IWANN INTERNATIONAL WORK CONFERENCE ON ARTIFICIAL NEURAL NETWORKS

PROGRAM AND ABSTRACTS

16-18 June, 2021

On-line

IWANN 2021 Short Program

Wednesday, June 16th 2021	
8:30-9:00	**REGISTRATION DESK** ***(start at 8:30h but it is opened during all the conference)***
9:00-10:10	**Session 1: Information fusion in Deep Learning for Biomedicine**
10:15-11:00	**Session 2: Intelligent Computing Solutions for SARS-CoV-2 Covid-19 (INClutions COVID-19)**
11:05-12:30	**Session 3: Advanced topics in computational intelligence (Part.I)**
12:30-14:00	**Session 4: Applications in artificial intelligence (Part. I)**
14:00-16:00	**LUNCH**
16:00-16:55	**Session 5: Biosignals Processing**
17:00-18:05	**Official Opening Ceremony. Plenary Talk:** **Prof. Pierre Baldi** **University of California, Irvine, USA**
18:10-19:45	**Session 6: Deep Learning (Part. I)**

NOTE:

1.- All times are Madrid timezone (Central European Summer Time, GMT+2). Please, check the time difference to connect to the Conference at the time indicated in the Program..

2.- There are **normal communications** (about 17 minutes) and **short communications** (about 4 minutes).

For more details visit the IWANN website.

Thursday, June 17th 2021	
8:30-9:00	**REGISTRATION DESK** ***(start at 8:30h but it is opened during all the conference)***
9:00-10:30	**Session 7: Advanced topics in computational intelligence (Part.II)**
10:35-11:25	**Session 8: Meta-learning and other automatic learning approaches in intelligent systems**
11:30-12:55	**Session 9: Artificial intelligence and Biomedicine**
13:00-14:30	**Tutorial: Hands-on Introduction to Deep Learning** **Coach: Raul Benitez Iglesias** **Universitat Politecnica de Catalunya**
14:30-16:00	**LUNCH**
16:00-17:00	**Session 10: Applications in artificial intelligence (Part. II)**
17:00-18:05	**Plenary Talk:** **Prof. Jeanna Matthews** **Division of Mathematics and Computer Science, Clarkson University**
18:10-19:30	**Session 11: Deep Learning (Part. II)**
19:30-20:15	**Session 12: Convolutional neural networks: beyond traditional solutions**

Friday, June 18th 2021	
8:30-9:00	**REGISTRATION DESK** ***(start at 8:30h but it is opened during all the conference)***
9:00-10:10	**Session 13: Bio-inspired systems and neuro-engineering**
10:15-11:35	**Session 14: Applications in artificial intelligence (Part. III)**
11:40-12:40	**Session 15: Agent-based models for policy design towards a more sustainable world**
12:45-13:45	**Session 16: Randomization in Deep Learning**
13:45-15:30	**LUNCH**
15:30-16:15	**Session 17: Neural Networks for Time Series Forecasting**
16:15-17:30	**Closing Ceremony. Plenary Talk:** **Prof. Davide Anguita** **University of Genova, Italy**

IWANN 2021 PROGRAM

Wednesday, June 16th 2021

(9:00-10:10) Session 1: Information fusion in Deep Learning for Biomedicine

Deep Learning for the Detection of Frames of Interest in Fetal Heart Assessment from First Trimester Ultrasound

Ruxandra Stoean, Dominic Iliescu, Catalin Stoean, Vlad Ilie, Ciprian Patru, Mircea Hotoleanu, Rodica Nagy, Dan Ruican, Rares Trocan, Andreea Marcu, Miguel Atencia and Gonzalo Joya

Deep Learning Based Neural Network for Six-Class-Classification of Alzheimer's Disease Stages Based on MRI Images

Tim Roerup, Peter Gloesekoetter, Hector Pomares and Ignacio Rojas Ruiz

Detection of Tumor Morphology Mentions in Clinical Reports in Spanish Using Transformers

Guillermo López-García, Jose M. Jerez, Nuria Ribelles, Emilio Alba and Francisco J. Veredas

Short Communication:

Enforcing Morphological Information in Fully Convolutional Networks to Improve Cell Instance Segmentation in Fluorescence Microscopy Images

Willard Zamora-Cardenas, Mauro Mendez, Saul Calderon-Ramirez, Martin Vargas, Gerardo Monge, Steve Quiros, David Elizondo, Jordina Torrents-Barrena and Miguel A. Molina-Cabello

(10:15-11:00) Session 2: Intelligent Computing Solutions for SARS-CoV-2 Covid-19 (INClutions COVID-19)

A Bayesian Classifier Combination Methodology for Early Detection of Endotracheal Obstruction of COVID-19 Patients in ICU

Francisco J. Suárez-Díaz, Juan L. Navarro-Mesa, Antonio G. Ravelo-García, Pablo Fernández-López, Carmen Paz Suárez-Araujo, Guillermo Pérez-Acosta and Luciano Santana-Cabrera

Toward an Intelligent Computing Solution for Endothraqueal Obstruction Prediction in COVID-19 Patients in ICU

Pablo Fernández-López, Carmen Paz Suárez-Araujo, Patricio García-Báez, Francisco Suárez-Díaz, Juan L. Navarro-Mesa, Guillermo Pérez-Acosta and José Blanco-López

Short Communication:

A free web service for fast COVID-19 classification of chest X-Ray images

Jose Bermudez Castro, Jose Ruiz, Pedro Achanccaray Diaz, Smith Arauco Canchumuni, Cristian Muñoz Villalobos, Felipe Borges Coelho, Leonardo Forero Mendoza and Marco Aurelio Pacheco

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(11:05-12:30) Session 3: Advanced topics in computational intelligence (Part.I)

Features Spaces with Reduced Variables Based on Nearest Neighbor Relations and their Inheritances

Naohiro Ishii, Kazunori Iwata, Naoto Mukai, Kazuya Odagiri and Tokuro Matsuo

High-dimensional data clustering with Fuzzy C-Means: problem, reason, and solution

Yinghua Shen, Hanyu E, Tianhua Chen, Zhi Xiao, Bingsheng Liu and Yuan Chen

Contrastive Explanations for Explaining Model Adaptations

André Artelt, Fabian Hinder, Valerie Vaquet, Robert Feldhans and Barbara Hammer

Dimensionality reduction: is feature selection more effective than random selection?

Laura Morán-Fernández and Verónica Bolón-Canedo

Short Communication:

Classification in Non-Stationary Environments Using Coresets Over Sliding Windows

Moritz Heusinger and Frank-Michael Schleif

(12:30-14:00) Session 4: Applications in artificial intelligence (Part. I)

Detection of Alzheimer's Disease versus Mild Cognitive Impairment using a New Modular Hybrid Neural Network

Alberto Sosa, Ylermi Cabrera-León, Pablo Fernandéz-López, Patricio García, Juan Luis Navarro-Mesa and Carmen Paz Suárez-Araujo

Fine-tuning of patterns assignment to subnetworks increases the capacity of an attractor network ensemble

Mario Gonzalez, Angel Sanchez, David Dominguez and Francisco de Borja Rodriguez

A combined approach for enhancing the stability of the variable selection stage in binary classification tasks

Silvia Cateni, Valentina Colla and Marco Vannucci

A convolutional neural network as a proxy for the XRF approximation of the chemical composition of archaeological artefacts in the presence of inter-microscope variability

Catalin Stoean, Leonardo Ionescu, Ruxandra Stoean, Marinela Boicea, Miguel Atencia and Gonzalo Joya

Short Communications:

Implementation of Data Stream Classification Neural Network Models over Big Data Platforms

Fernando Puentes Marchal, María Dolores Pérez Godoy, Pedro Gonzalez and Maria Jose Del Jesus

Performance Evaluation of Classical Classifiers and Deep Learning Approaches for Polymers Classification based on Hyperspectral Images

Javier Lorenzo-Navarro, Silvia Serranti, Giuseppe Bonifazi and Giuseppe Capobianco

Hotel Recognition via Latent Image Embeddings

Boris Tseytlin and Ilya Makarov

(16:00-16:55) Session 5: Biosignals Processing

Analysis of Electroencephalographic Signals from a Brain-Computer Interface for Emotions Detection

Beatriz García Martínez, Antonio Fernández-Caballero, Arturo Martínez-Rodrigo and Paulo Novais

A fine dry-electrode selection to characterize event-related potentials in the context of BCI

Vinicio Changoluisa, Pablo Varona and Francisco de Borja Rodriguez

Short Communications:

Detection of Emotions from Electroencephalographic Recordings by means of a Nonlinear Functional Connectivity Measure

Beatriz García Martínez, Antonio Fernández-Caballero, Raúl Alcaraz and Arturo Martínez-Rodrigo

P300 Characterization through Granger Causal Connectivity in the context of Brain-Computer Interface technologies

Vanessa Salazar, Vinicio Changoluisa and Francisco de Borja Rodriguez

Feature and Time Series Extraction in Artificial Neural Networks for Arousal Detection from Electrodermal Activity

Roberto Sánchez-Reolid, Francisco López de la Rosa, Daniel Sánchez-Reolid, Maria T. Lopez and Antonio Fernandez-Caballero

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(17:00-18:05) Official Opening Ceremony. Plenary Talk: Prof. Pierre Baldi

University of California, Irvine, USA.

(18:10-19:45) Session 6: Deep Learning (Part. I)

Context-aware Graph Convolutional Autoencoder

Asma Sattar and Davide Bacciu

Development and implementation of a neural network-based abnormal state prediction system for a piston pump

Mauricio Andrés Gómez Zuluaga, Ahmad Ordikhani, Christoph Bauer and Peter Gloesekoetter

Iterative adaptation to quantization noise
Dmitry Chudakov, Sergey Alyamkin, Alexander Goncharenko and Andrey Denisov

Short Communications:

A BERT based approach for Arabic POS Tagging
Rakia Saidi and Fethi Jarray

Facial expression interpretation in ASD using Deep Learning
Pablo Salgado, Oresti Banos and Claudia Villalonga

Rendering Scenes for Simulating Adverse Weather Conditions
Prithwish Sen, Anindita Das and Nilkanta Sahu

Automatic Fall Detection using Long Short-Term Memory Network
Carlos Magalhães, João Ribeiro, Argentina Leite, Eduardo Solteiro Pires and João Pavão

Deep Convolutional Neural Networks with Residual Blocks for Wafer Map Defect Pattern Recognition
Zemenu Endalamaw Amogne, Fu-Kwun Wang and Jia-Hong Chou

Thursday, June 17th, 2021

(9:00-10:30) Session 7: Advanced topics in computational intelligence (Part.II)

Deep Reinforcement Learning in VizDoom via DQN and Actor-Critic Agents
Maria Bakhanova and Ilya Makarov

Adaptive Ant Colony Optimization for Service Function Chaining in a Dynamic 5G Network
Segundo Moreno and Antonio Mora

On the Use of Fuzzy Metrics for Robust Model Estimation: a RANSAC-based Approach
Alberto Ortiz, Esaú Ortiz, Juan José Miñana and Óscar Valero

A New Detector Based On Alpha Integration Decision Fusion
Addisson Salazar, Gonzalo Safont, Nancy Vargas and Luis Vergara

Short Communications:

A Safe and Effective Tuning Technique for Similarity-based Fuzzy Logic Programs
Gines Moreno and José Antonio Riaza Valverde

Predictive ability of Response Surface Methodology (RSM) and Artificial Neural Network (ANN) to approximate biogas yield in a Modular biodigester
Modestus Okwu, Lagouge Tartibu, Olusegun Samuel, Henry Omoregbee and Anna Ivbanikaro

(10:35-11:25) Session 8: Meta-learning and other automatic learning approaches in intelligent systems

A study of the correlation of metafeatures used for metalearning
Adriano Rivolli, Luis Garcia, Ana Lorena and Andre Carvalho

Learning without Forgetting for 3D Point Cloud Objects
Townim Chowdhury, Mahira Jalisha, Ali Cheraghian and Shafin Rahman

Short Communications:

Patch-wise semantic segmentation of sedimentation from high-resolution satellite images using deep learning

Tahmid Hasan Pranto, Abdulla All Noman, Asaduzzaman Noor, Ummeh Habiba Deepty and Mohammad Rashedur Rahman

Learning Image Segmentation from Few Annotations. A REPTILE Application

Hector F. Satizabal and Andres Perez-Uribe

(11:30-12:55) Session 9: Artificial intelligence and Biomedicine

Impacted Tooth Detection in Panoramic Radiographs

James Faure and Andries Engelbrecht

Deep learning for diabetic retinopathy prediction

Ciro Rodriguez-Leon, William Arevalo, Oresti Banos and Claudia Villalonga

Facial Image Augmentation from Sparse Line Features Using Small Training Data

Shih-Kai Hung and John Gan

Short Communications:

Ensemble models for covid prediction in X-Ray images

Juan Carlos Morales Vega, Francisco Carrillo-Perez, Jesús Toledano Pavón, Ignacio Rojas Ruiz and Luis Javier Herrera Maldonado

Validation of a Nonintrusive Wearable Device for Distress Estimation During Robotic Roller Assisted Gait

Marta Díaz-Boladeras, Xavier Llanas, Elsa Pérez, Marta Musté, Carlos Pérez, Àlex Barco and Andreu Català

Deep Learning for Heart Sounds Classification using Scalograms and Automatic Segmentation of PCG Signals

John Gelpud, Silvia Castillo, Mario Jojoa, Begonya Garcia, Wilson Achicanoy and David Carbonero

Skin Disease Classification Using Machine Learning Techniques

Mohammad Ashraful Haque Abir, Golam Kibria Anik, Shazid Hasan Riam, Mohammed Ariful Karim, Azizul Hakim Tareq and Mohammad Rashedur Rahman

Construction of Suitable DNN-HMM for Classification between Normal and Abnormal Respiration
Masaru Yamashita

(13:00-14:30) Tutorial: Hands-on Introduction to Deep Learning
Coach: Raul Benitez Iglesias
Universitat Politecnica de Catalunya.

(16:00-17:00) Session 10: Applications in artificial intelligence (Part. II)

Time Series Prediction with Autoencoding LSTM Networks
Federico Succetti, Andrea Ceschini, Francesco Di Luzio, Antonello Rosato and Massimo Panella

Improving Indoor Semantic Segmentation with Boundary-level Objectives
Roberto Amoroso, Lorenzo Baraldi and Rita Cucchiara

Short Communications:

EvoMLP: a framework for evolving multilayer perceptrons
Luis Liñán-Villafranca, Mario Garcia Valdez, Jj Merelo and Pedro Castillo

Regularized One-Layer Neural Networks for Distributed and Incremental Environments
Oscar Fontenla-Romero, Bertha Guijarro-Berdiñas and Beatriz Pérez-Sánchez

The Jacobi wavelets regularization for support vector machines
Abbassa Nadira, Amir Abdessamad and Bahri Sidi Mohamed

Frailty level prediction in older age using hand grip strength functions over time
Elsa Pérez, José E. Torres Rangel, Marta Musté, Carlos Pérez, Oscar Macho, Francisco S. del Corral Guijarro, Aris Somoano, Cristina Giamella, Luis Ramírez and Andreu Català

(17:00-18:05) Plenary Talk: Prof. Jeanna Matthews

Division of Mathematics and Computer Science, Clarkson University.

(18:10-19:30) Session 11: Deep Learning (Part. II)

Enhanced Convolutional Neural Network for Age Estimation
Idowu Aruleba and Serestina Viriri

Deep Interpretation with Sign Separated and Contribution Recognized Decomposition
Lucas Y W Hui and De Wen Soh

Deep Learning for Age Estimation Using EfficientNet
Idowu Aruleba and Serestina Viriri

Short Communications:

Towards a Deep Reinforcement Approach for Crowd Flow Management
Wejden Abdallah, Dalel Kanzari and Kurosh Madani

Classification of images as photographs or paintings by using convolutional neural networks
Jose Miguel Lopez-Rubio, Miguel A. Molina-Cabello, Gonzalo Ramos-Jimenez and Ezequiel López-Rubio

Parallel Corpora Preparation for English-Amharic Machine Translation
Yohannes Biadgligne and Kamel Smaili

Fast Depth Reconstruction using Deep Convolutional Neural Networks
Dmitrii Maslov and Ilya Makarov

Voxel-based Three-dimensional Neural Style Transfer
Timo Friedrich, Barbara Hammer and Stefan Menzel

(19:30-20:15) Session 12: Convolutional neural networks: beyond traditional solutions

Error-correcting output codes in the framework of deep ordinal classification
Javier Barbero-Gómez, Pedro Antonio Gutiérrez and César Hervás-Martínez

Features as Keypoints and How Fuzzy Transforms Retrieve Them
Irina Perfilieva and David Adamczyk

Short Communications:

Instagram Hashtag Prediction using Deep Neural Networks
Anna Beketova and Ilya Makarov

Friday, June 18th, 2021

(9:00-10:10) Session 13: Bio-inspired systems and neuro-engineering

Temporal EigenPAC for dyslexia diagnosis

Nicolás J. Gallego, Marco Formoso, Andrés Ortiz, Francisco J. Martinez-Murcia and Juan L. Luque

Autonomous Driving of a Rover-like Robot using Neuromorphic Computing

Enrique Piñero-Fuentes, Salvador Canas-Moreno, Alejandro Linares-Barranco, Antonio Rios-Navarro and Tobi Delbruck

Effects of Training on BCI Accuracy in SSMVEP-based BCI

Piotr Stawicki, Aya Rezeika and Ivan Volosyak

Short Communications:

Effect of electrical synapses in the cycle-by-cycle period and burst duration of central pattern generators

Blanca Berbel Fernández, Alicia Garrido, Irene Elices, Roberto Latorre and Pablo Varona

Operation of neuronal membrane simulator circuit for tests with memristor based on graphene and graphene oxide

Marina Sparvoli, Jonas Marma, Gabriel Nunes and Fábio Jorge

(10:15-11:35) Session 14: Applications in artificial intelligence (Part. III)

Accuracy and Intrusiveness in Data-Driven Violin Players Skill Levels Prediction: MOCAP against MYO against KINECT

Vincenzo D'Amato, Erica Volta, Luca Oneto, Gualtiero Volpe, Antonio Camurri and Davide Anguita

Features selection for fall detection systems based on machine learning and accelerometer signals

Carlos Alfredo Silva Villafuerte, Rodolfo Valentin García Bermudez and Eduardo Casilari Pérez

Autonomous Docking of Mobile Robots by Reinforcement Learning Tackling the Sparse Reward Problem

Antonio Manuel Burgueño Romero, Jose Raul Ruiz Sarmiento and Javier Gonzalez Jimenez

Short Communications:

A Pisum Sativum L. (Pea) Leaves Image Dataset: Collection, Protocol, and Machine Learning Algorithms

Alejandro Bastidas, Juan Carlos Velez Díaz, Winston Percybrooks, Alexander Ortega, Jacobo Ruano and Mario Jojoa

Decision Support Systems for Air Traffic Control with Self-Enforcing Networks based on Weather Forecast and Reference Types for the Direction of Operation

Dirk Zinkhan, Sven Eiermann, Christina Kluever and Juergen Kluever

Impact of minority class variability on anomaly detection by means of Random Forests and Support Vector Machines

Faisal Saleem S Alraddadi, Luis F. Lago-Fernández and Francisco B. Rodríguez

Analyzing the Land Cover Change and Degradation in Sundarbans Mangrove Forest using Machine Learning and Remote Sensing Technique

Ashikur Rahman Khan, Anika Khan, Shehzin Masud and Mohammad Rashedur Rahman

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(11:40-12:40) Session 15: Agent-based models for policy design towards a more sustainable world

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Informing agent-based models of social innovation uptake

Patrycja Antosz, Wander Jager, J. Gareth Polhill and Douglas Salt

Sensitivity analysis of an empirical agent-based model of district heating network adoption

Gary Polhill, Doug Salt, Tony Craig, Ruth Wilson and Kathryn Colley

Generating a synthetic population of agents through decision trees and socio demographic data
Amparo Alonso-Betanzos, Bertha Guijarro-Berdiñas, Alejandro Rodríguez Arias and Noelia Sanchez-Maroño

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(12:45-13:45) Session 16: Randomization in Deep Learning

Improved Acoustic Modeling for Automatic Piano Music Transcription using Echo State Networks
Peter Steiner, Azarakhsh Jalalvand and Peter Birkholz

On Effects of Compression with Hyperdimensional Computing in Distributed Randomized Neural Networks
Antonello Rosato, Massimo Panella, Evgeny Osipov and Denis Kleyko

Benchmarking Reservoir and Recurrent Neural Networks for Human State and Activity Recognition
Davide Bacciu, Daniele Di Sarli, Claudio Gallicchio, Alessio Micheli and Niccolò Puccinelli

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(15:30-16:15) Session 17: Neural Networks for Time Series Forecasting

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Learning to Trade from Zero-Knowledge using Particle Swarm Optimization
Stefan Van Deventer and Andries Engelbrecht

Randomized Neural Networks for Forecasting Time Series with Multiple Seasonality
Grzegorz Dudek

Short Communications:

Prediction of air pollution using LSTM
Stanislaw Osowski

(16:15-17:30) Closing Ceremony. Plenary Talk: Prof. Davide Anguita

University of Genova, Italy.


WEDNESDAY,
June 16th
IWANN
ONLINE CONFERENCE
INTERNATIONAL
WORK CONFERENCE
ON ARTIFICIAL NEURAL NETWORKS
JUNE, 16TH-18TH, 2021
WORKSHOP
CONFERENCE
ABSTACTS
TECHNICAL SECRETARIAT

(9:00-10:10) Session 1: Information fusion in Deep Learning for Biomedicine

Deep Learning for the Detection of Frames of Interest in Fetal Heart Assessment from First Trimester Ultrasound

Ruxandra Stoean, Dominic Iliescu, Catalin Stoean, Vlad Ilie, Ciprian Patru, Mircea Hotoleanu, Rodica Nagy, Dan Ruican, Rares Trocan, Andreea Marcu, Miguel Atencia and Gonzalo Joya

Abstract. The current paper challenges convolutional neural networks to address the computationally undebated task of recognizing four key views in first trimester fetal heart scanning (the aorta, the arches, the atrioventricular flows and the crossing of the great vessels). This is the primary inspection of the heart of a future baby and an early recognition of possible problems is important for timely intervention. Frames depicting the views of interest were labeled by obstetricians and given to several deep learning architectures as a classification task against other irrelevant scan sights. A test accuracy of 95\% with an F1-score ranging from 90.91\% to 99.58\% for the four key perspectives shows the potential in supporting heart scans even from such an early fetal age, when the heart is still quite underdeveloped.

Deep Learning Based Neural Network for Six-Class-Classification of Alzheimer's Disease Stages Based on MRI Images

Tim Roerup, Peter Gloesekoetter, Hector Pomares and Ignacio Rojas Ruiz

Abstract. State of the art classifiers split Alzheimer's disease progression into a limited number of stages and use a comparatively small database. For the best treatment, it is desirable to have the highest resolution from the progression of the disease. This paper proposes a reliable deep convolutional neural network for the classification of six different Alzheimer's disease stages based on Magnetic Resonance Imaging (MRI). The peculiarity of this paper is the introduction of a new, sixth, disease stage, and the large amount of data that has been taken into account. Additionally, not only the testing accuracy is analyzed, but also the robustness of the classiffer to have feedback on how certain the neural network makes its predictions.

Detection of Tumor Morphology Mentions in Clinical Reports in Spanish Using Transformers

Guillermo López-García, Jose M. Jerez, Nuria Ribelles, Emilio Alba and Francisco J. Veredas

Abstract. The aim of this study is to systematically examine the performance of transformer-based models for the detection of tumor morphology mentions in clinical documents in Spanish. For this purpose, we analyzed 3 transformer models supporting the Spanish language, namely multilingual BERT, BETO and XLM-RoBERTa. By means of a transfer-learning-based approach, the models were first pretrained on a collection of real-world oncology clinical cases with the goal of adapting transformers to the distinctive features of the Spanish oncology domain. The resulting models were further fine-tuned on the Cantemist-NER task, addressing the detection of tumor morphology mentions as a multi-class sequence-labeling problem. To evaluate the effectiveness of the proposed approach, we compared the obtained results by the domain-specific version of the examined transformers with the performance achieved by the general-domain version of the models. The results obtained in this paper empirically demonstrated that, for every analyzed transformer, the clinical version outperformed the corresponding general-domain model on the detection of tumor morphology mentions in clinical case reports in Spanish. Additionally, the combination of the transfer-learning-based approach with an ensemble strategy

exploiting the predictive capabilities of the distinct transformer architectures yielded the best obtained results, achieving a precision value of 0.893, a recall of 0.887 and an F1-score of 0.89, which remarkably surpassed the prior state-of-the-art performance for the Cantemist-NER task.

Enforcing Morphological Information in Fully Convolutional Networks to Improve Cell Instance Segmentation in Fluorescence Microscopy Images

Willard Zamora-Cardenas, Mauro Mendez, Saul Calderon-Ramirez, Martin Vargas, Gerardo Monge, Steve Quiros, David Elizondo, Jordina Torrents-Barrena and Miguel A. Molina-Cabello

Abstract. Cell instance segmentation in fluorescence microscopy images is becoming essential for cancer dynamics and prognosis. Data extracted from cancer dynamics allows to understand and accurately model different metabolic processes such as proliferation. This enables customized and more precise cancer treatments. However, accurate cell instance segmentation, necessary for further cell tracking and behavior analysis, is still challenging in scenarios with high cell concentration and overlapping edges. Within this framework, we propose a novel cell instance segmentation approach based on the well-known U-Net architecture. To enforce the learning of morphological information per pixel, a deep distance transformer (DDT) acts as a back-bone model. The DDT output is subsequently used to train a top-model. The following top-models are considered: a three-class (e.g., foreground, background and cell border) U-net, and an unsupervised watershed transform. The obtained results suggest a performance boost over traditional U-Net architectures. This opens an interesting research line around the idea of injecting morphological information into a fully convolutional model.

(10:15-11:00) Session 2: Intelligent Comp. Solutions for SARS-CoV-2 Covid-19 (INClutions COVID-19)

A Bayesian Classifier Combination Methodology forEarly Detection of Endotracheal Obstruction of COVID-19 Patients in ICU

Francisco J. Suárez-Díaz, Juan L. Navarro-Mesa, Antonio G. Ravelo-García, Pablo Fernández-López, Carmen Paz Suárez-Araujo, Guillermo Pérez-Acosta and Luciano Santana-Cabrera

Abstract. Due to the complications of COVID-19, many of the diagnosed patients end up needing intensive care. Complications are often severe, to such an extent that mortality in these patients may be high. Among the wide variety of complications, we find the necrotizing tracheobronchitis, which appears suddenly with the obstruction of the endotracheal tube. This complication can cause severe damage to the patient or even death. In order to help clinicians in managing this situation, we propose a methodology based on Machine Learning for detecting and anticipating the phenomenon of obstruction. Through the use of Bayesian classifiers, classifier combination, morphological filtering and a track-while-scan detection mode we establish an indicator that serves as a reference to clinicians. Our experiments show promising results and lay the foundations of an intelligent system for early detection of endotracheal obstruction.

Toward an Intelligent Computing Solution for Endothraqueal Obstruction Prediction in COVID-19 Patients in ICU

Pablo Fernández-López, Carmen Paz Suárez-Araujo, Patricio García-Báez, Francisco Suárez-Díaz, Juan L. Navarro-Mesa, Guillermo Pérez-Acosta and José Blanco-López

Abstract. Nowadays there is a world pandemic of a tricky respiratory illness, COVID-19. A large part of COVID-19 patients evolves to severe or fatal complications, in such a way that require an ICU admission. COVID-19 has been shown a mor-tality rate close to 30% due to complications like obstruction the trachea and bronchi of patients during the ICU stay.

An endothraqueal obstruction in which COVID-19 patient enter in any mo-ment during its ICU stay is one of the most complicated situations that clinicians must face and solve. Therefore, it is very important to know in advance when a COVID-19 patient could enter in the pre-obstruction zone.

In this work we present an intelligent computing solution to predict endotra-cheal obstruction in patients of COVID-19 in ICU. It is the Binomial Gate LSTM (BigLSTM), a new and innovative deep modular neural architecture based on the recurrent neural network LSTM. Its main ability is the tolerance to missing data and to deal with time series with no regular sample frequency. These are the main characteristics of the BigLSTM information environment. This ability is imple-mented in BigLSTM by an information redundancy injection mechanism and to cope with time control.

We applied BigLSTM with first wave COVID-19 patients in ICU of Comple-jo Hospitalario Universitario Insular Materno Infantil. The study's encouraging results, working even with a very small data set, indicates that our developing go toward an efficient intelligent prediction system very appropriate for this kind of problem.

A free web service for fast COVID-19classification of chest X-Ray images

Jose Bermudez Castro, Jose Ruiz, Pedro Achanccaray Diaz, Smith Arauco Canchumuni, Cristian Muñoz Villalobos, Felipe Borges Coelho, Leonardo Forero Mendoza and Marco Aurelio Pacheco

Abstract. The coronavirus outbreak became a major concern for societyworldwide. Technological innovation and ingenuity are essential to fightCOVID-19 pandemic and bring us one step closer to overcome it. Researchers over the world are working actively to find available alternativesin different fields, such as the Healthcare System, pharmaceutic, healthprevention, among others. With the rise of artificial intelligence (AI)in the last 10 years, IA-based applications have become the prevalentsolution in different areas because of its higher capability, being nowadopted to help combat against COVID-19. This work provides a fastdetection system of COVID-19 characteristics in X-Ray images basedon deep learning (DL) techniques. This system is available as a freeweb deployed service for fast patient classification, alleviating the highdemand for standards method for COVID-19 diagnosis. It is constitutedof two deep learning models, one to differentiate between X-Ray andnon-X-Ray images based on Mobile-Net architecture, and another one toidentify chest X-Ray images with characteristics of COVID-19 based onthe DenseNet architecture. For real-time inference, it is provided a pair ofdedicated GPUs, which reduce the computational time. The whole systemcan filter out non-chest X-Ray images, and detect whether the X-Raypresents characteristics of COVID-19, highlighting the most sensitiveregions.

(11:05-12:30) Session 3: Advanced topics in computational intelligence (Part.I)

Features Spaces with Reduced Variables Based on Nearest Neighbor Relations and their Inheritances

Naohiro Ishii, Kazunori Iwata, Naoto Mukai, Kazuya Odagiri and Tokuro Matsuo

Abstract. Generation of useful variables in the features spaces is an important issue throughout the neural networks, the machine learning and artificial intelligence for their efficient and discriminative computations. In this paper, the nearest neighbor relations are proposed for the minimal generation and the reduced variables for the feature spaces. First, the nearest neighbor relations are shown to be minimal independent and inherited for the construction of the feature space. For their analyses, convex cones are made of the nearest neighbor relations, which are independent vectors for the generation of the reduced variables. Then, edges of convex cones are compared for the discrimination of variables. Finally, feature spaces with the reduced variables based on the nearest neighbor relations are shown to be useful for the real documents classification.

High-dimensional data clustering with Fuzzy C-Means: problem, reason, and solution

Yinghua Shen, Hanyu E, Yuan Chen and Bingsheng Liu

Abstract. In this study, we point out a major problem faced by the Fuzzy C-Means (FCM) clustering algorithm when it is used for the high-dimensional data, i.e., the obtained prototypes could not be distinguished with each other. Many studies have claimed that the concentration of the distance (CoD) could be a major reason for this phenomenon. We carefully analyze the reason for causing the failure of FCM, and highlight that CoD could either decrease or increase the performance of the clustering algorithm, but more attention should be paid to the noisy and independent features of the data because with more of these kind of features the performance of the clustering algorithm could be negatively affected. To tackle this, we resort to a neural network model, i.e., the autoencoder, to reduce the dimensionality of the feature space and hopefully only these most relevant feature information could be preserved. We also conduct several experiments to show the validity of the proposed strategy for the FCM algorithm.

Contrastive Explanations for Explaining Model Adaptations

André Artelt, Fabian Hinder, Valerie Vaquet, Robert Feldhans and Barbara Hammer

Abstract. Many decision making systems deployed in the real world are not static - a phenomenon known as model adaptation takes place over time. The need for transparency and interpretability of AI-based decision models is widely accepted and thus have been worked on extensively. Usually, explanation methods assume a static system that has to be explained. Explaining non-static systems is still an open research question, which poses the challenge how to explain model adaptations.
In this contribution, we propose and (empirically) evaluate a framework for explaining model adaptations by contrastive explanations. We also propose a method for automatically finding regions in data space that are affected by a given model adaptation and thus should be explained.

Dimensionality reduction: is feature selection more effective than random selection?

Laura Morán-Fernández and Verónica Bolón-Canedo

Abstract. The advent of Big Data has brought with it an unprecedented and overwhelming increase in data volume, not only in samples but also in available features. Feature selection, the process of selecting the relevant features and discarding the irrelevant ones, has been successfully applied over the last decades to reduce the dimensionality of the datasets. However, there is a great number of feature selection methods available in the

literature, and choosing the right one for a given problem is not a trivial decision. In this paper we will try to determine which of the multiple methods in the literature are the best suited for a particular type of problem, and study their effectiveness when comparing them with a random selection. In our experiments we will use an extensive number of datasets that allow us to work on a wide variety of problems from the real world that need to be dealt with in this field. Seven popular feature selection methods were used, as well as five different classifiers to evaluate their performance. The experimental results suggest that feature selection is, in general, a powerful tool in machine learning, being correlation-based feature selection the best option with independence of the scenario. Also, we found out that the choice of an inappropriate threshold when using ranker methods leads to results as poor as when randomly selecting a subset of features.

Classification in Non-Stationary Environments Using Coresets Over Sliding Windows

Moritz Heusinger and Frank-Michael Schleif

Abstract. In non-stationary environments, several constraints require algorithms to be fast, memory-efficient, and highly adaptable.
While there are several classifiers of the family of lazy learners and tree classifiers in the streaming context, the application of prototype-based classifiers has not found much attention. Prototype-based classifiers however have some interesting characteristics, which are also useful in streaming environments, in particular being highly interpretable. Hence, we propose a new prototype-based classifier, which is based on \emph{Minimum Enclosing Balls} over sliding windows.
We propose this algorithm as a linear version as well as kernelized. Our experiments show, that this technique is on a par with another popular prototype-based streaming classifier -- the \emph{Adaptive Robust Soft Learning Vector Quantization} but with an additional benefit of having a configurable window size to catch rapidly changing drift and the ability to use the internal mechanics for drift detection.

(12:30-14:00) Session 4: Applications in artificial intelligence (Part. I)

Detection of Alzheimer's Disease versus Mild Cognitive Impairment using a New Modular Hybrid Neural Network

Alberto Sosa, Ylermi Cabrera-León, Pablo Fernandéz-López, Patricio García, Juan Luis Navarro-Mesa and Carmen Paz Suárez-Araujo

Abstract. At present, there is a population ageing which leads to an increasing of geriatric and non-communicable diseases. One of the major socio-sanitary challenge our society's facing is dementia, with the Alzheimer's disease (AD) as the most prevalent one. AD is a progressive neurodegenerative disorder over years, with several stages. One of them is the prodromal one, also called Mild Cognitive Impairment (MCI). Despite the recent advances in diagnostic criteria for AD, its definitive diagnosis is just possible post-mortem because there is nonspecific AD biomarker. Therefore, an early and differential diagnosis of AD is still an issue of high concern. Extensive research looking for appropriate methods of diagnosis has been done.
In this paper, we will present an innovative smart computing solution based on hybrid and ontogenetic neural architecture, to deal with these challenges. It is an intelligent clinical decision-making system which has a non-neural pre-processing module and a neural processing one. This last is a Modular Hybrid Growing Neural Gas (MyGNG), developed in this work. MyGNG consists of an input layer a Growing Neural Gas and a labelling

layer, Perceptron type, modules hierarchically organized with different neurodynamic, connection topologies and learning laws.
Using just neuropsychological tests of 495 patients (150 AD, 345 MCI) from Alzheimer's Disease Neuroimaging Initiative (ADNI) repository, our proposal has provided very promising results in the early detection of AD versus MCI, reaching values of AUC of 0.95; Sensitivity of 0.89 and Accuracy of 0.81. It is a very appropriate diagnosis system for any clinical setting.

Fine-tuning of patterns assignment to subnetworks increases the capacity of an attractor network ensemble

Mario Gonzalez, Angel Sanchez, David Dominguez and Francisco de Borja Rodriguez

Abstract. It is known that dividing an attractor network into a set of subnetworks whose connectivity is equivalent to the attractor network from which they come, and therefore with the same computational cost, increases the system's recovery capacity. This opens the possibility of optimizing the assignment of pattern subsets to the ensemble modules. The patterns subsets assignment to the network modules can be considered as a combinatorial optimization problem, where varied strategies (i.e. random vs. heuristic assignments) can be tested. In this work, we present a possible heuristic strategy driven by an overlap minimization in the subsets for assigning the patterns input to the modules of the ensemble attractor neural network. In terms of system pattern storage capacity, the assignment driven by the overlap minimization in each subset/module proved to be better than no specific assignment, i.e. distribution of patterns to modules randomly.

A combined approach for enhancing the stability of the variable selection stage in binary classification tasks

Silvia Cateni, Valentina Colla and Marco Vannucci

Abstract. Variable selection is an essential tool for gaining knowledge on a problem or phenomenon, by identifying the factors that shows the highest influence on it. It is also fundamental for the implementation of machine learning-based approaches to modelling and classification tasks, by improving performances and reducing computational cost. Furthermore, in many real-world applications, such as the ones in the medical field, a relevant number of variables are jointly observed, but the number of available observations is quite limited. In these cases, variable se-lection is clearly essential, but standard variable selection approaches become "unstable", as the high correlation among different variables or their similar rele-vance with respect to the considered target lead to multiple solutions leading to similar performances. In machine-learning based classification, the stability of variable selection, namely its robustness with respect variations in the classifier training dataset, is as important as the performance of the classifier itself. The pa-per presents an automatic procedure for variable selection in classification tasks, which ensures excellent stability of the selection and does not require any a priori information on the available data.

A convolutional neural network as a proxy for the XRF approximation of the chemical composition of archaeological artefacts in the presence of inter-microscope variability

Catalin Stoean, Leonardo Ionescu, Ruxandra Stoean, Marinela Boicea, Miguel Atencia and Gonzalo Joya

Abstract. The paper puts forward a convolutional neural network model for multi-output regression, which is trained on images from two distinct microscope types to estimate the concentration of a pair of chemical elements from the surface of archaeological metal objects. The target is to simulate the approximation behaviour of the more complex XRF technology, which is used as ground truth in training the model. Experiments investigate the adequacy of learning on either type of data and then using the models to test images coming

from each microscope in turn and in combination. Under these terms of performance and flexibility, the technology can be successfully used in the front line of ancient object restoration across laboratories irrespective of the equipment available.

Implementation of Data Stream Classification Neural Network Models over Big Data Platforms

Fernando Puentes Marchal, María Dolores Pérez Godoy, Pedro Gonzalez and Maria Jose Del Jesus

Abstract. Streaming is being increasingly demanded because it analyzes data in real-time and help in decision making. Over time new devices appear and the number of existing devices increases continuously, so a lot of data is generated and it is not practical to process this information with traditional algorithms. Due to the enormous amount of data it is necessary to apply distributed algorithms in a Big Data context. In this paper Apache Spark is used to implement some distributed versions of algorithms based on Extreme Learning Machine (ELM). In addition, these algorithms have been evaluated with different real and synthetic datasets and two experiments have been performed. First experiment is to demonstrate that performance of distributed algorithms is the same as sequential versions. Second is a study about the behavior of the algorithms in presence of concept drift, an important research area within streaming.

Performance Evaluation of Classical Classifiers and Deep Learning Approaches for Polymers Classification based on Hyperspectral Images

Javier Lorenzo-Navarro, Silvia Serranti, Giuseppe Bonifazi and Giuseppe Capobianco

Abstract. Plastics are very valuable material for their desirable properties being one of them, its durability. But this durability becomes an environmental problem when they end in the environment and they turn into one source of contamination that can last even for centuries. Thus, the first step for effective recycling is to identify correctly the different types of plastics. In this paper, different classical classifiers as random forest, KNN, or SVM are compared with 1-D CNN and LSTM to classify plastics using input hyperspectral images. Also, partial least squares discriminant analysis has been included as the baseline because is one of the most widely used classifiers in the field of Chemometrics community. The images were preprocessed with several techniques as Standard Normal Variate or Savitzky-Golay Polynomial Derivative to compare their effectiveness with raw data in the classifiers under consideration. The experiments were carried out using hyperspectral images with a 240 bands spectrum and six types of polymers were considered (PE, PA, PP, PS, PVC, EPS). The best results were obtained with SVM+RBF and 1-D CNN with an accuracy of 99.41\% and 99.31\% preprocessing the images with Standard Normal Variate. Also, PCA and t-SNE were tested as feature reduction methods but they don't introduce any improvement in the classifier performance.

Hotel Recognition via Latent Image Embeddings

Boris Tseytlin and Ilya Makarov

Abstract. We approach the problem of hotel recognition with deep metric learning. We overview the existing approaches and propose a modification to Contrastive loss called Contrastive-Triplet loss. We construct a robust pipeline for benchmarking metric learning models and perform experiments on Hotels50K and CUB200 datasets. Contrastive-Triplet loss is shown to achieve better retrieval on Hotels50K. The code for reproducing our experiments is available on Github.

(16:00-16:55) Session 5: Biosignals Processing

Analysis of Electroencephalographic Signals from a Brain-Computer Interface for Emotions Detection

Beatriz García Martínez, Antonio Fernández-Caballero, Arturo Martínez-Rodrigo and Paulo Novais

Abstract. Despite living in a digital society, the relation between humans and automatic systems is still far from being similar to the interaction among humans. In order to solve the lack of emotional intelligence of those systems, many works have designed algorithms for an automatic recognition of emotions through the assessment of physiological signals, with special interest in electroencephalography (EEG). However, the complexity of professional EEG recording devices limits the possibility of developing and testing these algorithms in real life scenarios, out of laboratory conditions. On the contrary, the use of wearable brain-computer interfaces could solve this limitation. For this reason, the present work analyzes EEG signals recorded with a BCI device for the classification of emotional states. Concretely, the spectral power in the different frequency bands of the EEG spectrum has been computed and assessed to discern between high and low levels of valence and arousal. Results reported an interesting classification performance of the BCI device in all frequency bands, being beta waves those which reported the best outcomes, 68.21% of accuracy for valence and 72.54% for arousal. In addition, the application of a sequential forward selection approach before the classification step revealed the relevance of frontal areas for valence detection and posterior regions for arousal identification.

A fine dry-electrode selection to characterize event-related potentials in the context of BCI

Vinicio Changoluisa, Pablo Varona and Francisco de Borja Rodriguez

Abstract. A brain-computer interface (BCI) detects brain activity and converts it to external commands, facilitating the interaction with external devices. One way to implement a BCI is through event-related potentials (ERP), which are positive or negative voltage deflections detected by electroencephalography (EEG) through conductive electrodes. A very promising technology of dry electrodes has been used in recent years, which is much easier and faster to install; useful also for daily life applications. But the disadvantage is that its signal-to-noise ratio is lower compared to traditional wet electrodes technology. Thus, we hypothesized that an appropriate selection of dry electrodes allows the recovery of much more information than traditional standard electrodes and therefore improves the BCI performance. This work shows the importance of electrode selection to obtain a better detection of the ERPs of the EEG signal with a minimum number of electrodes in a personalized manner. To illustrate this problem, we designed a BCI experiment based on P300-ERPs with a dry electrodes wireless EEG system and we evaluated its performance with two electrode selection methodologies designed for this purpose in 12 subjects. The experimental analysis of this work shows that our electrode selection methodology allows the P300-ERPs to be detected with greater precision than a standard electrode set choice. Besides, this minimum electrode selection methodology allows dealing with the well-known problem of inter- and intrasubject variability of the EEG signal, thus customizing the optimal selection of electrodes for each individual. This work contributes to the design of more friendly BCIs through a reduction in the number of electrodes, thus promoting more precise, comfortable, and lightweight equipment for real-life BCI applications.

Detection of Emotions from Electroencephalographic Recordings by means of a Nonlinear Functional Connectivity Measure

Beatriz García Martínez, Antonio Fernández-Caballero, Raúl Alcaraz and Arturo Martínez-Rodrigo

Abstract. The brain has been typically assessed as a group of independent structures focused on the realization of determined processes separately. Nevertheless, recent findings have confirmed the existence of interconnections between all brain regions, thus demonstrating that the brain works as a network. These areas can be interconnected either physically, by anatomical links, or functionally, through functional associations created for a coordinated development of mental tasks. In this sense, the assessment of functional connectivity is crucial for discovering new information about the brain's behavior in different scenarios. In the present study, the nonlinear functional connectivity metric cross-sample entropy (CSE) is applied in the research field of emotions recognition from EEG recordings. Concretely, CSE is computed to discern between four different emotional states. The results obtained indicated that the strongest coordination appears in intra- and inter-hemispheric interactions of central, parietal and occipital brain regions, whereas associations between left frontal and temporal lobes with the rest of areas show the most dissimilar dynamics, thus a higher uncoordinated activity. In addition, coordination is globally higher under emotional conditions of high arousal/low valence (like fear or distress) and low arousal/high valence
(such as relaxation or calmness).

P300 Characterization through Granger Causal Connectivity in the context of Brain-Computer Interface technologies

Vanessa Salazar, Vinicio Changoluisa and Francisco de Borja Rodriguez

Abstract. The analysis of connectivity in brain networks has been widely researched and it has been shown that certain cognitive processes require the integration of distributed brain areas. Functional connectivity attempts to statistically quantify the interdependence between these brain areas. In this paper, we propose an analysis of functional connectivity in the Event-Related Potential (ERP) context, more specifically on the P300 component using the Granger Causality measure. For this intend, we propose a methodology that consists of quantifying the causality in the P300 and non-P300 signals in the context of Brain-Computer Interfaces (BCIs). Causality is calculated using two approaches: i) using standard electrodes and, ii) using electrodes selected by Bayesian Linear Discriminant Analysis and sequential forward electrode selection (BLDA-FS). Based on this analysis, it is shown that the Granger Causality metric is valid to show a significant connectivity difference between P300 and non-P300 signals. The electrodes selected using BLDA-FS were found to be more discriminative in this regard. Studying functional connectivity with Granger Causality allowed us to recognize the changes in connectivity detected during the presence of a target stimulus compared to a non-target stimulus. This additional information about the connectivity differences found can be incorporated as a new feature in further studies, allowing for better detection of the P300 signal and consequently improving the performance of P300-based BCIs.

Feature and Time Series Extraction in ArtificialNeural Networks for Arousal Detection from Electrodermal Activity

Roberto Sánchez-Reolid, Francisco López de la Rosa, Daniel Sánchez-Reolid, Maria T. Lopez and Antonio Fernández-Caballero

Abstract. The detection of arousal is very important given its great implication on daily well-being. In this regards, the use of artificial neural networks and other classifiers applied to physiological signals has increased considerably. Different architectures for arousal detection using electrodermal activity are presented in this paper. Moreover, two different strategies are analysed and compared. The first one is based on the collection of 21 features (temporal, morphological, statistical and frequential), whereas the second used the processed EDA data (phasic component data) directly on different machine learning algorithms. The first approach offers F1-

scores 92.02\% and 90.95\% for a multilayer perceptron and a one-dimensional convolutional network, respectively. For the second scenario, it has been found that the best F1-scores are 91.02\% and 88.12\% for bilateral long short-term memory and long short-term memory, respectively.

(17:00-18:05) Official Opening Ceremony. Plenary Talk:

Prof. Pierre Baldi

University of California, Irvine, USA

(18:10-19:45) Session 6: Deep Learning (Part. I)

Context-aware Graph Convolutional Autoencoder

Asma Sattar and Davide Bacciu

Abstract. Recommendation problems can be addressed as link prediction tasks in a bipartite graph between user and item nodes, labelled with rating on edges. Existing matrix completion approaches model the user's opinion on items by ignoring context information that can instead be associated with the edges of the bipartite graph. Context is an important factor to be considered as it heavily affects opinions and preferences. Following this line of research, this paper proposes a graph convolutional auto-encoder approach which considers users' opinion on items as well as the static node features and context information on edges. Our graph encoder produces a representation of users and items from the perspective of context, static features, and rating opinion. The empirical analysis on three real-world datasets shows that the proposed approach outperforms recent state-of-the-art recommendation systems.

Development and implementation of a neural network-based abnormal state prediction system for a piston pump

Mauricio Andrés Gómez Zuluaga, Ahmad Ordikhani, Christoph Bauer and Peter Gloesekoetter

Abstract. This paper reflects the development and implementation of a neural network system for abnormal state prediction of piston pumps. After a short in-troduction into piston pumps and their potential abnormal states, statistical and periodical analysis are presented. Then the design and implementation of suita-ble neural

networks are discussed. Finally, a conclusion is drawn and the ob-served accuracies as well as potential next steps are discussed.

Iterative adaptation to quantization noise

Dmitry Chudakov, Sergey Alyamkin, Alexander Goncharenko and Andrey Denisov

Abstract. Quantization allows accelerating neural networks significantly, especially for mobile processors. Existing quantization methods require either training neural network from scratch or gives significant accuracy drop for the quantized model. Low bits quantization (e.g., 4- or 6-bit) task is a much more resource consumptive problem in comparison with 8-bit quantization, it requires a significant amount of labeled training data. We propose a new low-bit quantization method for mobile neural network architectures that doesn't require training from scratch and a big amount of train labeled data and allows to avoid significant accuracy drop.

A BERT based approach for Arabic POS Tagging

Rakia Saidi and Fethi Jarray

Abstract. Large pre-trained language models, such as BERT, have recently achieved state-of-the-art performance in different natural language processing tasks. However, BERT based models in Arabic language are less abundant than in other languages. This paper aims to design a grammatical tagging system for texts in Arabic language using BERT. The main goal is to label an input sentence with the most likely sequence of tags at the output. We also build a large corpus by combining the available corpora such as the Arabic WordNet and the Quranic Arabic Corpus. The accuracy of the developed system reached 91.69\%. Our source code and corpus are available at GitHub upon request.

Facial expression interpretation in ASD using Deep Learning

Pablo Salgado, Oresti Banos and Claudia Villalonga

Abstract. People with autism spectrum disorder (ASD) are known to show difficulties in the interpretation of human conversational facial expressions. With the recent advent of artificial intelligence, and more specifically, deep learning techniques, new possibilities arise in this context to support people with autism in the recognition of such expressions. This work aims at developing a deep neural network model capable of recognizing conversational facial expressions which are prone to misinterpretation in ASD. To that end, a publicly available dataset of conversational facial expressions is used to train various CNN-LSTM architectures. Training results are promising, however, the model shows limited generalization. Therefore, better conversational facial expressions datasets are required before attempting to build a full-fledged ASD-oriented support system.

Rendering Scenes for Simulating Adverse Weather Conditions

Prithwish Sen, Anindita Das and Nilkanta Sahu

Abstract. Most of the object detection schemes do not perform well when the input image is captured in adverse weather. Reason being that the available data sets for training/testing of those schemes didn't have many images in such weather conditions. Thus in this work, a novel approach to render foggy and rainy datasets is proposed. The rain is generated via estimation of the area of the scene image and then computing streak volume and finally overlapping the streaks with the scene image. As visibility reduces with depth due to fog, rendering of fog must take depth-map into consideration. In the proposed scheme, the depth map is generated from a single image. Then, the fog coefficient is generated by modifying the 3D Perlin noise with respect to the depth map. Further, blending the corresponding density of the fog with the scene image at a particular region based on precomputed intensities at that region. Demo dataset is available in https://github.com/senprithwish1994/DatasetAdverse.

Automatic Fall Detection using Long Short-Term Memory Network

Carlos Magalhães, João Ribeiro, Argentina Leite, Eduardo Solteiro Pires and João Pavão

Abstract. Falls, especially in the elderly, are one of the main factors of hospitalization. Time-consuming intervention can be fatal or cause irreversible damages to the victims. On the other hand, there is currently a significant amount of smart clothing equipped with various sensors, particularly gyroscopes and accelerometers, which can be used to detect accidents. The creation of a tool that automatically detects eventual falls allows helping the victims as soon as possible. This works focuses in the automatic fall detection from sensors signals using long short-term memory networks.
To train and test this approach, the Sisfall dataset is used, which considers the simulation of 23 adults and 15 older people. These simulations are based on everyday activities and the falls that may result from their execution. The results indicate that the procedure provides an accuracy score of 97.1% on the test set.

Deep Convolutional Neural Networks with Residual Blocks for Wafer Map Defect Pattern Recognition

Zemenu Endalamaw Amogne, Fu-Kwun Wang and Jia-Hong Chou

Abstract. Different deep convolution neural network (DCNN) models have been proposed for wafer map pattern identification and classification tasks in previous studies. However, factors such as the effect of input image resolution on the classification performance of the proposed models and class imbalance in the training set after splitting the data into training and test sets have not been considered in the previous studies. This study proposes a DCNN model with residual blocks, called Opt-ResDCNN model, for wafer map defect pattern identification and classification by considering 26*26 input image resolutions and class imbalance issues during the model training. The proposed model is compared with the previously published defect pattern recognition and classification models in terms of accuracy, precision, recall, and F1 score for 26*26 input image size. Using a publicly available wafer map dataset (WM-811K), the proposed method can obtain an average accuracy, precision, recall, and F1 score results of 99.672%, 99.664%, 99.695%, 99.692%, respectively for the 26*26 input image resolution.


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(9:00-10:30) Session 7: Advanced topics in computational intelligence (Part.II)

Deep Reinforcement Learning in VizDoom via DQN and Actor-Critic Agents

Maria Bakhanova and Ilya Makarov

Abstract. In this work, we study the problem of learning reinforcement learning based agent in first-person shooter environment VizDoom. We compare several well-known architectures, such as DQN, DDQN, A3C and Curiosity-driven model, while highlighting the main differences in learned policies of agents trained via these models.

Adaptive Ant Colony Optimization for Service Function Chaining in a Dynamic 5G Network

Segundo Moreno and Antonio Mora

Abstract. 5G Networks are strongly dependent on software-based management and processing. Thus, Software-defined Networks (SDNs) and Network Function Virtualization (NFV) are part of the core of these networks. Services offered inside this environment are composed of several Virtual Network Functions (VNFs) that must be executed in a (normally) strict order. This is known as Service Function Chaining (SFC) and, given that those VNFs could be placed in different nodes along the network together with the expected low latency in the processing of 5G services, makes SFC a tough optimization problem.
In a previous work, the authors presented an Ant Colony Optimization (ACO) algorithm for the minimization of the routing cost of service chain composition, but it was a preliminary approach able to solve simple and 'static' instances; i.e. those where the network topology remains the same during the resolution. This is far from the real situation in networks, where usually nodes (and links) are appearing and disappearing continuously.
Thus, in this work we describe an evolution of our previous proposal, which consider a dynamic model of the problem, closer to the real scenario. So, in the instances nodes and links can be removed suddenly or, on the contrary, they could arise. The ACO algorithm will be able to adapt to these changes and still yield optimal solutions.
The Adaptive Ant-SFC method has been tested in three dynamic instances with different sizes, obtaining correct and very promising results.

On the Use of Fuzzy Metrics for Robust Model Estimation: a RANSAC-based Approach

Alberto Ortiz, Esaú Ortiz, Juan José Miñana and Óscar Valero

Abstract. Application domains, such as robotics and computer vision (actually, any sensor data processing field), often require from robust model estimation techniques because of the imprecise nature of sensor data. In this regard, this paper describes a robust model estimator which is actually a modified version of RANSAC that takes inspiration from the notion of fuzzy metric, as a suitable tool for measuring similarities in the presence of the uncertainty inherent to noisy data. More precisely, it makes use of a fuzzy metric within the main RANSAC loop to encode as a similarity the compatibility of each sample to the current hypothesis/model. Further, once a

number of hypotheses have been explored and the winning model has been selected, we make use of the same fuzzy metric to obtain a refined version of the model. In this work, we consider two fuzzy metrics that permit us to express the distance between the sample and the model under consideration as a kind of degree of similarity measured relative to a parameter. By way of illustration of the performance of the approach, we report on the accuracy achieved by the proposed estimator and other RANSAC variants for a benchmark comprising two kinds of perception problems typically encountered in vision applications, and a large number of datasets with varying proportion of outliers and different levels of noise. The proposed estimator is shown able to outperform the classical counterparts considered.

A New Detector Based On Alpha Integration Decision Fusion

Addisson Salazar, Gonzalo Safont, Nancy Vargas and Luis Vergara

Abstract. This paper presents a new detector method based on alpha integration decision fusion. The detector incorporates a regularization element in the cost function. This element is considered a measure of the smoothness of the signal in graph signal processing. We theorize that minimizing this term will reduce the dispersion of the statistics of the fusion, and thus improving the separation between the two hypotheses of the detection. To highlight the performance of alpha integration methods and regularization classification, two experiments are presented. The first one consists of simulated data, and the proposed method is compared with alpha integration without regularization. The second one consists of detection of ultrasound pulses buried into highly background noisy. In this latter experiment, three single classifiers were im-plemented: support vector machine; quadratic linear discriminant; and random forest. The results obtained from those classifiers were fused by using the mean; standard alpha integration and alpha integration with regularization. In all experiments the advantages of the proposed method were demonstrated.

A Safe and Effective Tuning Technique for Similarity-based Fuzzy Logic Programs

Gines Moreno and José Antonio Riaza Valverde

Abstract. We have recently designed a symbolic extension of FASILL (acronym of <<Fuzzy Aggregators and Similarity Into a Logic Language>>), where some truth degrees, similarity annotations and fuzzy connectives can be left unknown, so that the user can easily see the impact of their possible values at execution time. By extending our previous results in the development of tuning techniques not dealing yet with similarity relations, in this work we automatically tune FASILL programs by appropriately substituting the symbolic constants appearing on their rules and similarity relations with the concrete values that best satisfy the user's preferences. The approach has been proved correct under some safe conditions and an online tool is provided to check its effectiveness.

Predictive ability of Response Surface Methodology (RSM) and Artificial Neural Network (ANN) to approximate biogas yield in a Modular biodigester

Modestus Okwu, Lagouge Tartibu, Olusegun Samuel, Henry Omoregbee and Anna Ivbanikaro

Abstract. This study indicates the modelling and optimization of biogas production on assorted substrates of poultry wastes (PW) and cow dung using RSM and ANN. Three-layered ANN feedforward BP and RSM models were developed to estimate the yield of biogas produced via mixture of CD and PW droppings produced from a bio-digester system in the ratio 1:2. At the first run, maximum biogas yield of 51.3% was achieved with 38:23 CD/PW within the retention time of 9 days. The results showed that the coefficient of determination (R2) of the RSM and ANN models were 0.9998 and 1.0. The root-mean-square-error (RMSE) for best RSM and ANN were

obtained at 0.0055 and 0.00022188. The study showed that ANN result seems marginally better than the RSM model. This is a confirmation that biomass could be harnessed in solving the current global energy crisis.

(10:35-11:25) Session 8: Meta-learning and other automatic learning approaches in intelligent systems

A study of the correlation of metafeatures used for metalearning

Adriano Rivolli, Luis Garcia, Ana Lorena and Andre Carvalho

Abstract. Metalearning has been largely used over the last years to recommend machine learning algorithms for new problems based on past experience. For such, the first step is the creation of metabase, or metadataset, containing metafeatures extracted from several datasets along with the performance of a pool of candidate algorithm(s). The next step is the induction of machine learning metamodels using the metabase as input. These models can recommend the most suitable algorithms for new datasets based on their metafeatures values. An effective metalearning system must employ metafeatures that characterize essential aspects of the datasets while also distinguishing different problems and solutions. The characterization process should also show a low computational cost, otherwise, the recommendation system can be replaced by a standard trial-and-error approach. This paper proposes the use of an unsupervised correlation-based feature selection strategy to identify a reduced subset of metafeatures for metalearning systems. Empirically, the predictive performance achieved by metalearning systems using the subset of selected metafeatures is similar or better than the performance obtained using the whole set of metafeatures. In addition, a noteworthy reduction in the number of metafeatures needed is observed, implying computational cost reductions.

Learning without Forgetting for 3D Point Cloud Objects

Townim Chowdhury, Mahira Jalisha, Ali Cheraghian and Shafin Rahman

Abstract. When we fine-tune a well-trained deep learning model for a new set of classes, the network learns new concepts but gradually forgets the knowledge of old training. In some real-life applications, we may be interested in learning new classes without forgetting the capability of previous experience. Such learning without forgetting problem is often investigated using 2D image recognition tasks. In this paper, considering the growth of depth camera technology, we address the same problem for the 3D point cloud object data. This problem becomes more challenging in the 3D domain than 2D because of the unavailability of large datasets and powerful pretrained backbone models. We investigate knowledge distillation techniques on 3D data to reduce catastrophic forgetting of the previous training. Moreover, we improve the distillation process by using semantic word vectors of object classes. We observe that exploring the interrelation of old and new knowledge during training helps to learn new concepts without forgetting old ones. Experimenting on three 3D point cloud recognition backbones (PointNet, DGCNN, and PointConv) and synthetic (ModelNet40, ModelNet10) and real scanned (ScanObjectNN) datasets, we establish new baseline results on learning without forgetting for 3D data. This research will instigate many future works in this area.

Patch-wise semantic segmentation of sedimentation from high-resolution satellite images using deep learning

Tahmid Hasan Pranto, Abdulla All Noman, Asaduzzaman Noor, Ummeh Habiba Deepty and Mohammad Rashedur Rahman

Abstract. In recent times, satellite data availability has increased signi ficantly, helping researchers worldwide to explore, analyze and approach different problems using the most recent techniques. The segmentation of sediment load in coastal areas using satellite imagery can be considered as a cost-efficient process as sediment load analysis can be costly and time-consuming if done hands on. In this work, we created dataset of Bangladesh marine area for segmenting sediment load and showed the applicability of deep learning technique to segment sedimentation into 5 different classes (Land, Hight Sediment, Moderate Sediment, Low Sediment and No Sediment). We used a modified U-Net architecture to segment our training images using corresponding label masks. As the high-resolution satellite images are enormous, we showed how patch-wise learning technique can be a effective solution. Among the four models, highest dice coefficient of 86% and validation dice co-efficient of 87% has been acquired for Dec-2019 dataset. For the other 3 models, these values are above 85%. The models scored highest 77% of pixel accuracy and 78% of validation accuracy for the same dataset and for the other three models, this score is above 74%.

Learning Image Segmentation from Few Annotations. A REPTILE Application

Hector F. Satizabal and Andres Perez-Uribe

Abstract. How to build machine learning models from few annotations is an open research question. This article shows an application of a meta-learning algorithm (REPTILE) to solve the problem of object segmentation. We evaluate how using REPTILE during a pre-training phase helps to improve the performance of the resulting segmentation in poor labeling conditions and compare these results against training the detectors using basic transfer learning. Two scenarios are tested: (i) how segmentation performance evolves through training epochs with a fixed amount of labels and (ii) how segmentation performance improves with an increasing amount of labels after a fixed amount of epochs. The results suggest that REPTILE is useful making learning faster in both cases.

(11:30-12:55) Session 9: Artificial intelligence and Bio-medicine

Impacted Tooth Detection in Panoramic Radiographs

James Faure and Andries Engelbrecht

Abstract. This paper proposes an approach to analyse panoramic radiographs in order to automate diagnosis of impacted teeth. The panoramic radiographs go through an intensive labelling process which demarcates impacted teeth using rectangular bounding boxes. A convolutional neural network is trained on these labelled images to predict different types of impacted teeth. The empirical results illustrate good performance with respect to impacted teeth prediction.

Deep learning for diabetic retinopathy prediction

Ciro Rodriguez-Leon, William Arevalo, Oresti Banos and Claudia Villalonga

Abstract. Diabetic retinopathy is a complication of diabetes mellitus. Its early diagnosis can prevent its progression and avoid the development of other major complications such as blindness. Deep learning and transfer learning appear in this context as powerful tools to aid in diagnosing this condition. The present work proposes to experiment with different models of pre-trained convolutional neural networks to determine which one fits best the problem of predicting diabetic retinopathy. The Diabetic Retinopathy Detection dataset supported by the EyePACS competition is used for evaluation. Seven pre-trained CNN models implemented in the Keras library developed in Python and, in this case, executed in the Kaggle platform, are used. Results show that no architecture performs better in all evaluation metrics. From a balanced behaviour perspective, the MobileNetV2 model stands out, with execution times almost half that of the slowest CNNs and without falling into overfitting with 20 learning epochs. InceptionResNetV2 stands out from the perspective of best performance, with a Kappa coefficient of 0.7588.

Facial Image Augmentation from Sparse Line Features Using Small Training Data

Shih-Kai Hung and John Gan

Abstract. Data collection is expensive in many research fields. Data augmentation from a very small dataset, such as synthesising realistic images from limited or incomplete information available from a small number of sample images, is still an enormous challenge using deep convolutional neural networks that traditionally require a large number of training data to achieve reasonable performance. For the purpose of manipulating the synthetic results with diversity, line features, which can be easily obtained through computer vision, hand-drawn lines, or customer-designed sketches, can be utilized to provide extra details to effectively augment a small training dataset for many applications. In this paper, a novel conditional generative adversarial network (GAN) framework for synthesising photorealistic facial images using small training data and limited line features is proposed, where sparse line features are expected to simulate abstract and incomplete hand-drawn sketches for introducing diversity in the augmented facial images. The proposed GAN framework can automatically recover the lost information caused by incomplete input features, which has been proved to efficiently reduce unexpected distortions but enhance data diversity with controllable sparse line features. Experimental results have demonstrated that the proposed method with a very small dataset, 50 training images only, can generate images of higher quality than the traditional translation methods and preserve essential details to synthesise diverse but realistic facial images. Compared to the state-of-the-art methods, the proposed GAN framework can generate more photorealistic facial images using controllable sparse line features in terms of higher FID and KID scores as well as preference evaluation by human perception.

Ensemble models for covid prediction in X-Ray images

Juan Carlos Morales Vega, Francisco Carrillo-Perez, Jesús Toledano Pavón, Ignacio Rojas Ruiz and Luis Javier Herrera Maldonado

Abstract. In this paper we compare a deep learning model with an ensemble model in the task of COVID diagnosis using X-Rays. For the DL model, we have used only frontal DX X-Ray images. For the ensemble model, we have used frontal DX and CR X-Ray images, as well as lateral DX and CR X-Ray images. The features of these four images are combined and a final prediction is made. Since not every patient possess all types of images, the model is also robust against missing information. We first make a review over several information fusion techniques and then present a simple ensemble model for multi-image COVID prediction that show improvements over the single image model. We conclude that having different sources of information can be very useful for any type of automatic learning, which is particularly true for medical data.

Validation of a Nonintrusive Wearable Device for Distress Estimation During Robotic Roller Assisted Gait

Marta Díaz-Boladeras, Xavier Llanas, Elsa Pérez, Marta Musté, Carlos Pérez, Àlex Barco and Andreu Català

Abstract. Successful robot rollators work under the shared control paradigm as the best way to adjust dynamically to users' needs and preferences in rehabilitation and daily living activities. To decide how much weight users have in emerging motion commands is necessary to assess their condition and needs, usually from on-board sensors. Unfortunately, some relevant parameters for safe and comfortable gait assistance (i.e. balance or stress) are extremely difficult to measure using only on-board sensors. Therefore, wearable devices that offers real-time physiological data acquisition are meant to be a valuable source of relevant information of users' psychological states such stress. However, detecting stress in real life with an unobtrusive wearable device is a challenging task. The objective of this study is to develop a method for real-time stress detection based in the wrist band Empatica E4 that can accurately, continuously and unobtrusively monitor psychological stress in real life to feed the system to provide smart gait-assistance. In this preliminary study we explore the feasibility, accuracy and reliability of the wrist-band with machine learning and signal processing techniques applied to electrodermal activity from nine healthy participants in laboratory conditions. Specifically, the participants' electrodermal activity (EDA) gathered by the Empatica E4 under a standardized stress induction test (Affective Picture System) is analized to evaluate the sensitivity, validity and robustness of the measure. Additionally, the Empatica's galvanic response measures have been compared with the corresponding measured by the medical certified two electrodes sensor in the Equivital Lifemonitor, equipment used as a goal standard in other studies (Yan Liu et al. 2013). The results of the accuracy and precision of the measurements and the validation for the purpose of the research will be presented and discussed. The present study will be followed by a pilot in the lab with 20 participants fulfilling trajectories of different level of difficulty with the roller, previously to the clinical trials with rehabilitation patients. Both studies have been approved by the Ethical Committee of the Universitat Politècnica de Catalunya.

Yan Liu, Shai H. Zhu, Guo H. Wang, Fei Ye & Peng Z. Li (2013) Validity and Reliability of Multiparameter Physiological Measurements Recorded by the Equivital Lifemonitor During Activities of Various Intensities, Journal of Occupational and Environmental Hygiene, 10:2, 78-85, DOI: 10.1080/15459624.2012.747404

Deep Learning for Heart Sounds Classification using Scalograms and Automatic Segmentation of PCG Signals

John Gelpud, Silvia Castillo, Mario Jojoa, Begonya Garcia, Wilson Achicanoy and David Carbonero

Abstract. Phonocardiogram (PCG) signals contain valuable information about the heart health status, and they could help us in early detection and diagnosis of potential abnormalities. In this paper, we propose different Deep Learning algorithms for classifying PCG scalogram, into normal or abnormal categories, supported on reliable signal processing algorithms to automatically denoise and segment the sounds to improve the Deep Learning detection task. At the first stage, we denoised the PCG signal using a multi-resolution analysis based on the Discrete Wavelet Transform (DWT). At the second one, we segment automatically the sounds using an algorithm based on the Teager Energy Operator (TEO) and the autocorrelation. This is very important, because we need to select the S1 component related to the systole, and S2 component related to the diastole. Finally, scalogram images are obtained using Continuous Wavelet Transform (CWT). We executed the classication task using the heart sounds from the 2016 PhysioNet/CinC Challenge database, and pretrained Convolutional Neural Networks (CNNs) ResNet152 and VGG16, achieving an accuracy of 91.19% and 90.75%, respectively. The results of our proposed model presents a good contribution to heart sounds classication area, in comparison with the state of the art accuracy which is 87%.

Skin Disease Classification Using Machine Learning Techniques

Mohammad Ashraful Haque Abir, Golam Kibria Anik, Shazid Hasan Riam, Mohammed Ariful Karim, Azizul Hakim Tareq and Mohammad Rashedur Rahman

Abstract. According to Global Burden of Disease project, skin diseases are the fourth leading cause for benign sickness throughout the world. Diagnosis of dermatological diseases presents a challenge alongside the absence of trained dermatologists and access to formal medical care. This presents a critical challenge, especially in countries with a large rural population and minimal development. The aim of this paper is to study machine learning based classifiers for predicting skin infections for three classes from a clinical dataset. Convolutional neural network (CNN) has been proved to perform well in the image classification. The performance of the neural network is compared with a benchmark multiclass SVM classifier. The results analysis and possible future works are also discussed in this paper

Construction of Suitable DNN-HMM for Classification between Normal and Abnormal Respiration

Masaru Yamashita

Abstract. In many situations, abnormal sounds termed adventitious sounds are part of the lung sound of a subject suffering from a pulmonary disease. In this study, we aim to achieve the automatic detection of abnormal sounds from auscultatory sound. For this purpose, we expressed the acoustic features of normal lung sound for healthy subjects and abnormal lung sound for patients by using the Gaussian mixture model (GMM)-hidden Markov model (HMM) and distinguished between normal and abnormal lung sounds. However, the classification rate between normal and abnormal respiration was low (86.53%). In speech recognition, the accuracy was improved using a deep neural network (DNN)-HMM. However, in the case of lung sound, we cannot use a DNN because the amount of training data is small. In this paper, we present the construction of a DNN-HMM with high accuracy by selecting a suitable acoustic feature and set-ting the number of hidden layers and units for the DNN-HMM. By selecting a suitable number of hidden layers and units for the DNN-HMM, the classification rate was increased (91.26%). The results proved the effectiveness of the pro-posed method.

(13:00-14:30) Tutorial: Hands-on Introduction to Deep Learning

Coach: Raul Benitez Iglesias

Universitat Politecnica de Catalunya

(16:00-17:00) Session 10: Applications in artificial intelligence (Part. II)

Time Series Prediction with Autoencoding LSTM Networks

Federico Succetti, Andrea Ceschini, Francesco Di Luzio, Antonello Rosato and Massimo Panella

Abstract. Nowadays, solving prediction problems in green computing is an open and challenging task, for which solutions based on deep learning are studied. In this work, we present a forecasting algorithm based on Long Short-Term Memory networks applied to renewable energy sources time series prediction. We make use of an encoder-decoder structure to extract useful representative sequence data, employing a stacked LSTM architecture for data embedding and successive prediction. By comparing the performance of the proposed forecasting scheme with a classical two layer LSTM structure, we are able to assess the performance of the former as a robust tool for solving prediction problems in the green computing framework.

Improving Indoor Semantic Segmentation with Boundary-level Objectives

Roberto Amoroso, Lorenzo Baraldi and Rita Cucchiara

Abstract. While most of the recent literature on semantic segmentation has focused on outdoor scenarios, the generation of accurate indoor segmentation maps has been partially under-investigated, although being a relevant task with applications in augmented reality, image retrieval, and personalized robotics.
With the goal of increasing the accuracy of semantic segmentation in indoor scenarios, we develop and propose two novel boundary-level training objectives, which foster the generation of accurate boundaries between different semantic classes.
In particular, we take inspiration from the Boundary and Active Boundary losses, two recent proposals which deal with the prediction of semantic boundaries, and propose modified geometric distance functions that improve predictions at the boundary level.
Through experiments on the NYUDv2 dataset, we assess the appropriateness of our proposal in terms of accuracy and quality of boundary prediction and demonstrate its accuracy gain.

EvoMLP: a framework for evolving multilayer perceptrons

Luis Liñán-Villafranca, Mario Garcia Valdez, Jj Merelo and Pedro Castillo

Abstract. Designing neural networks for classification or regression can be considered a search problem, and, as such, can be approached using different optimization procedures, all of them with several design challenges: The first and more important is to constrain the search space in such a way that proper solutions can be found in a reasonable amount of time; the second is to take into account that, depending on how the optimization procedure is formulated, the fitness score used for it can have a certain degree of uncertainty. This means that creating a framework for evolving neural networks for classification implies taking a series of decisions that range from the purely technical to the algorithmic at different levels: neural or the optimization framework chosen. This will be the focus of this paper, where we will introduce DeepGProp, a framework for genetic optimization of multilayer perceptrons that efficiently explores space of neural nets with different layers and layer size.

Regularized One-Layer Neural Networks for Distributed and Incremental Environments

Oscar Fontenla-Romero, Bertha Guijarro-Berdiñas and Beatriz Pérez-Sánchez

Abstract. Deploying machine learning models at scale is still a major challenge; one reason is that performance degrades when they are put into production. It is therefore very important to ensure the maximum possible generalization capacity of the models and regularization plays a key role in avoiding overfitting. We describe Regularized One-Layer Artificial Neural Network (ROLANN), a novel regularized training method for one-layer neural networks. Despite its simplicity, this network model has several advantages: it is noniterative, has low complexity, and is capable of incremental and privacy-preserving distributed learning, while maintaining or improving accuracy over other state- of-the-art methods as demonstrated by the experimental study in which it has been compared with ridge regression, lasso and elastic net over several data sets.

The Jacobi wavelets regularization for support vector machines

Abbassa Nadira, Amir Abdessamad and Bahri Sidi Mohamed

Abstract. In this work, a new kernel based on a family of regularized Jacobi wavelets is constructed for support vector machines. The Reproducing Kernel Hilbert Space of this kernel is identified using kernel and frame theories. We show that without being a universal kernel, the proposed one possesses a good separation property and a big ability to extract more discriminative features. These theoretical results are supported by numerical experiments, which show that this kernel can provide competitive results compared to other kernels.

Frailty level prediction in older age using hand grip strength functions over time

Elsa Pérez, José E. Torres Rangel, Marta Musté, Carlos Pérez, Oscar Macho, Francisco S. del Corral Guijarro, Aris Somoano, Cristina Giamella, Luis Ramírez and Andreu Català

Abstract. Frailty syndrome can be defined as a clinical state in which there is a rise in individual vulnerability, developing an increase in both the dependence of the person and mortality when exposed to a stressor. Frailty is completely related to age, being highly prevalent in the elderly, reaching up to 30% in people over 75 years of age. On the other hand, there is evidence through several studies that show that the appearance of frailty can be anticipated, delayed or even avoided [9]. Therefore, a fundamental factor to apply rehabilitative interventions successfully resides in having a simple, effective and reliable method capable of identifying people with frailty syndrome.

Currently, there are several validated methods for identifying frailty. One of the most complete method is the VIG (comprehensive geriatric assessment) [2] that takes into consideration the Biomedical, Pharmacological, Psychological, Functional and Social data of the patients. Others, like Fried index [3], focus their attention only in the functional part. In any case the procedure is carried out in the doctor's office and there are several sources of uncertainty trough the opinion of the patients, white coat effect and external factors.

However, in the clinical practice, the experience of the geriatricians led them to determine an approximation of the evolution of the frailty level only with a simple handshake. Hand grip strength (HGS) has been widely used in tests by investigators and therapists to be able to diagnose sarcopenia and frailty, as it is a reliable indicator of the overall muscle strength, which decreases with age. Most researches focused mainly on peak HGS, which will not necessarily give insight on how the patient's strength was distributed or applied over the course of the procedure, hence its behaviour. Therefore, there is still a lack of consistency when it comes to evaluate HGS over a period of time. In the present work, a system based on Machine Learning for the identification of frailty levels is developed using physiological features like age, gender, body mass index, and the classical signal processing based on statistics of the windowed signals of the grip force signal.

The starting hypothesis is that we can identify the "way" of performing HGS correlated with the level of frailty. To achieve this goal a clinical study was designed and carried out with a cohort of 70 elderly persons, in two Hospitals, (Hospital Central de la Cruz Roja San José y Santa Adela de Madrid, Consorci Sanitari de l'Alt

Penedès i Garraf). The protocol includes the registration of several frailty indexes like VIG, Fried and Barthel and the performance of 3 HGS test recorded with a modified Deyard dynamometer to store and transmit the produced signals. The present research protocol was approved by the "Comité de Ética de la Investigación con Medicamentos de la Comunidad de Madrid" (Ref 47/916546.9/19)
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(17:00-18:05) Plenary Talk:

Prof. Jeanna Matthews

Division of Mathematics and Computer Science,

Clarkson University.

(18:10-19:30) Session 11: Deep Learning (Part. II)

Enhanced Convolutional Neural Network for Age Estimation

Idowu Aruleba and Serestina Viriri

Abstract. The human face constitutes various biometric features that could be used to estimate an important detail such as age. Variations in facial landmarks and appearances have presented challenges to automated age estimation. This accounts for limitations attributed to conventional approaches such as the traditional hand-crafted method, which cannot efficiently and adequately estimate age. In this study, a six-layered
Convolutional Neural Network (CNN) was proposed, which extracts features from facial images taken in an uncontrolled environment, and classifies them into appropriate classes. Since a huge dataset is needed to obtain good accuracy from the trained model and minimize overfitting, data augmentation was performed on the datasets to balance the number of images in each class. The UTKFace dataset was used to train the model while validation was carried out on the FGNET dataset. With the proposed novel method, an accuracy of 89.75% was recorded on the UTKFace dataset, which is a significant improvement over existing state-of-the-art methods previously implemented on the UTKFace dataset.

Deep Interpretation with Sign Separated and Contribution Recognized Decomposition

Lucas Y W Hui and De Wen Soh

Abstract. Network interpretation in context of explainable AI continues to gather interest not only because of the need to explain algorithm decisions, but also because of potential improvements that can be made to network design.
A large pool of research effects have been made including explanation by training sample representer points, exhaustive feature occlusion methods, locally learned interpretable models, sensitivity methods using network gradients, and relevance models using layer-wise back-propagation.
It is however a constant challenge to interpret different network architectures or even different network function layers given the multiplicity of models, tools, rules and assumptions. In addition, there are challenges in producing good interpretable results; in particular, that of jointly improving both the sensitivity and relevancy of each attribute contribution within a network to the final network decision.
A unified decomposition rule based on new propositions about negative features and majority contribution is proposed in this paper to address these challenges. Furthermore, quantitative measures are discussed to address performance of both sensitivity and relevancy of interpretation.

Deep Learning for Age Estimation Using EfficientNet

Idowu Aruleba and Serestina Viriri

Abstract. The human face constitutes various biometric features that could be used to estimate important details from humans, such as age. The automation of age estimation has been further limited by variations in facial landmarks and appearances, together with the lack of enormous databases. These have also limited the efficiencies of conventional approaches such as the handcrafted method for adequate age estimation.
More recently, Convolutional Neural Network (CNN) methods have been applied to age estimation and image classification with recorded improvements. In this work, we utilize the CNN-based EfficientNet architecture for age estimation, which, so far, has not been employed in any current study to the best of our knowledge. This research focused on applying the EfficientNet architecture to classify an individual's age in the appropriate age group using the UTKface and Adience datasets. Seven EfficientNet variants (B0 { B6) were presented herein, which were finetuned and used to evaluate age classification efficiency. Experimentation showed that the EfficientNet-B4 variant had the best performance on both datasets with an accuracy of 73.5% and 81.1% on UTKFace and Adience, respectively. The models showed a promising pathway in solving problems related to learning global features, reducing training time and computational resources.

Towards a Deep Reinforcement Approach for Crowd Flow Management

Wejden Abdallah, Dalel Kanzari and Kurosh Madani

Abstract. Reinforcement Learning knows an important success in various applications such as robotics, games, resource management, etc. However, it is proving insufficient to solve the problem of crowd evacuation, in a realistic environment because the crowd situation is very dynamic, with many changing variables and complex constraints that make it difficult to solve. And there is no standard reference environment that can be used to train agents in an evacuation. A realistic environment can be complex to design. In this paper, we use Deep Reinforcement Learning to train agents in evacuation planning. The environment is modeled as a grid with obstacles and the solution is modeled using intelligent agents. It takes into account certain parameters, such as the number of occupants, the capacity level, and the time to pass through the exit doors. The objective is to allow the evacuation of the occupants as quickly as possible and to help the agent decide on the optimal escape

route under varying conditions over time. And subsequently, this approach will be useful to evacuation decision makers to better implement dynamic arrow signs. The results are motivating to use this type of learning to optimize decision support in evacuation situations.

Classification of images as photographs or paintings by using convolutional neural networks

Jose Miguel Lopez-Rubio, Miguel A. Molina-Cabello, Gonzalo Ramos-Jimenez and Ezequiel López-Rubio

Abstract. Determining whether an image is a photograph or a painting is an unsolved problem, and it is not trivially or automatically performed by humans. In previous works, humans decided which metrics should be calculated on an image to make a prediction, achieving a maximum precision of 94.82%. In this work, we propose the use of a deep learning convolutional neural network that processes the images directly, without determining the most relevant properties of an image in advance. Different modifications of the VGG network architecture are analyzed. After training the network with 16,000 images and for 100 epochs, an AUC ROC above 0.99 is achieved in images from ImageNet and in the Kaggle Painters by Numbers competition, and 0.942 in the images used by the most recent proposal in the field.

Parallel Corpora Preparation for English-Amharic Machine Translation

Yohannes Biadgligne and Kamel Smaili

Abstract. In this paper, we describe the development of an EnglishAmharic parallel corpus and Machine Translation (MT) experiments conducted on it. Two different tests have been achieved. Statistical Machine Translation (SMT) and Neural Machine Translation (NMT) experiments. The performance using the BLEU metric shows 26.47 and 32.44 respectively for SMT and NMT. The corpus was collected from the Internet using automatic and semi-automatic techniques. The harvested corpus concerns domains coming from Religion, Law, and News. Finally, the corpus, we built is composed of 225,304 parallel sentences, it will be shared for free with the community. In our knowledge, this is the biggest parallel corpus so far concerning the Amharic language

Fast Depth Reconstruction using Deep Convolutional Neural Networks

Dmitrii Maslov and Ilya Makarov

Abstract. In this paper, we study depth reconstruction via RGB-based, Sparse-Depth, and RGBd approaches. We showed that combination of RGB and Sparse Depth approach in RGBd scenario provides the best results. We also proved that the models performance can be further tuned via proper selection of architecture blocks and number of depth points guiding RGB-to-depth reconstruction. We also provide real-time architecture for depth estimation that is on par with state-of-the-art real-time depth reconstruction methods.

Voxel-based Three-dimensional Neural Style Transfer

Timo Friedrich, Barbara Hammer and Stefan Menzel

Abstract. Neural Style Transfer has been successfully applied in the creative process for generating novel artistic 2D images by transferring the style of a painting to an existing content image. These techniques which rely on deep neural networks have been extended to further computational creativity tasks like video, motion and animation stylization. However, only few research has been conducted to utilize Neural Style Transfer in the spatially three-dimensional space. Existing 2D/3D hybrid approaches avoid the extra dimension during the stylization process and add postprocessing or differentiable rendering to transform the results to 3D. In this paper, we propose for the first time a complete three-dimensional Neural Style Transfer pipeline based on a

high-resolution voxel representation. Following our previous research, our architecture includes the standardized gram matrix style loss for noise reduction and visual improvement, the bipolar exponential activation function for symmetric feature distributions and best practices for the underlying classification network. In addition, we propose regularization terms for voxel-based 3D Neural Style Transfer optimization and demonstrate their capability to significantly reduce noise and undesired artefacts. We apply our 3D Neural Style Transfer pipeline on a set of style targets. The style transfer results are evaluated using 3D shape descriptors which confirm the subjective visual improvements.

(19:30-20:15) Session 12: Convolutional neural networks: beyond traditional solutions

Error-correcting output codes in the framework of deep ordinal classification

Javier Barbero-Gómez, Pedro Antonio Gutiérrez and César Hervás-Martínez

Abstract. Automatic classification tasks have been revolutionized by Convolutional Neural Networks (CNNs), but the focus has been on binary and nominal classification tasks. Only recently, ordinal classification (where class labels present a natural ordering) has been tackled through the framework of CNNs, such as adapting the classic Proportional Odds Model to deep architectures. Also, ordinal classification datasets commonly present a high imbalance in the number of samples of each class, making it an even harder problem. In this work, we present a new CNN architecture based on the Ordinal Binary Decomposition (OBD) technique using Error-Correcting Output Codes (ECOC) and show how it can improve performance over previously proposed methods.

Features as Keypoints and How Fuzzy Transforms Retrieve Them

Irina Perfilieva and David Adamczyk

Abstract. We are focused on a new fast and robust algorithm of image/signal feature extraction in the form of representative keypoints.
We analyze various multi-scale representations of a one-dimensional signal in spaces with a closeness relation determined by a symmetric and positive semi-definite kernel. We show that kernels arising from generating functions of fuzzy partitions can be used in a scale space representation of a one-dimensional signal.
We show that the reconstruction from the proposed multi-scale representations is of better quality than the reconstruction from MLP with almost double the number of neurons in 4 hidden layers. Finally, we propose a new algorithm of keypoints localization and description and test it on financial time series with high volatility.

Instagram Hashtag Prediction using Deep Neural Networks

Anna Beketova and Ilya Makarov

Abstract. Instagram is one of the most popular photos sharing service. For more convenient content search people use hashtags (#nature, #love, etc.) in posts with photos. The author's aim is to make hashtag prediction possible and convenient for users.

The paper provides a reader with a detailed theoretical overview of Multi-Label Image Classification, Knowledge Distillation, and overview of ResNet architecture. Next author proposes improvements on ResNet architecture allowing the model to boost quality and converge faster. Finally, the model type Self-Improving-Modified-Resnet (SIMR) is presented. Their main feature is the additional bottleneck block used as the tool incorporating benefits from novel self distillation (a combination of self training and knowledge distillation, introduced in 2019).


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(9:00-10:10) Session 13: Bio-inspired systems and neuro-engineering

Temporal EigenPAC for dyslexia diagnosis

Nicolás J. Gallego, Marco Formoso, Andrés Ortiz, Francisco J. Martinez-Murcia and Juan L. Luque

Abstract. Electroencephalography signals allow to explore the functional activity of the brain cortex in a non-invasive way. However, the analysis of these signals is not straightforward due to the presence of different artifacts and the very low signal-to-noise ratio. Cross-Frequency Coupling (CFC) methods provide a way to extract information from EEG, related to the synchronization among frequency bands. However, CFC methods are usually applied in a local way, computing the interaction between phase and amplitude at the same electrode. In this work we show a method to compute PAC features among electrodes to study the functional connectivity. Moreover, this has been applied jointly with Principal Component Analysis to explore patterns related to Dyslexia in 7-years-old children. The developed methodology reveals the temporal evolution of PAC-based connectivity. Directions of greatest variance computed by PCA are called eigenPACs here, since they resemble the classical eigenfaces representation. The projection of PAC data onto the eigenPACs provide a set of features that has demonstrates their discriminative capability, specically in the Beta-Gamma bands.

Autonomous Driving of a Rover-like Robot using Neuromorphic Computing

Enrique Piñero-Fuentes, Salvador Canas-Moreno, Alejandro Linares-Barranco, Antonio Rios-Navarro and Tobi Delbruck

Abstract. Autonomous driving solutions are based on artificial vision and machine learning for understanding the environment and facilitate decision making tasks. Similar techniques are used for indoor robot navigation. Deep learning architectures, which are usually computationally expensive, are impacting our daily lives. This technology is evolving with a notable improvement of cost-efficiency in terms of energy consumption, enabling AI-edge computing. However, these architectures are usually trained on powerful GPUs, what represents the limit for edge computing. Nevertheless, after this training, efficient edge computing devices can process these architectures locally. Neuromorphic engineering shows o on solving the energy bottleneck problem through bio-inspired sensors, processors and spike-based computation techniques. This work presents a mobile robotic platform commanded through the Robotic Operating System (ROS), which obeys the classification output of an AI-edge CNN accelerator for FPGA connected to a neuromorphic dynamic vision sensor. The classification system can process up to 200 fps for 64x64 histograms collected with 2k events per frame and executing a 5 layer CNN with 18MOPs for indoor robot navigation based on different traf- c signs. The collected training dataset has been made available online. The system accuracy has been measured to be 97.62% and 99.96% in the validation and test datasets.

Effects of Training on BCI Accuracy in SSMVEP-based BCI

Piotr Stawicki, Aya Rezeika and Ivan Volosyak

Abstract. This paper investigates the effects of the training process on the classification accuracy in a SSMVEP-based BCI paradigm.

An SSMVEP-based BCI works similar to SSVEP with the main difference that the stimulus is smoothly changing it's appearance, with a continuous motion, leading to less user fatigue.

Typical SSMVEP classification utilises correlation algorithms, comparing the incoming EEG data with a sine-cosine template.
Collecting user training data to increase the classification performance of BCI algorithms has been a common practice recently, usually for template-matching detection algorithms.
The incoming EEG data are compared with an individually created template from the user's own pre-recorded EEG response to the stimulus. In this offline study, previously recorded data collected during an online experiment with 86 participants were used.
Task-related component analysis is an state of the art classification method.
The cross paradigm utilisation of the training data was also investigated, e.g. the TRCA model build from SSVEP data was used to classify the SSMVEP data and vice versa.
Results show a significant difference in favour for the usage of the training data over the sine-cosine template for the SSMVEP paradigm classification.

Effect of electrical synapses in the cycle-by-cycle period and burst duration of central pattern generators

Blanca Berbel Fernández, Alicia Garrido, Irene Elices, Roberto Latorre and Pablo Varona

Abstract. Central Pattern Generators (CPGs) are neural circuits that generate robust coordinated neural activity to control motor rhythms. Many CPGs are convenient neural circuits for locomotion control in autonomous robots. In this context, invertebrate CPGs are key networks to understand rhythm generation and coordination, as their cells and connections can be identified and mapped, like in the crustacean pyloric CPG. Experiments during the last decades have shown that mutual inhibition by chemical synapses together with electrical coupling underlie the timing of neuron activations that shape each rhythm cycle of this CPG. Due to the presence of inhibitory and electrical synapses, regular and irregular triphasic spiking-bursting activity can be found in the pyloric CPG, always preserving the same neuron activation sequence. In this study, we use a model of this well-known CPG to assess the role of electrical synapses in shaping the cycle-by-cycle period and individual cell burst duration. We show that electrical coupling strength asymmetrically affects the burst duration of each individual neuron, as well as the overall cycle-by-cycle duration. Our results support the view that electrical coupling largely contributes to shape the intervals that define functional sequences in CPGs, which can be applied in bioinspired autonomous robotic motor control.

Operation of neuronal membrane simulator circuit for tests with memristor based on graphene and graphene oxide

Marina Sparvoli, Jonas Marma, Gabriel Nunes and Fábio Jorge

Abstract. Artificial neural networks have been developed by researchers based on understanding of different brain skills, such as learning and remembering. Memristors can simulate from memory process to neural membrane functioning. Since the first neural networks were proposed, research has been divided into two areas: one aimed at simulating biological phenomena and the other directed at applications. In this work, we intend to carry out a study on reproduction of a neuronal membrane behavior through an RC circuit associated with a memristor. RC circuit has the property of simulating neural membrane at the moment of action potential, through charge and discharge curve of capacitor. Memristor will be the component responsible for non-linear behavior of circuit due to its resistive switching (RS) property, where it switches from a high resistance state (HRS) to low resistance state (LRS), or vice versa, depending on the voltage; this phenomenon can be reproduced many times. Two types of experiments were performed: first one, temporal, where the output voltage was obtained as a function of time and time constant could be calculated for each section of graph. In second measure, it was possible to obtain the output voltage behavior as a function of input voltage; non-linearity could be observed through hysteresis formation and changes could be perceived by formation of a step in some cases, which indicates a change in continuity of behavior in relation to voltage. Important observations were made regarding the operation of RC circuit; both resistance and capacitor used had an influence on output voltage

curve behavior. Together with memristor, it was possible to verify that behavior of neurotransmitters in action potential could be simulated.

(10:15-11:35) Session 14: Applications in artificial intelligence (Part. III)

Accuracy and Intrusiveness in Data-Driven Violin Players Skill Levels Prediction: MOCAP against MYO against KINECT

Vincenzo D'Amato, Erica Volta, Luca Oneto, Gualtiero Volpe, Antonio Camurri and Davide Anguita

Abstract. Learning to play and perform violin is a complex task, that requires a high conscious control and coordination for the player.
In this paper, our aim is to understand which technology and which motion features can be used to efficiently and effectively distinguish a professional performance from a student one trading off intrusiveness and accuracy.
We collected and made freely available a dataset consisting of Motion Capture (MOCAP), Electromyography, Accelerometer, and Gyroscope (MYO), and Microsoft Kinect (KINECT) recordings of different violinists with different skills performing different exercises covering different pedagogical and technical aspects.
We then engineered peculiar features starting from the different sources (MOCAP, MYO, and KINECT) and trained a data-driven classifier to distinguish among two different levels of violinist experience, namely Beginners and Experts.
We then studied how much accuracy do we loose when, instead of using MOCAP data (the most intrusive and costly technology), MYO data (which is less intrusive than MOCAP), or the KINECT data (the less intrusive technology) are exploited.
In accordance with the hierarchy present in the dataset, we study two different scenarios: extrapolation with respect to different exercises and violinists.
Furthermore we study which features are the most predictive ones of the quality of a violinist to corroborate the significance of the results.
Results, both in terms of accuracy and insight on the cognitive problem, support the proposal and support the use of the presented technique as an effective tool for students to monitor and enhance their home study and practice.

Features selection for fall detection systems based on machine learning and accelerometer signals

Carlos Alfredo Silva Villafuerte, Rodolfo Valentin García Bermudez and Eduardo Casilari Pérez

Abstract. Fall among older people is a major medical concern. Fall Detection Systems (FDSs) have been actively investigated to solve this problem. In this sense, FDSs must effectively reduce both the rates of false alarms and unnoticed fall. In this work we carry out a systematic evaluation of the performance of one of the most widely used machine learning supervised algorithm (Support Vector Machine) when using different input features. To evaluate the impact of the feature selection, we use Area Under the Curve (AUC) of Receiver Operating Characteristic (ROC) Curve as the performance metric. The results showed that with four features it is possible to obtain acceptable values for the detection of falls using accelerometer signals obtained from the user's waist. In addition, we also investigate if the impact of selecting the features based on the analysis of a dataset different from the final application framework where the detector will be operative.

Autonomous Docking of Mobile Robots by Reinforcement Learning Tackling the Sparse Reward Problem

Antonio Manuel Burgueño Romero, Jose Raul Ruiz Sarmiento and Javier Gonzalez Jimenez

Abstract. Most mobile robots are powered by batteries, which must be charged before their level become too low to continue providing services.
This paper contributes a novel method based on Reinforcement Learning (RL) for the autonomous docking of mobile robots at their charging stations. Our proposal considers a RL network that is fed with images to visually sense the environment and with distance measurements to safely avoid obstacles, and produces motion commands to be executed by the robot.
Additionally, since the autonomous docking is in essence a sparse reward task (the only state that returns a positive reward is when the robot docks at the charging station), we propose the usage of reward shaping to successfully learn to dock.
For that we have designed extrinsic rewards that are built on the results of a Convolutional Neural Network in charge of detecting the pattern typically used to visually identify charging stations.
The experiments carried out support our design decisions and validate the method implementation, reporting a ~100% of success in the docking task with obstacle-free paths, and ~93% when obstacles are considered, along with short execution times (10s and 14s on average, respectively).

A Pisum Sativum L. (Pea) Leaves Image Dataset: Collection, Protocol, and Machine Learning Algorithms

Alejandro Bastidas, Juan Carlos Velez Díaz, Winston Percybrooks, Alexander Ortega, Jacobo Ruano and Mario Jojoa

Abstract. In this article, we present the protocol used to collect a high-quality dataset of images related to two agricultural crops of Pisum Sativum L. located in Nariño, Colombia. Pisum Sativum L., like all legumes, are an important source of fiber. Besides, it is very important to consume them, since it is rich in minerals such as phosphorus and iron, contains a high concentration of fibers and is low in fat. The department of Nariño in Colombia is the main producer of Pisum Sativum L., or pea as it is popularly known, and 16,000 hectares are cultivated annually. Nevertheless, production is affected by diseases that reduce productivity by up to 50 %. In this first public dataset for research proposals, three experts in the identification and detection of diseases in the crop were used to collect the information. We carry out a controlled environment for taking pictures where we use a set of lighting composed of 8 bulbs, to configure the same lighting in each photo. In addition, we use the same distance for each photograph, a tripod for the camera and a digital SLR camera with a Nikon D5300 brand reference. In the camera we define different specifications such as: sensor sensitivity to capture light ISO 320, camera aperture F11, shutter speed 1/100. Each photograph has a resolution of 6 megapixels, 2000 pixels high and 3000 pixels wide. The dataset is balanced and consists of 375 images evenly divided into three classes corresponding to 125 anthracnose images, 125 ascochite images, and 125 healthy images. We also propose a comparison between two machine learning algorithms and provide different and powerful models for classifying diseases in crops. Before algorithm training, we extract features from images using methods based on color and statistical. After training, the models can predict whether the leaves are infected with up to 6 % error. This dataset provides the opportunity to include machine learning in the study of pea not only in Colombian agriculture but also in the world.

Decision Support Systems for Air Traffic Control with Self-Enforcing Networks based on Weather Forecast and Reference Types for the Direction of Operation

Dirk Zinkhan, Sven Eiermann, Christina Kluever and Juergen Kluever

Abstract. The increasing of air traffic, changing weather conditions, and the requirements of climate protection intensifies the complex problem of finding optimal flight routes to avoid delays. Especially the prediction of weather conditions for the selection of the right direction of operation for runways at airports imply a particular challenge. Because the interpretation of the forecasted weather data requires meteorological expert knowledge, a system is needed, which enables to communicate the results for air traffic control-lers in an easily understandable way.

As a decision support system, the Self-Enforcing Network (SEN), a self-organized learning neural network, was developed for the selection of the right direction of operation for runways at the airport of Frankfurt am Main. The SEN processes the forecasted wind situations and generates a recommendation for the selection of a suited direction of operation. These recommendations are communicated through the „Meteorological Airport Briefing“ web-portal in a graphical visualization.

Impact of minority class variability on anomaly detection by means of Random Forests and Support Vector Machines

Faisal Saleem S Alraddadi, Luis F. Lago-Fernández and Francisco B. Rodríguez

Abstract. The increased connectivity of our world has resulted in a drastic rise of cyberattacks. This has created a dire need for improved security methods that can protect data. Many techniques and technologies have been developed to meet security and privacy demands. Machine learning algorithms are one of such techniques that can be used to detect cyberattacks. In a real network, the attacks represent only a small fraction of the traffic and, therefore, these events can be considered as an anomaly. This article discusses how the anomaly ratio affects results such as the accuracy, the recall, the true positive rate, or the false positive rate when machine learning algorithms are used to detect cyberattacks. Two different algorithms, Random Forests and Support Vector Machines, and two datasets, UNSW-NB15 and CICIDS-2017, are used to carry out this study. We observe that class imbalance affects each algorithm in a very different way. While SVMs fail to recognize the anomalies with acceptable accuracy, RFs seem to be more robust against class imbalance, although in cases of extreme anomaly the detection begins to deteriorate in a similar way. It is, therefore, necessary to investigate new methodologies that solve the problem of detecting attacks when their proportion is very small, and even when this proportion can change dynamically over time.

Analyzing the Land Cover Change and Degradation in Sundarbans Mangrove Forest using Machine Learning and Remote Sensing Technique

Ashikur Rahman Khan, Anika Khan, Shehzin Masud and Mohammad Rashedur Rahman

Abstract. The purpose of our research work is to understand the efficiency and advantage of Remote Sensing Field. Our study area was Sundarbans mangrove forest, and we have detected landcover changes in this area. In the last 20 years, Sundarbans mangrove forest has declined by 0.2% due to Human settlements, deforestation, Natural calamity, increasing water salinity etc. The images we have used were collected from Landsat 8 OLI, ETM+, TM data. After pre-processing the images, we classified them applying the Maximum Likelihood classifier. We got overall accuracy of 80%, 75%, and 77.1% and our kappa efficiency was 0.80, 0.62, and 0.69 from 2001, 2011, 2021 years, respectively. To determine the overall accuracy and kappa efficiency, we used confusion matrix.

(11:40-12:40) Session 15: Agent-based models for policy design towards a more sustainable world

Informing agent-based models of social innovation uptake

Patrycja Antosz, Wander Jager, J. Gareth Polhill and Douglas Salt

Abstract. This paper discusses how data and theory were used to inform ten agentbased models in an EU Horizon2020 project SMARTEES. The project investigates cases of social innovations implemented in different European cities, which promote low-carbon energy sources, ranging from communities insulating houses to cycling for
urban transportation. The aim is to support local governments of cities in transitioning to energy efficiency and sustainability through simulating plausible effects of implementing similar social innovations in new contexts. We describe the concept for using theory together with quantitative and qualitative data to inform model assumption, calibration and validation, and the consequences of that concept for the research design in the ten case studies conducted in the project. We outline the role of (1) primary data collection of individual in-depth interviews, questionnaires and stakeholder workshops, and (2) secondary desk research including socio-demographic data and media analysis in developing agent-based models. We emphasize challenges encountered in how to use data from different sources to calibrate and validate agent-based models. The article is a compendium of lessons learned from the project, which can be useful for future collaborations in multi-case study, multi-research teams, and mixed-methods projects where one of the methods used is agent-based modeling.

Sensitivity analysis of an empirical agent-based model of district heating network adoption

Gary Polhill, Doug Salt, Tony Craig, Ruth Wilson and Kathryn Colley

Abstract. We present results from a sensitivity analysis study of an agent-based model of district heating network adoption in an area of Aberdeen, Scotland.

Generating a synthetic population of agents through decision trees and socio demographic data

Amparo Alonso-Betanzos, Bertha Guijarro-Berdiñas, Alejandro Rodríguez Arias and Noelia Sanchez-Maroño

Abstract. Agent based models (ABM) are computational models employed for simulating the actions and interactions of autonomous agents with the objective of assessing their effects on the system as a whole. They have been extensively applied in social sciences because ABM simulations, under different running conditions, can help to test the implications of a policy intervention or to observe the population dynamics in different scenarios. We have developed an ABM to model how citizens behave with respect to superblocks, i.e, a type of social innovation where the urban space is reorganized to maximize public space and foster social and economic interactions while minimizing private motorized transports. In this model, the main entity is the citizen agent, so we must acquire personal attribute information to calibrate, validate, and apply the model to test different policy scenarios. Two main data sources were used to derive this information: census data and a survey.

However, both were insufficient to generate a realistic population for the model. In this work we present how decision trees were used to generate a synthetic population using both types of data sources.

(12:45-13:45) Session 16: Randomization in Deep Learning

Improved Acoustic Modeling for Automatic Piano Music Transcription using Echo State Networks

Peter Steiner, Azarakhsh Jalalvand and Peter Birkholz

Abstract. Automatic music transcription (AMT) is one of the challenging problems in Music Information Retrieval with the goal of generating a score-like representation of a polyphonic audio signal. Typically, the starting point of AMT is an acoustic model that computes note likelihoods from feature vectors. In this work, we evaluate the capabilities of Echo State Networks (ESNs) in acoustic modeling of piano music. Our experiments show that the ESN-based models outperform state-of-the-art Convolutional Neural Networks (CNNs) by an absolute improvement of 0.5 F1-score without using an extra language model. We also discuss that a two-layer ESN, which mimics a hybrid acoustic and language model, achieves better results than the best reference approach that combines Invertible Neural Networks (INNs) with a biGRU language model by an absolute improvement of 0.91 F1-score.

On Effects of Compression with Hyperdimensional Computing in Distributed Randomized Neural Networks

Antonello Rosato, Massimo Panella, Evgeny Osipov and Denis Kleyko

Abstract. A change of the prevalent supervised learning techniques is foreseeable in the near future: from the complex, computational expensive algorithms to more flexible and elementary training ones. The strong revitalization of randomized algorithms can be framed in this prospect steering. We recently proposed a model for distributed classification based on randomized neural networks and hyperdimensional computing, which takes into account cost of information exchange between agents using compression. The use of compression is important as it addresses the issues related to the communication bottleneck, however, the original approach is rigid in the way the compression is used. Therefore, in this work, we propose a more flexible approach to compression and compare it to conventional compression algorithms, dimensionality reduction, and quantization techniques.

Benchmarking Reservoir and Recurrent Neural Networks for Human State and Activity Recognition

Davide Bacciu, Daniele Di Sarli, Claudio Gallicchio, Alessio Micheli and Niccolò Puccinelli

Abstract. Monitoring of human states from streams of sensor data is an appealing applicative area for Recurrent Neural Network (RNN) models. In such a scenario, Echo State Network (ESN) models from the Reservoir Computing paradigm can represent good candidates due to the efficient training algorithms, which, compared to fully trainable RNNs, definitely ease embedding on edge devices. In this paper, we provide an experimental analysis aimed at assessing the performance of ESNs on tasks of human state and activity recognition, in both shallow and deep setups. Our analysis is conducted in comparison with vanilla RNNs, Long Short-Term Memory, Gated Recurrent Units, and their deep variations. Our empirical results on several datasets clearly

indicate that, despite their simplicity, ESNs are able to achieve a level of accuracy that is competitive with those models that require full adaptation of the parameters. From a broader perspective, our analysis also points out that recurrent networks can be a first choice for the class of tasks under consideration, in particular in their deep and gated variants.

(15:30-16:15) Session 17: Neural Networks for Time Series Forecasting

Learning to Trade from Zero-Knowledge using Particle Swarm Optimization

Stefan Van Deventer and Andries Engelbrecht

Abstract. Competitive co-evolutionary particle swarm optimization (CEPSO) algorithms have been developed to train neural networks (NNs) to predict trend reversals. These approaches considered the optimization problem, i.e. training of the NNs to maximize net profit and to minimize risk, as a static optimization problem. Based on the dynamic nature of the financial stock market, this paper proposes that the training should rather be treated as a dynamic optimization problem. A new dynamic CEPSO is proposed and used to train a NN on technical market indicators to predict trade actions. In addition, this paper incorporates approaches to combat saturation of the activation functions -- an aspect neglected in previous research. The dynamic CEPSO is evaluated and compared with the static CEPSO approach, a buy-and-hold strategy, and a rule-based strategy. Results show that the new CEPSO performs significantly better on a selection of South African stocks.

Randomized Neural Networks for Forecasting Time Series with Multiple Seasonality

Grzegorz Dudek

Abstract. This work contributes to the development of neural forecasting models with novel randomization-based learning methods. These methods improve the fitting abilities of the neural model in relation to the standard method by generating network parameters in accordance with the data and target function features. A pattern-based representation of time series makes the proposed approach useful for forecasting time series with multiple seasonality. In the simulation study, we evaluate the performance of the proposed models and find that they can compete in forecasting accuracy with fully-trained networks.
Extremely fast and easy training, simple architecture, ease of implementation, high accuracy as well as dealing with nonstationarity and multiple seasonality in time series make the proposed model very attractive for a wide range of complex time series forecasting problems.

Prediction of air pollution using LSTM

Stanislaw Osowski

Abstract. The paper describes the application of long short-term memory (LSTM) for air pollution forecasting. LSTM is a special design of deep recurrent neural net-works, which is very well suited for the prediction of the sequences of data. This work investigates its properties in the task of the short-time one-hour ahead pre-diction of air pollutants such as PM10, SO2, NO2, and ozone in Warsaw, Po-land. The results of numerical

investigations have shown very good accuracy in online prediction, exceeding the corresponding values obtained at the application of feedforward neural structures.

(16:15-17:30) Closing Ceremony. Plenary Talk:

Prof. Davide Anguita

University of Genova, Italy.

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