Catarina), Alexandre César de Oliveira (Universidade Federal do Maranhão) and Bruno Agard (Polytechnique Montréal).

Scalability is a challenge for Large Scale Optimization Problems (LSGO). Improving the scalability of efficient Differential Evolution algorithms (DE) has been a research focus due to their successful application to high-dimensional problems. Recently, a DE-based algorithm called LSMDE (Low-dimensional Space Modeling-based Differential Evolution) has shown promising results in solving LSGO problems on the CEC'2013 large-scale global optimization suite. LSMDE uses dimensionality reduction to generate an alternative search space and Gaussian mixture models to deal with the information loss caused by uncertainty from space transformation. This paper aims to extend the initial research through the scalability analysis of the LSMDE's performance compared with its main competitors, SHADE-ILS and GL-SHADE, on bbob-largescale suite functions. The results show that although all competing algorithms perform worse as dimensionality increases, LSMDE outperforms the competition and is robust to dimensionality expansion in search spaces with diverse characteristics, achieving a target hit rate between 40% and 80%.

[5627] *Long-Term Hail Risk Assessment with Deep Neural Networks*

Mikhail Mozikov (Skolkovo Institute of Science and Technology), Ivan Lukyanenko (Moscow Institute of Physics and Technologies), Yury Maximov (Los Alamos National Laboratory), Ilya Makarov (Artificial Intelligence Research Institute) and Alexander Bulkin (Skolkovo Institute of Science and Technology, Moscow, Russia).

Hail risk assessment is crucial for businesses, particularly in the agricultural and insurance sectors, as it helps estimate and mitigate potential losses. Although significant attention has been given to short-term hail forecasting, the lack of research on climatological-scale hail risk estimation adds to the overall complexity of this task. Hail events are rare and localized, making their prediction a long-term open challenge.

One approach to address this challenge is to develop a model that classifies vertical profiles of meteorological variables as favorable for hail formation while neglecting important spatial and temporal information. The main advantages of this approach lie in its computational efficiency and scalability. A more advanced strategy involves combining convolutional layers and recurrent neural network blocks to process geospatial and temporal data, respectively.

This study compares the effectiveness of these two approaches and introduces a model suitable for forecasting changes in hail frequency.

[5638] *Fair Empirical Risk Minimization Revised*

Danilo Franco (University of Genoa), Luca Oneto (University of Genoa) and Davide Anguita (University of Genoa).

Artificial Intelligence is nowadays ubiquitous, thanks to a continuous process of commodification, revolutionizing but also impacting society at large. In this paper, we address the problem of algorithmic fairness in Machine Learning: ensuring that sensitive information does not unfairly influence the outcome of a classifier. We extend the Fair Empirical Risk Minimization framework, where the fair risk minimizer is estimated via constrained empirical risk minimization. In particular, we first propose a new, more general, notion of fairness which translates into a fairness constraint. Then, we propose a new convex relaxation with stronger consistency properties deriving both risk and fairness bounds. By extending our approach to kernel methods, we will also show that the proposal empirically over-performs the state-of-the-art Fair Empirical Risk Minimization approach on a number of real-world datasets.

[5752] *SpikeBALL: Neuromorphic dataset for object tracking*

Maria P Guerrero-Lebrero (University of CAdiz), F.M. Quintana (University of Cadiz) and E. Guerrero (University of Cadiz).

Most of widely used datasets are not suitable for SNNs due to the need to encode the static data into spike trains and then put them into the network. In addition, all these datasets have been generated to classify object and can not used it to solve object tracking problems. Therefore, we propose a new neuromorphic dataset, \textit{SpikeBALL}, for object tracking that contributes to improve the development of the SNN algorithm for these type of problems.

[5921] *Video Scene Segmentation based on Triple Loss Ranking*

Miguel Esteve Brotons (Telefonica I+D), Jorge Carmona Blanco (Telefonica I+D), Francisco Javier Lucendo (Telefonica I+D) and Jose Garcia-Rodriguez (University of Alicante).

Scene segmentation is the task of segmenting the video in groups of frames with a high degree of semantic similarity. In this paper, we contribute to the task of video scene segmentation with the creation of a novel dataset for temporal scene segmentation. In addition, we propose the combination of two deep models to classify whether two video frames belong to the same or a different scene. The first model consists of a triplet network that is composed of 3 instances of the same 2D convolutional network. These instances correspond to a multi-scale net that performs frame embedding efficiently based on their similarity. We feed this network with an efficient triplet sampling algorithm. The second model is responsible for classifying whether these embeddings correspond to frames from different scenes by fine-tuning a siamese network.

[5957] *AATiENDe: Automatic ATtention Evaluation on a Non-invasive Device*

Felix Escalona (University of Alicante), Francisco Gomez-Donoso (University of Alicante), Francisco Morillas-Espejo (University of Alicante), Monica Pina-Navarro (University of Alicante), Luis Marquez-Carpintero (University of Alicante) and Miguel Cazorla (University of Alicante).

The study of student attention is an important topic in education because this type of analysis provides important information to teachers to potentially improve the quality of their classes. In this paper, we present AATiENDe, a system that uses emotion recognition, gaze direction approximation and body posture analysis as features to classify whether students are paying attention to their computer screens. To do this, we use a mixture of deep learning-based techniques and novel machine learning techniques applied to tabular classifiers to produce the final predictions. We also capture and label a customized dataset to train the models. Our approach provides over 90\% accuracy using two cameras and over 80\% accuracy using only the foreground camera.

[5981] *Temporal Dynamics of Drowsiness Detection Using LSTM-Based Models*

Rafael Silva (Instituto Superior Técnico, Universidade de Lisboa; Instituto de Telecomunicações), Lourenço Abrunhosa Rodrigues (CardioID Technologies), André Lourenço (CardioID Technologies) and Hugo Plácido da Silva (Instituto Superior Técnico, Universidade de Lisboa; Instituto de Telecomunicações).

Different LSTM-based models were tested for binary drowsiness detection using the ULg Multimodality Drowsiness Database (DROZY). The dataset contains physiological signals and behavioral measures collected from participants during different experimental conditions designed to induce varying levels of drowsiness. The LSTM models were trained using a sequential approach using the inter-beat intervals, where they were exposed to increasing levels of drowsiness over time. The performance of the models was evaluated in terms of accuracy, precision, recall, F1-score, and AUC. The results showed that the stacked bidirectional LSTM model achieved the highest performance with an accuracy of 0.873, precision of 0.825, recall of 0.793, F1-score of 0.808, and AUC of 0.918. These findings suggest that LSTM-based models can learn to capture the temporal dynamics of drowsiness and make accurate predictions based on the current and previous levels of drowsiness.

[5995] *Towards a voxelized semantic representation of the workspace of mobile robots*

Antonio Jesús Pérez Bazuelo (University of Málaga), José Raúl Ruiz Sarmiento (University of Málaga), Gregorio Ambrosio Cestero (University of Málaga) and Javier Gonzalez-Jimenez (University of Malaga).

The primitives used to model objects in semantic maps heavily influence their suitability for certain robot tasks, as well as the computational load required to process them. This paper contributes a semantic mapping framework that incrementally and efficiently builds a voxelized representation of the robot workspace, providing a balanced trade-off between model expressiveness and computational load. Our proposal detect objects in intensity images coming from an RGB-D camera, and uses depth information to retrieve their point cloud representations. These point clouds are then voxelized and enhanced with their probability of belonging to certain object categories. Finally, voxels are fused with the semantic map in a Bayesian probabilistic framework. Efficiency comes from its client-server design, which allows multiple mobile robots to participate as clients and leaves computationally intensive processes to the server. The proposed framework has been evaluated in both simulated and real environments, yielding accurate voxelized representations.

[6156] *Optimizing an IDS (Intrusion Detection System) by means of Advanced Metaheuristics*

Antonio Mora (University of Granada), Maribel García-Arenas (University of Granada), Andrés Romero Horno (University of Granada) and Pedro Castillo (University of Granada).

Intrusion Detection Systems (IDSs) are a primary research area in Cybersecurity nowadays. These are programs or methods designed to monitor and analyze network traffic aiming to identify suspicious patterns/attacks. MSNM (Multivariate Statistical Network Monitoring) is a state-of-the-art algorithm capable of detecting various security threats in real network traffic data with high performance. However, semi-supervised MSNM heavily relies on a set of weights, whose values are usually determined using a relatively simple optimization algorithm. This work proposes the application of various Evolutionary Algorithm approaches to optimize this set of variables and improve the performance of MSNM against four types of attacks using the UGR'16 dataset (includes real network traffic flows). Furthermore, we analyzed the performance of a Particle Swarm Optimization approach and a Simulated Annealing algorithm, as a baseline. The results obtained are very promising and show that EAs are a great tool for enhancing the performance of this IDS.

[6181] *On the use of first and second derivative approximations for biometric online signature recognition*

Marcos Faundez-Zanuy (Tecnocampus) and Moises Diaz-Cabrera (Universidad de Las Palmas de Gran Canaria).

Feature extraction plays a key role in pattern recognition applications. In this paper, we explore the relevance of different approximations for feature ex-traction based on delta (first derivative) and delta-delta (second derivative) parameters. Experimental results obtained with MCYT330 online signature database for identification and verification reveals an

omptimal value of eleven points approximation, yielding a relative improvement of 1.4% in identification rate, 36.8% in random forgeries and 1.4% in skilled forgeries over the one point approximation.

[6268] *Unsupervised Clustering at the Service of Automatic Anomaly Detection in Industry 4.0*

Dylan Molinié (LISSI - Université Paris-Est Créteil (UPEC)), Kurosh Madani (LISSI - Université Paris-Est Créteil (UPEC)) and Véronique Amarger (LISSI - Université Paris-Est Créteil (UPEC)).

Industrial processes are among the most complex systems, for they are dynamic, nonlinear and comprise many interdependent parts. In the scope of the contemporaneous fourth industrial revolution, known as Industry 4.0, the trend is to integrate Artificial Intelligence and hyper-connectivity to intelligently exploit any available system's resources. A key issue for system management is the control of anomalies, which may cause failures if not corrected rapidly, or affect product quality; defining and knowing how to handle them is thus highly important. In this paper, we propose to apply Machine Learning-based unsupervised clustering to industrial data to automatically identify the anomalies historically encountered; this is expected to help understand the system and define a framework for failures prediction. We show that unsupervised clustering is able to detect salient data groups, which can therefore be classified as anomalies by comparing them to the regular system's behaviors, obtained using another unsupervised clustering round.

[6469] *Fall Detection in Smart Environments: A Comparative Study between Thermal Cameras and IMU-based Devices*

Marcos Lupión Lorente (University of Almería), Luz López (University of Almería), Vicente González-Ruiz (University of Almería), Juan Francisco Sanjuan Estrada (University of Almeria) and Pilar M. Ortigosa (University of Almeria).

Falls are a major concern among older adults due to their declining psychomotor skills, leading to adverse health outcomes and frequent placement in long-term care centers. Smart environments utilizing IoT technology have been developed to detect falls accurately and quickly, enabling older adults to live independently. Wearable devices such as wristbands and cameras have been proposed for this purpose, but limitations such as battery autonomy and privacy concerns can hinder their deployment. In this work, two IMU-based devices and three thermal cameras were deployed in a Smart Home to assess the advantages and disadvantages of each type of device in a common setup. Preliminary results show that both types of devices achieve more than 90% accuracy, indicating a promising performance when used together.

[6564] *Random Forests Model for HVAC System Fault Detection in Hotel Buildings*

Iva Matetić (University of Rijeka, Faculty of Engineering), Ivan Štajduhar (University of Rijeka, Faculty of Engineering), Igor Wolf (University of Rijeka, Faculty of Engineering), Darko Palaić (University of Rijeka, Faculty of Engineering) and Sandi Ljubic (University of Rijeka, Faculty of Engineering).

Heating, ventilation, and air conditioning (HVAC) systems are essential for maintaining a comfortable indoor environment in modern buildings. However, HVAC systems are known to consume a lot of energy, which can account for up to 50% of a building's energy consumption. Therefore, it is important to detect and troubleshoot problems in HVAC systems timely. Fault detection and diagnosis (FDD) techniques can help with HVAC monitoring and optimizing system performance for efficient use of energy. In this paper, we demonstrate how to create efficient fault detectors using physics-based modeling and machine learning. We show how to build a simulation model of a hotel building, which we then use to sample augmented data with typical faults commonly found in HVAC systems. We train predictive models using random forests (RFs). The results suggest that RFs can be used as stand-alone detectors for FDD, albeit their performance depends heavily on the data quality.

[6652] *A Scalable Binary Neural Associative Memory on FPGA*

Marius Kortekamp (Bielefeld University), Sarah Pilz (Bielefeld University), Jens Hagemeyer (Bielefeld University) and Ulrich Rückert (Bielefeld University).

The human brain and its ability to associate is one of the most fascinating things in nature. The long-known concept of binary neural associative memory offers the possibility to build a very simple hardware architecture, that allows direct association. In a BINAM the presented input is associated with the stored content of the memory, without the need for addressing. Hereby the BINAM is a fault-tolerant concept, which allows that erroneous input vectors will usually result in a correct output. We propose a modern hardware architecture of a BINAM on the VCU1525 FPGA board. We implemented the architecture in VHDL as a scalable, modular, generic, and easy to use design. For the evaluation designs in the range of 8,000 to 740,000 neurons have been generated and tested. Currently, a maximum clock frequency of ∼200 MHz with a resource utilization of only ∼33% CLB, ∼22% LUTs, and ∼10% FF can be achieved.

[6680] *A deep transfer learning approach to support opportunistic wearable activity recognition*

Oresti Banos (University of Granada), David Gil (University of Alicante), Javier Medina (University of Granada), Adrian Sanchez (University of Granada) and Claudia Villalonga (University of Granada).

Most wearable activity recognition systems are defined to be used for a specific sensor setup. However, changes in the body sensor network are sometimes experienced due to sensor failures or upgrades. In such cases, the default activity recognition models are no longer applicable and a complete retraining of the system is normally needed, which is both time and resource-consuming. In this work, we present a deep transfer learning approach to automatically instruct new unseen wearable sensors by using the recognition capabilities of the existing activity recognition models used for the default sensor setup. The proposed approach is validated in a popular wearable activity recognition dataset, yielding quite promising results.

[6744] *Automatic recording and processing of saccadic electrooculograms*

Roberto Antonio Becerra García (University of Malaga), Gonzalo Joya (University of Malaga), Rodolfo García-Bermúdez (Centro Docente de Formación Profesional CENEC, Málaga) and Francisco Garcia-Lagos (University of Malaga).

This work presents a technology that processes human eye movement records in a fully automatic way. Our research has two complementary objectives: design a fully automatic method to extract the relevant medical data from saccadic eye movement record- ings; and design and testing a low-cost device to record eye movements for clinical purposes. To accomplish the first goal, we have defined a processing pipeline which comprises the following blocks: filtering, differentiation, segmentation and biomarkers extraction. For each one of these blocks, we have analyzed the current methodology employed and obtained a set of methods and algorithms that fit best for our kind of signals. To fulfill the second goal, we present the development of a low-cost equipment that uses electrooculography to record eye movements. The system was tested by analyzing the data recorded to 10 healthy volunteers and comparing them against data from professional equipment and results in literature.

[6779] *A model for classifying emergency events based on social media multimodal data*

Zhenhua Wu (University of Chinese Academy of Sciences), Liangyu Chen (University of Chinese Academy of Sciences) and Yuantao Song (University of Chinese Academy of Sciences).

Social media has emerged as a crucial source of information for emergency management. However, the diverse range of data types, including textual and visual information, presents a significant challenge for scholars seeking to analyze this information effectively. In this paper, we propose a novel multimodal model that employs cross-attention mechanisms to effectively integrate textual and visual information. The model is further enhanced with attention-based pooling layer, whole word masking, and RandAugment image data enhancement techniques, which are leveraged to classify contingencies in social media tweets. Empirical evaluation on the CrisisMMD dataset demonstrates that our model outperforms multiple existing baseline approaches for informative tasks and humanitarian action classification tasks. These results affirm the effectiveness of the model in integrating features from multiple modalities and demonstrate its superior generalization capabilities.

[6803] *Halyomorpha Halys Detection in Orchard from UAV Images Using Convolutional Neural Networks*

Alexandru Dinca (University Politehnica of Bucharest), Dan Popescu (Politehnica University of Bucharest), Cristina Maria Pinotti (University of Perugia), Loretta Ichim (University Politehnica of Bucharest), Lorenzo Palazzetti (University of Florence) and Nicoleta Angelescu (Valahia University of Targoviste).

Halyomorpha halys, commonly known as the brown marmorated stink bug, is an invasive insect that causes significant damage in orchards. Neural net-works have the potential to improve insect pest detection and classification in modern agriculture, which can lead to better pest management. The de-tection of these insects in orchards using drones imposes special problems because the images are taken from a limited distance and the foliage of the trees makes detection difficult. In this article, we studied the possibility of detecting the respective insects using the latest generation Yolo v8 neural networks and compared the results with the well-known Yolo v5 network. The results were obviously better for Yolo v8: accuracy = 94.55%. However, satisfactory results were also obtained in the case of YOLOv5: accuracy = 94.55%.

[6929] *Gender Influence on cVEP-based BCI Performance*

Ivan Volosyak (Rhine-Waal University of Applied Sciences), Foluke Adepoju (Rhine-Waal University of Applied Sciences), Piotr Stawicki (Rhine-Waal University of Applied Sciences), Paul Rulffs (Rhine-Waal University of Applied Sciences), Atilla Cantürk (Rhine-Waal University of Applied Sciences) and Lisa Henke (Rhine-Waal University of Applied Sciences).

This paper investigates performance differences in code-modulated visual evoked potentials based BCI system between subjects of different genders. In this regard, the cVEP-based spelling interface with four targets was tested between two gender groups - 18 females and 18 males each, with ages ranging from 20 to 39 years. Three different spelling tasks were performed - writing of two command-balanced words and a pangram. Both groups (female and male) successfully completed all spelling tasks, achieving for the pangram task, a mean information transfer rate of 29.38 bits per minute, and 28.09 bpm, respectively. Although the difference was not statistically significant for the pangram task, recognizable differences were observed for the command-balanced tasks. Consequently, a trend (rather than a substantial difference) was realized between the male and female groups' performance in the pangram task. Regarding the level of annoyance, subjects from both groups rated similar results on the visual stimulation setup.

[7009] *Embedded temporal feature selection for time series forecasting using deep learning*

Manuel Jesús Jiménez Navarro (University of Seville), María Martínez Ballesteros (University of Seville), Francisco Martínez-Álvarez (Universidad Pablo de Olavide) and Gualberto Asencio-Cortés (Pablo de Olavide University).

Traditional time series forecasting models often use all available variables, including potentially irrelevant or noisy features, which can lead to overfitting and poor performance. Feature selection can help address this issue by selecting the most informative variables in the temporal and feature dimensions. However, selecting the right features can be challenging for time series models. Embedded feature selection has been a popular approach, but many techniques do not include it in their design, including deep learning methods, which can lead to less efficient and effective feature selection. This paper presents a deep learning-based method for time series forecasting that incorporates feature selection to improve model efficacy and interpretability. The proposed method uses a multidimensional layer to remove irrelevant features along the temporal dimension. The resulting model is compared to several feature selection methods and experimental results demonstrate that the proposed approach can improve forecasting accuracy while reducing model complexity.

[7054] *CPMC: A multi-level controllable music generation model with fine-grained control*

Weipeng Wang (Zhengzhou University), Ziqiang Hu (Department of Applied and Computational Mathematics and Statistics, University of Notre Dame), Xiaobing Li (Central Conservatory of Music), Yun Tie (Zhengzhou University) and Qi Lin (Zhengzhou University).

Music generation tasks have been well developed, but the black box character of the music generation process that has been limiting its application. In this paper, we first classify music into three levels according to its essentially different nature and extract the corresponding interpretable control attributes. Then by adding the control attributes to the music representation, a multi-level connection between music generation process and human composition is established, which makes the music generation process highly controllable and easier to generate music that matches the composer's motivation. Meanwhile, this paper proposes a model CPMC with multi-level control attributes, which can exert different influences on the model according to the three levels divided by music, thus adjusting the gen-eration results in all aspects. The experiments show that our generative model not only improves on the basic music metric compared to the baseline, but also per-forms well on the controllability metric.

[7078] *Fast Convolutional Analysis of Task-based fMRI Data for ADHD Detection*

Federica Colonnese (DIET Dept., University of Rome "La Sapienza"), Francesco Di Luzio (DIET Dept., University of Rome "La Sapienza"), Antonello Rosato (DIET Dept., University of Rome "La Sapienza") and Massimo Panella (DIET Dept., University of Rome "La Sapienza").

Among the most common neurodevelopmental disorders, Attention Deficit Hyperactivity Disorder (ADHD) is a complex and challenging one to be identified. There are no objective medical techniques, and diagnoses are based only on interviews and symptoms evaluated by psychiatrists. In the recent years, the use of Deep Learning has emerged as a promising solution for accurately classifying ADHD, using non-intrusive advanced imaging techniques such as task-based fMRI data. They enable researchers to examine the functional activity of the brain during tasks that involve working memory, which is known to be affected in individuals with this disorder. In this paper, we introduce a 3D Convolutional Neural Network-based approach that uses individual time instants of working memory task-based fMRI data for real-time ADHD classification. The proposed approach achieves a remarkable accuracy with a very fast inference phase and hence, it is suitable for real-time classification and integration into medical systems, including computer-aided diagnosis.

[7177] *A Performance Evaluation of Lightweight Deep Learning Approaches for Bird Recognition*

Dmitrij Teterja (University of Alicante), Jorge Azorin-Lopez (University of Alicante), Jose Garcia-Rodriguez (University of Alicante), Esther Sebastian-Gonzalez (University of Alicante), Srdjan Krco (DunavNet, Novi Sad), Dejan Drajic (DunavNet, Novi Sad) and Dejan Vukobratovic (University of Novi Sad).

Reliable identification of bird species is a critical task for many applications, such as conservation biology, biodiversity assessments, and monitoring bird populations. However, identifying birds in the wild by visual observation can be time-consuming and prone to error. There is a growing need for efficient and accurate bird recognition methods that can help researchers and conservationists to identify bird species quickly and reliably. In this paper, we provide a comparative analysis of performance of state-of-the-art deep convolution neural networks on a significantly sized bird dataset, with the aim of developing a more accurate and efficient bird recognition method able to work in edge computing devices. The results show that lightweight networks as EfficientNetB0 provide a great accuracy (more than 97%) and low time of response with a small demand for technological resources. Our findings could provide a reliable means of identifying bird species in the wild.

[7192] *Offline substitution Machine Learning model for the prediction of fitness of GA-ARM.*

Leila Hamdad (Ecole nationale Supérieure en Informatique, ESI, laboratoire LCSI), Cylia Laoufi (Ecole nationale Supérieure en Informatique, ESI), Rima Amirat (Ecole nationale Supérieure en Informatique, ESI), Karima Benatchba (Ecole nationale Supérieure en Informatique, ESI, laboratoire LMCS.) and Souhila Sadeg (Ecole nationale Supérieure en Informatique, ESI, laboratoire LMCS.).

Association rule mining (ARM) is one of the most popular tasks in the field of data mining, very useful for decision-making. It is an NP-hard problem for which Genetic algorithms have been widely used. This is due to the obtained competitive results. However, their main drawback is the fitness computation which is time-consuming, especially when working with huge data. To overcome this problem, we propose an offline approach in which we substitute the computation of the fitness of a GA with a Machine Learning model. The latter will predict the quality of the different

generated solutions. The performed tests on several wellknown datasets of different sizes show the effectiveness of our approach

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[7299] *Neonatal Incubator Modeling and Adaptive Neural Control Using the SIMSCAPE Object-Oriented Approach*

Javier Fernandez de Canete (University of Malaga) and Inmaculada Garcia Moral (University of Malaga).

Thermoregulation is a major problem in premature infants, which are often kept in neonatal incubators to maintain thermal and moisture conditions. The objective of this study is the realization of a physical model of a neonatal incubator, and the design of an automatic adaptive control system based on neural networks that regulates the temperature inside the incubator along with the temperature of the neonate's skin. This modelling task is performed by using the object-oriented language MATLAB-SIMSCAPE using physical interconnected components to define the underlying dynamic equations, together with the use of MATLAB neural network tools to design the temperature controller. Computer simulation results show the ability of the neural control to maintain a stable temperature inside the incubator in face of external air temperature disturbances. The adaptive nature of the control approach presented makes it possible to adjust the thermoregulation treatment to the specific needs of each infant.

[7372] *Random ensemble of extended CNN structures for medical image recognition*

Stanislaw Osowski (Warsaw Uiversity of Technology), Bartosz Swiderski (University of Life Sciences, Warsaw), Jaroslaw Kurek (University of Life Sciences, Warsaw) and Cezary Chudobinski (Copernicus Regional Multi-Speciality Oncology and Trauma Centre, Lodz).

The paper presents new approach for creating ensemble of deep neural CNN networks for medical image recognition. The idea is to add the extra layer of limited number of neurons to two different CNN structures. The added layers in both networks are fully connected to the previous flattened layer of the CNN. The outputs of these two layers are randomly mixed to form the set that supplies final classifier. Averaging results of many repetitions of such a procedure with random weights provides the final classification decision. Such a form of signal processing is equivalent to implicit regularization. The proposed system has been applied to the recognition of images representing two classes of USG images of lymph nodes. The extensive experiments have shown an advantage over the results obtained by using the same standard CNN structures. The proposed method can be easily adapted to other deep network structures and different tasks.

[7376] *TM-SNN: Threshold Modulated Spiking Neural Network for Multi-task Learning*

Paolo Gabriel Cachi Delgado (Virginia Commonwealth University), Sebastián Ventura (University of Cordoba. Dept. of Computer Science and Numerical Analysis) and Krzysztof Cios (Professor and Chair).

This paper introduces a spiking neural network able to learn multiple tasks using their unique characteristic, namely, that their behavior can be changed based on the modulation of the firing threshold of spiking neurons. We designed and tested a threshold-modulated spiking neural network (TM-SNN) to solve multiple classification tasks using the approach of learning only one task at a time. The task to be performed is determined by a firing threshold: with one threshold the network learns one task, with the second threshold another task, etc. TM-SNN was implemented on Intel's Loihi2 neuromorphic computer and tested on neuromorphic NMNIST data. The results show that TM-SNN can actually learn different tasks through modifying its dynamics via modulation of the neurons' firing threshold. It is the first application of spiking neural networks to multi-task classification problems.

[7443] *Pilot Program to Attract Talented Students in STEM, with a Focus on Girls*

Marta Musté (UPC), Marta Díaz (UPC), Xavier Parra (UPC) and Andreu Català (UPC).

STEM jobs, specifically in Computer Science and ICT, are in high demand worldwide, with a 12.8% increase predicted by 2030. However, women only make up 27% of STEM professionals. This gender imbalance is due to a lack of role models, unconscious bias, a confidence gap, and the unfriendly academic environment in STEM fields. The Community Driven

Technology (TOC) research group at UPC is proposing a pioneering Catalonia program to attract talented youngsters, especially girls, between 7 and 14. The five-module program covers mathematics, mechanics, electricity, robotics, and computer science. Students will give feedback on activities in each module to track their interest in tech and identify potential career paths. TOC is committed to empowering female students with autonomous working and confidence-boosting measures, breaking any gender stereotypes. The group aims to enable students to overcome challenges in STEM fields with the knowledge that mistakes can lead to learning.

[7493] *An approach to predicting social events via dailies tracking*

Zeev Volkovich (Braude College of Engendering, Karmiel, Israel), Renata Avros (Braude College of Engendering, Karmiel, Israel), Dan Lemberg (Braude College of Engendering, Karmiel, Israel) and Elena Ravve (Braude College of Engendering, Karmiel, Israel).

The study is devoted to a novel method for a real-time prediction of significant discontinuities in social states using the automatic analyses of Arabic dailies' overall logical structures. The paper introduces the novel, named the super-frequent N-gram approach and the Regression Mean Rank Dependency characteristic and presents their arrangement with a new model. It makes it possible to reliably forecast social changes based on the dailies' semantic content's high-level repercussions. An evaluation of the approach in a prominent Arabic daily demonstrates its ability to reflect changes in the social state and expose significant events of the "Arab Spring". The study shows that the resulting N-gram models corresponding to different sizes of N can provide a more vital prediction tool so that the methodology can consistently predict substantial changes in the social state in an online simulation fashion.

[7688] *Enhancing Efficiency at BAMline: Employing Data Science and Machine Learning for X-Ray Research*

Martin Radtke (BAM), Cafer Tufan Cakir (Bundesanstalt für Materialforschung und -prüfung (BAM)) and Ana Guilherme Buzanich (Federal Institute for Materials Research and Testing (BAM)).

This contributions investigates the use of Bayesian optimization and Gaussian processes at BAMline, a potent synchrotron research tool, to address challenges in data acquisition, processing, analysis, and interpretation. These methods substantially improve beamline component alignment and sample scanning efficiency, enabling researchers to achieve comparable results with fewer measurements and less time. As X-ray research progresses, these techniques will be vital for tackling complex synchrotron data challenges and opportunities.

[7755] *Driver's Condition Detection System Using Multimodal Imaging and Machine Learning Algorithms*

Paulina Leszczełowska (Gdańsk University of Technology), Maria Bollin (Gdańsk University of Technology), Karol Lempkowski (Gdańsk University of Technology), Mateusz Żak (Gdańsk University of Technology) and Jacek Rumiński (Gdańsk University of Technology).

To this day, driver fatigue remains one of the most significant causes of road accidents. In this paper, a novel way of detecting and monitoring a driver's physical state has been proposed. The goal of the system was to make use of multimodal imaging from RGB and thermal cameras working simultaneously to monitor the driver's current condition. A custom dataset was created consisting of thermal and RGB video samples. Acquired data was further processed and used for the extraction of necessary metrics pertaining to the state of the eyes and mouth, such as the eye aspect ratio (EAR) and mouth aspect ratio (MAR), respectively. Breath characteristics were also measured. A customized residual neural network was chosen as the final prediction model for the entire system. The results achieved by the proposed model validate the chosen approach to fatigue detection by achieving an average accuracy of 75% on test data.

[7860] *Fine-Tuned SqueezeNet Lightweight Model for Classifying Surface Defects in Hot-Rolled Steel*

Francisco López de la Rosa (Universidad de Castilla-La Mancha), José Luis Gómez-Sirvent (Universidad de Castilla-La Mancha), Lidia María Belmonte Moreno (Universidad de Castilla-La Mancha), Rafael Morales Herrera (Universidad de Castilla-La Mancha) and Antonio Fernández-Caballero (Universidad de Castilla-La Mancha).

The advent of powerful artificial intelligence-based tools is opening up new opportunities to improve the efficiency of processes in the manufacturing industry. One of those processes is visual inspection, where deep learning approaches, particularly convolutional neural networks (CNNs), have achieved human-level defect classification performance. The problem in using CNNs is that training takes a long time and they are computationally expensive. However, in recent years, lightweight models have emerged as an alternative. The most representative lightweight model is SqueezeNet, which can compete with deep CNNs in terms of classification performance with few trainable parameters. In this paper, a SqueezeNet model is used to classify surface defects on hot-rolled steel plates in a public surface defect database. The model is fine-tuned using a grid search algorithm and evaluated by 5-fold cross-validation, achieving an F1-score of 0.96984.

[7864] *On macroscopic observations about COVID-19 mortality in Israel*

Manuel Graña (University of the Basque Country) and Goizalde Badiola (University of the Basque Country).

Regarding studies about COVID-19 mortality, the predominant approaches in the literature are machine learning models trying to predict the time series on the basis of previous observations independently of other relevant time series. In this extended abstract and subsequent presentation at the conference, if accepted, we would like to address the issue of the relation among diverse measures of pandemic evolution on the basis of the data published at the well known ourworldindata.org site (OWD).

[7878] *Classification of subjectively evaluated images with Self-Enforcing Networks using reference types, and a cue validity factor*

Christina Kluever (CoBASC Research Group) and Jürgen Klüver (CoBASC Research Group).

Learning and classifying images with neural networks that are evaluated by humans according to subjective criteria is a major challenge. In this case, the ambient lights for luxury cars were scratched or manipulated under laboratory conditions to check the homogeneous radiation of the light. The intact and defective ambient lights were inserted in a special system and recorded with a built-in camera and at a later point in time evaluated. Using a Self-Enforcing Network (SEN), forming reference types for each flowless and fault type, and determining a so-called cue validity factor is a promising approach to correctly cluster and classify subjectively labeled images. We demonstrate the advantage of SEN based on the classification of ambient lighting, compared to previous approaches with Convolutional Neural Networks (CNN) and Deep Belief Networks (DBN).

[8027] *Advanced architecture of a home-based patient monitoring system for diabetes. Initial experiences in a real environment.*

David Díaz Jiménez (Universidad de Jaén), José Luis López Ruiz (Universidad de Jaén), Alicia Montoro Lendínez (Universidad de Jaén), Jesús González Lama (Maimonides Biomedical Research Institute of Cordoba (IMIBIC)) and Macarena Espinilla Estévez (University of Jaen).

Diabetes is a disease that requires monitoring of healthy habits for its treatment. A recent study suggests that sensor-based activity recognition approaches are a suitable tool for monitoring such habits that are established between clinical personnel and the patient through a therapeutic contract. To date, there is no fully described system architecture for implementing a sensor-based activity recognition approach to monitor healthy habits. In this paper, we present the advanced architecture of a system for monitoring healthy habits of multiple diabetes patients in their homes. The presented system, called AI2EPD, features a complex architecture that encompasses from the sensor devices deployed in each patient's home to persistence in the central server and visualisation in the technical and clinical interface. The system has been deployed in the municipality of Cabra in Córdoba (Spain) in collaboration with the Cabra Health Center. Sensor installation, issues and challenges encountered during system deployment, are presented.

[8069] *Time Series forecasting with Quantum Neural Networks*

Manuel P. Cuéllar (University of Granada), María del Carmen Pegalajar (University of Granada), Luis Gonzaga Baca Ruiz (University of Granada) and Carlos Cano-Gutierrez (University of Granada).

In this work we explore the use of Quantum Computing for Time Series forecasting. More specically, we design Variational Quantum Circuits as the quantum analogy of feedforward Articial Neural Networks, and use a quantum neural network pipeline to perform time series forecasting tasks. According to our experiments, our study suggests that Quantum Neural Networks are able to improve results in error prediction while maintaining a lower number of parameters than its classical machine learning counterpart.

[8129] *Intra- and all-day PV power forecasting using expansion PDE models composed of the L-transform components in nodes of step-by-step evolved polynomial binary-nets*

Ladislav Zjavka (VŠB-Technical University of Ostrava, Ostrava) and Václav Snášel (VŠB-Technical University of Ostrava, Ostrava).

Photo-Voltaic (PV) power is one of the most important energy sources in back-country regions or developing countries with missing infrastructure. Intra- or all-day statistical models can predict PV power for a plant-specific location and con-dition. Differential Polynomial Neural Network (D-PNN) is a novel neurocom-puting technique that can model weather characteristics. D-PNN decomposes the n-variable Partial Differential Equation (PDE), allowing a complex representation of the near-ground atmospheric dynamics, into a set of 2-input node sub-PDEs. These are converted and substituted using the Laplace transform formulations of Operation Calculus. D-PNN produces applicable PDE components, one by one using the selected binary nodes to extend its sum models. Historical spatial data are examined to pre-assess daily training samples for a specific inputs->output time shift used in forecasting Clear Sky Index. Iterative 1-9 hour and 24-hour se-quence PV power prediction models using machine learning and statistics are compared to evaluate the model performance.

[8169] *Iterative Graph Embedding and Clustering*

Artem Oborevich (National Research University Higher School of Economics) and Ilya Makarov (AIRI).

Graph embedding can be seen as a transformation of any graph into low-dimensional vector space, where each vertex of the graph has a one-to-one correspondence with a vector in that space. The latest study in this field shows a particular interest in a slightly different approach of graph embedding, where each node is inclined to preserve a community membership to respect high-order proximity and community awareness. We investigate different options of solving both tasks jointly, so a practical solution to one problem could be shared to enhance a solution to another problem and vice-versa. We imply that many iterations of such transferring can be made to achieve better results in both problems simultaneously. As a result of our work, we introduce a model that outperforms traditional methods which consider problems of graph embedding and community detection separately.

[8220] *On stability assessment using the WalkIT smart rollator*

Manuel Fernandez-Carmona (University of Malaga), Joaquin Ballesteros (Universidad de Málaga), Jesus Manuel Gomez-De-Gabriel (Universidad de Málaga) and Cristina Urdiales (ISIS group University of Malaga).

Stability loss may lead to serious injury. Fall risk is often assessed using wearable sensors and/or external motion capture devices. However, these approaches may not be valid for all environments. As rollators are widely used to improve stability and provide physical support, in this work we propose a stability assessment method to proactively predict balance using only onboard rollator sensors. We use Machine Learning to predict how a person's gait is affecting their stability. Prediction can be used to proactively provide warnings or, if the rollator allows it, to physically affect gait to reduce fall risk. The method has been tested by volunteers using a smart rollator. Best results in terms of instability prediction were obtained using Regression Trees.

[8278] *Bit-wise reconstruction of non-binary visual stimulation patterns from EEG using deep learning: a promising alternative for user-friendly high-speed c-VEP-based BCIs*

Eduardo Santamaría-Vázquez (University of Valladolid), Víctor Martínez-Cagigal (University of Valladolid) and Roberto Hornero (University of Valladolid).

Brain-computer interfaces (BCI) based on code-modulated visual evoked potentials (c-VEP) have shown great potential for communication and device control. These systems encode each command using different sequences of visual stimuli. Normally, the stimulation pattern is binary (i.e., black and white), but non-binary stimuli sequences with different shades of gray could reduce eyestrain and improve user-friendliness. This study introduces a novel approach to decode non-binary visual stimuli patterns from electroencephalography (EEG) signals using deep learning. The proposed method uses, for the first time, a bit-wise reconstruction strategy for stimulation patterns encoded with 2, 3, 5, 7 and 11 levels of gray. The performance of the proposed approach was evaluated on a dataset of 16 subjects, reaching an average command decoding accuracy over 95\% for all stimulation sequences. The high accuracy and speed of the proposed method make it a promising alternative for user-friendly, high-speed c-VEP-based BCIs.

[8315] *Analysis of the effect of the time interval between samples on the solar forecasting*

Carlos M. Travieso-González (University of Las Palmas de Gran Canaria (ULPGC)) and Alejandro Piñan (University of Las Palmas de Gran Canaria (ULPGC)).

This paper analyzes the effect of the choice of the frequency between samples in the field of solar forecasting. To perform the study, the time series of solar radiation is used, in an autoregressive mode, to predict a single time step. Regarding the models used for the tests, the persistent model, baseline, and neural networks are used, the most common and in creasingly elaborate: Linear, MLP, CNN1D, and LSTM models. To compare the prediction accuracy two error metrics are used: RMSE and MAE. From the results it can be deduced that the analysis of the time interval between samples is a key factor, since a bad choice can result that persistent model being as good as the best predictions of the CNN1D and LSTM models. In addition, it is shown that as the time interval between samples increases, the choice of a model and its input window becomes more important.

[8418] *Scalable Convolutional Neural Networks for Decoding of Terminated Convolutional Codes*

Werner Teich (Ulm University, Institute of Communications Engineering) and Weikun Pan (Ulm University, Institute of Communications Engineering).

We present a convolutional neural network (CNN) for the decoding of a terminated convolutional code (CC). For this use cases, an unlimited amount of labeled training data can be generated. However, the number of code words, i.e., pattern, to be learned by the CNN increases exponentially with the dimension of the code. Therefore, scalablility of the neural network is of critical importance. The CNN is trained with a CC with small code word length, i.e., a limited number of code words. Therrefore the training complexity is feasable. As the CNN is properly matched to dimension and structural properties of the CC, it can actually learn the structure of the CC. This allows to upscale the CNN decoder to match to CCs with larger code dimension. A retraining of weights is not required. The upscaled CNN successfully decodes code words it has never seen during the training process (generalization).

[8457] *Ensemble of Randomized Neural Networks with STD decomposition for Forecasting Time Series with Complex Seasonality*

Grzegorz Dudek (Czestochowa University of Technology).

This paper proposes a novel ensemble forecasting method that combines randomized neural networks (RandNNs) and seasonal-trend-dispersion decomposition (STD) in four different ways to construct ensembles for time series with multiple seasonal patterns. We evaluate the performance of the proposed ensemble methods on short-term load forecasting problems with triple seasonality and demonstrate that the hybridization of RandNN and STD decomposition results in highly accurate and reliable forecasting.

[8483] *Adversarial Attacks on Leakage Detectors in Water Distribution Networks*

Paul Stahlhofen (University of Bielefeld), André Artelt (University of Bielefeld), Luca Hermes (University of Bielefeld) and Barbara Hammer (University of Bielefeld).

Many Machine Learning models are vulnerable to adversarial attacks: There exist methodologies that add a small (imperceptible) perturbation to an input such that the model comes up with a wrong prediction. Better understanding of such attacks is crucial in particular for models used in security-critical domains, such as monitoring of water distribution networks, in order to devise counter-measures enhancing model robustness and trustworthiness.

We propose a taxonomy for adversarial attacks against machine learning based leakage detectors in water distribution networks. Following up on this, we focus on a particular type of attack: an adversary searching the least sensitive point, that is, the location in the water network where the largest possible undetected leak could occur. Based on a mathematical formalization of the least sensitive point problem, we use three different algorithmic approaches to find a solution. Results are evaluated on two benchmark water distribution networks.

[8817] *Data Fusion for Prediction of Variations in Students Grades*

Renata Teixeira (Algoritmi Centre/LASI), Francisco Marcondes (Algoritmi Centre/LASI), Henrique Lima (Codevision, S.A., Braga, Portugal), Dalila Duraes (Algoritmi Centre/LASI) and Paulo Novais (Algoritmi Centre/LASI).

Considering the undeniable relevance of education in today's society, it is of great interest to be able to predict the academic performance of students in order to change teaching methods and create new strategies taking into account the situation of the students and their needs.

This study aims to apply data fusion to merge information about several students and predict variations in their Portuguese Language or Math grades from one trimester to another, that is, whether the students improve, worsen or maintain their grade. The possibility to predict changes in a student's grades brings great opportunities for teachers, because they can get an idea, from the predictions, of possible drops in grades, and can adapt their teaching and try to prevent such drops from happening. The original dataset, after data processing, resulted in 4 datasets, 2 per subject, which were then used to test various prediction models.

[8827] *STANN – Synthesis Templates for Artificial Neural Network Inference and Training*

Marc Rothmann (Osnabrueck University) and Mario Porrmann (Osnabrueck University).

While Deep Learning accelerators have been a research area of high interest, the focus was usually on monolithic accelerators for the inference of large CNNs. Only recently have accelerators for neural network training started to gain more attention. STANN is a template library that enables quick and efficient implementations of neural net- works for high-level synthesis. It supports both inference and training to be applicable to domains such as deep reinforcement learning. Its tem- plates are highly configurable and can be composed in different ways to create different hardware architectures. The evaluation compares different accelerator architectures implemented with STANN to showcase STANN's flexibility. A Xilinx Alveo U50 and a Xilinx Versal ACAP development board are used as the hardware plat- forms for the evaluation. The results show that the new Versal architec- ture is very promising for neural network training due to its improved support for floating-point calculations.

[8877] *Digit Recognition using Spiking Neural networks on FPGAs*

Shamini Koravuna (Bielefeld University), Sanaullah (Bielefeld University of Applied Sciences), Thorsten Jungeblut (Bielefeld University of Applied Sciences) and Ulrich Rückert (Bielefeld University).

This paper presents the results of our first assessment on the emulation of SNNs on FPGAs. Our approach utilizes a modular design con- sisting of three key modules, which enable us to create a fully functional neural network. The first module utilizes an accurate yet computationally efficient mathematical model to simulate the properties, characteristics, and behavior of a single neuron. The second module is a communication system known as AER, which manages the information flow between neurons in the network. The third module is a training algorithm called STDP, which provides the neural network with its functionality. This modular approach allows for the flexibility and scalability necessary to

simulate various SNNs and different numbers of neurons. The network description is performed using VHDL in the vivado simulator. The SNN model for digit recognition is implemented and emulated on the Basys3 FPGA to demonstrate the accuracy of the model's operation.

[8922] *On the use of artificial neural networks for automatic heliostat aiming*

J.A. Carballo (Plataforma Solar de Almería), N.C. Cruz (University of Granada), J. Bonilla (Plataforma Solar de Almería), J.D. Álvarez (University of Almería) and M. Berenguel (University of Almería).

One of the aspects to manage when operating solar power tower plants is the aiming of heliostats. Although the naive approach might be to aim all of them at the center of their receiver, it is inappropriate. Receivers have specific operation conditions, and radiation peaks can reduce their working life. Different strategies deal with this control problem, yet the most established methods still rely on fixed patterns, alarms, and human supervision. Nevertheless, an active research line seeks new control solutions using advanced methods, such as meta-heuristic optimizers and field models. This work tries to develop an advanced automatic control system for heliostat fields. It is based on an artificial neural network trained with an accurate model of the field to keep uniform flux distributions while maximizing the absorbed power. Preliminary results in a model of the Solar Platform of Almería are promising.

[9051] *An Efficient Parallel Multi-population Wrapper for Solving Feature Selection Problems in High-dimensional Space*

Juan Carlos Gómez López (University of Granada), Daniel Castillo Secilla (Fujitsu Technology Solutions S.A.), Dragi Kimoviski (University of Klagenfurt) and Jesús González Peñalver (University of Granada).

One of the most widely accepted approaches to address feature selection problems are wrappers based on evolutionary algorithms. Over the years, these approaches have evolved from single-population models to multi-population models to achieve better-quality solutions. Moreover, they are highly parallelizable as each subpopulation evolves independently. This paper proposes two parallel strategies for a multi-population wrapper to take advantage of a multicore CPU. The first one, based on the Fork/Join model, focuses on parallelizing only the evaluation method since it is the main bottleneck of the procedure. Although this strategy speeds up the execution of the wrapper, it is far from optimal. In this context, the second strategy implements an Island-based model, where each subpopulation evolves independently in each CPU core, exchanging information via asynchronous migrations. The results show that the wrapper achieves a speedup of almost 35 with the Island-based model when individuals are distributed into 24 subpopulations.

[9088] *Bioinspired Reinforcement Learning Control for a Biomimetic Artificial Muscle Pair*

Michele Foggetti (Danmarks Tekniske Universitet) and Silvia Tolu (Danmarks Tekniske Universitet).

Artificial muscles are recently developed actuators extremely promising for compliant robotic systems. Their accurate closed-loop control is challenging due to their highly nonlinear behavior. In this work, we model an artificial muscle pair adopting a non-pulley configuration mimicking more realistically the behavior of biological muscles. Inspired by how the brain regulates dopamine-based learning from interaction with the environment, it is possible to design efficient reinforcement learning control algorithms. Therefore, we propose a reinforcement learning-based controller bioinspired by the parallels between the behavior of temporal difference errors and the activity of dopaminergic neurons. Simulated experiments conducted in a virtual scenario show that the control action can accurately tackle the nonlinear control problem. The proposed solution could be extended to the dynamic control of more realistic and complex anthropomorphic limb systems due to its inherent adaptability and control effectiveness regardless of the complexity of the environment.

[9108] *Intersection over Union with smoothing for bounding box regression*

Petra Stevuliakova (Centre of Excellence IT4Innovations - Division of the University of Ostrava - IRAFM) and Petr Hurtik (IRAFM).

We focus on the construction of a loss function for the bounding box regression. The Intersection over Union (IoU) metric is improved to converge faster, to make the surface of the loss function smooth and continuous over the whole searched space, and to reach a more precise approximation of the labels. The main principle is adding a smoothing part to the original IoU, where the smoothing part is given by a linear space with values that increases from the ground truth bounding box to the border of the input image, and thus covers the whole spatial search space. We show the motivation and formalism behind this loss function and experimentally prove that it outperforms IoU, DIoU, CIoU, and SIoU by a large margin. We experimentally show that the proposed loss function is robust with respect to the noise in the dimension of ground truth bounding boxes.

[9342] *On Comparing Early and Late Fusion Methods*

Luis Manuel Pereira (Universitat Politècnica de València), Addisson Salazar (Universitat Politècnica de València) and Luis Vergara (Universitat Politècnica de València).

This paper presents a theoretical comparison of early and late fusion meth-ods. An initial discussion on the conditions to apply early or late (soft or hard) fusion is introduced. The analysis show that, if large training sets are available, early fusion will be the best option. If training sets are limited we must do late fusion, either soft or hard. In this latter case, the complications inherent in optimally estimating the fusion function could be avoided in ex-change for lower performance. The paper also includes a comparative re-view of the fusion state of the art methods with the following divisions: early sensor-level fusion; early feature-level fusion; late score-level fusion (late soft fusion); and late decision-level fusion (late hard fusion). The main strengths and weaknesses of the methods are discussed.

[9480] *Extending Drift Detection Methods to Identify When Exactly the Change Happened*

Markus Vieth (Bielefeld University), Alexander Schulz (Bielefeld University) and Barbara Hammer (Bielefeld University).

Data changing, or drifting, over time is a major problem when using classical machine learning on data streams. One approach to deal with this is to detect changes and react accordingly, for example by retraining the model. Most existing drift detection methods only report that a drift has happened between two time windows, but not when exactly. In this paper, we present extensions for three popular methods, MMDDDM, HDDDM, and D3, to determine precisely when the drift happened, i.e. between which samples. One major advantage of our extensions is that no additional hyperparameters are required. In experiments, with an emphasis on high-dimensional, real-world datasets, we show that they successfully identify when the drifts happen, and in some cases even lead to fewer false positives and false negatives, while making the methods only negligibly slower. In general, our extensions may enable a faster, more robust adaptation to changes in data streams.

[9564] *Energy-aware KNN for EEG Classification: A Case Study in Heterogeneous Platforms*

Juan José Escobar Pérez (University of Granada), Francisco Rodríguez (University of Granada), Rukiye Savran Kızıltepe (Karadeniz Technical University), Beatriz Prieto (University of Granada), Dragi Kimovski (University of Klagenfurt), Andrés Ortiz (University of Málaga), Alberto Prieto (University of Granada) and Miguel Damas (University of Granada).

The growing energy consumption caused by IT is forcing application developers to consider energy efficiency as one of the fundamental design parameters. This parameter acquires great relevance in HPC systems when running artificial neural networks and Machine Learning applications. Thus, this article shows an example of how to estimate and consider energy consumption in a real case of EEG classification. An efficient and distributed implementation of the KNN algorithm that uses mRMR as a feature selection technique to reduce the dimensionality of the dataset is proposed. The performance of three different workload distributions is analyzed to identify which one is more suitable according to the experimental conditions. The proposed approach outperforms the classification results obtained by previous works. It achieves an accuracy rate of 88.8% and a speedup of 74.53 when running on a multi-node heterogeneous cluster, consuming only 13.38% of the energy of the sequential version.

[9664] *A Deep Neural Network for RNA G-quadruplexes Binding Proteins Classification*

Francesco Di Luzio (DIET Dept., University of Rome "La Sapienza"), Alessandro Paiardini (Dept. of Biochemical Sciences, University of Rome "La Sapienza"), Federica Colonnese (DIET Dept., University of Rome "La Sapienza"), Antonello Rosato (DIET Dept., University of Rome "La Sapienza") and Massimo Panella (DIET Dept., University of Rome "La Sapienza").

In the last years, a plethora of studies unveiled the fundamental roles of RNA G-quadruplexes (RG4s), unique structural RNA strands featuring guanine-rich nucleic acid sequences, in basic cellular processes, as well as in the pathogenesis of important diseases, such as cancer and neurodegeneration. As the knowledge of the pathological roles played by RG4s has grown wider, the involvement of RG4-binding proteins in designing new diagnostic and therapeutic strategies has become increasingly recognized, but the classification of these proteins is still challenging. In this paper, we describe the architecture and the training procedure of a deep neural network based on Long Short-Term Memory layers to classify RG4-binding proteins. The impressive classification accuracy achieved on the test set provides a strong foundation for future investigations on more data samples and several experimental purposes.

[9676] *Pedestrian Multi-Object Tracking Algorithm Based on Attention Feature Fusion*

Yan Zhou (Xiangtan University), Zhennan Du (Xiangtan University) and Dongli Wang (Xiangtan University).

To address the problem of low target tracking accuracy in complex scenes, this paper proposes an end-to-end multi-object tracking algorithm based on attention feature fusion. First, a new lightweight attention module is introduced into the backbone network, which enhances the ability of the network to capture key information and locate targets without increasing the computational complexity. Second, the feature pyramid structure is improved to reduce the loss of features in the fusion process and improve the feature expres- sion ability of the model. Finally, the Intersection over Union (IoU) of the original model is optimised and the regression ability of the bounding box is improved using polyloss to optimise the cross-entropy loss. Exper- imental results on the MOT16 and MOT17 benchmarks show that the proposed algorithm effectively improves the accuracy and robustness of multi-object pedestrian tracking compared to other algorithms, and has better tracking performance.

[9711] *A Dictionary-based approach to Time Series Ordinal Classification*

Rafael Ayllón-Gavilán (Universidad de Córdoba), David Guijo-Rubio (Universidad de Córdoba), Pedro Antonio Gutierrez (Universidad de Cordoba) and César Hervás-Martínez (Universidad de Córdoba).

Time Series Classification (TSC) is an extensively researched field from which a broad range of real-world problems can be addressed obtaining excellent results. One sort of the approaches performing well are the so-called dictionary-based techniques. The Temporal Dictionary Ensemble (TDE) is the current state-of-the-art dictionary-based TSC approach. In many TSC problems we find a natural ordering in the labels associated with the time series. This characteristic is referred to as ordinality, and can be exploited to improve the methods performance. The area dealing with ordinal time series is the Time Series Ordinal Classification (TSOC) field, which is yet unexplored. In this work, we aim to present an ordinal adaptation of the TDE algorithm, known as ordinal TDE (O-TDE). For this, a comprehensive comparison using a set of 18 TSOC problems. Experiments conducted show the improvement achieved by the ordinal dictionary-based approach in comparison to four other existing nominal dictionary-based techniques.

[9860] *Adaptive Surrogate Modelling in Continuous Black-Box Optimization*

Jiří Tumpach (Faculty of Mathematics and Physics, Charles University Prague), Jan Koza (Faculty of Information Technology, Czech Technical University Prague) and Martin Holeňa (Institute of Computer Science, Czech Academy of Sciences, Prague).

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