



# The 3rd International Conference on Machine Learning and Intelligent Systems (MLIS2021)

November 8th-11th, 2021

Online Conference | Microsoft Teams Meeting

## Conference Program

**Organizer:**



華僑大學  
HUAQIAO UNIVERSITY



# MLIS 2021 CONFERENCE PROGRAM

November 8th-11th, 2021  
**China Standard Time (UTC/GMT+8:00)**

ONLINE-Microsoft Teams Meeting

**For MLIS 2021 Conference Academic Exchange Only**



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# Part I Conference Schedule

## Monday, November 8th, 2021

*MS Teams Link: <http://www.academicconf.com/teamslink?confname=MLIS2021>*

09:30-12:00 Ice Breaking and MS Teams Application Testing

15:00-17:00 Ice Breaking and MS Teams Application Testing

## Tuesday, November 9th, 2021

*MS Teams Link: <http://www.academicconf.com/teamslink?confname=MLIS2021>*

### OPENING CEREMONY

09:00-09:10 *Prof. Jin Gou, College of Computer Science and Technology, Huaqiao University, China*

09:10-09:50 **Plenary Speech 1: Need of #ActiveLearning in #AI4Healthcare (infectious disease: #Pneumonia, #TB and #Covid-19)**

*Prof. KC Santosh, University of South Dakota, USA*

09:50-10:30 **Plenary Speech 2: Real-Time Machine Learning for Quickest Detection**

*Dr. Houbing Song, Embry-Riddle Aeronautical University, USA*

10:30-10:40 **BREAK**

10:40-11:20 **Plenary Speech 3: An Optimized Byzantine Fault Tolerance Algorithm for Consortium Blockchain**

*Prof. Zhihan Lv, Qingdao University, China*

11:20-12:00 **Poster Presentation**

12:00-15:00 **BREAK**

*Chaired by Prof. Chien-Hung Yeh, Beijing Institute of Technology, China*

15:00-15:40 **Plenary Speech 4: Context-Sensitive Control of Adaptation: Self-Modeling Networks for Human Mental Processes Using Mental Models Applied to Model Organisational Learning**

*Prof. Jan Treur, Vrije Universiteit Amsterdam, Netherlands*

*Dr. Gülay Canbaloglu, Delft University of Technology, Netherlands*

15:40-16:20 **Plenary Speech 5: Novel Developments and Contributions in Industry 4.0 for Smart Manufacturing, AI, Data Analytics and Security**

*Prof. Victor Chang, Teesside University, UK*

16:20-16:30 **BREAK**

16:30-17:10 **Plenary Speech 6: Micro-Edge Learning for IntelliSensing: A Data Science Perspective**

*Prof. Antonio Liotta, Free University of Bolzano, Italy*

17:10-17:50 **Plenary Speech 7: Neural Differential Equations, Control and Machine Learning**

*Prof. Enrique Zuazua, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany*

## Wednesday, November 10th, 2021

*MS Teams Link: <http://www.academicconf.com/teamslink?confname=MLIS2021>*

08:30-12:25	<b>Oral Session 1: Data Mining and Analysis</b>
12:40-13:30	<b>LUNCH BREAK</b>
13:30-20:00	<b>Oral Session 2: Machine Learning and Application</b>

## Thursday, November 11th, 2021

*MS Teams Link: <http://www.academicconf.com/teamslink?confname=MLIS2021>*

08:30-12:40	<b>Oral Session 3: Neural Networks, IoT and Digitalization</b>
12:40-13:30	<b>LUNCH BREAK</b>
13:30-19:10	<b>Oral Session 4: AI Application and Intelligent System</b>

## Part II Plenary Session

### Opening and Welcome Speech from Conference General Chair



*MLIS 2021 Conference General Chair  
Prof. Jin Gou*

*Dean, College of Computer Science and  
Technology, Huaqiao University, China*

### Plenary Speech 1: Need of #ActiveLearning in #AI4Healthcare (infectious disease: #Pneumonia, #TB and #Covid-19)



*Prof. KC Santosh*

*Department of Computer Science, University of South Dakota,  
USA*

**Biography:** Professor KC Santosh, Ph.D., is Chair of the Department of Computer Science at the University of South Dakota (USD). He also serves International Medical University as an Adjunct Professor (Full). Before joining USD, he worked as Research Fellow at the US National Library of Medicine (NLM), National Institutes of Health (NIH). He was Postdoctoral Research Scientist at the Loria Research Centre (with industrial partner, ITESOFT (France)). He has demonstrated expertise in artificial intelligence, machine learning, pattern recognition, computer vision, image processing, and data mining with applications- such as medical imaging informatics, document imaging, biometrics, forensics and speech analysis. His research projects are funded (of more than \$2m) by multiple agencies, such as SDCRGP, Department of Education, National Science Foundation, and Asian Office of Aerospace Research and Development. He is the proud recipient of the Cutler Award for Teaching and Research Excellence (USD, 2021), the President's Research Excellence Award (USD, 2019), and the Ignite from the U.S. Department of Health & Human Services (2014).

**Abstract:** AI has contributed a lot in healthcare. Infectious disease outbreak is no exception. The talk will provide a walk through about how AI-guided tools help in predicting/detecting infectious diseases, such as Pneumonia, TB, and Covid-19. Infectious disease prediction and unexploited data will be discussed, as predictive analytical tools are limited to education and training (at least for Covid19). It also covers shallow learning (handcrafted features) as well as deep learning mechanism in both image modalities: CT scan and Chest X-ray. Additionally, an obvious question, how big data is big will be discussed by taking two key points into account: data augmentation and transfer learning. Of course, the talk primarily focuses on the need of active learning in #AI4Healthcare, with a focus on Covid-19.

## Plenary Speech 2: Real-Time Machine Learning for Quickest Detection



*Dr. Houbing Song*

*Electrical Engineering and Computer Science, Embry-Riddle  
Aeronautical University, USA*

*Director, Security and Optimization for Networked Globe  
Laboratory, Embry-Riddle Aeronautical University, USA*

**Biography:** Houbing Song (M'12–SM'14) received the Ph.D. degree in electrical engineering from the University of Virginia, Charlottesville, VA, in August 2012, and the M.S. degree in civil engineering from the University of Texas, El Paso, TX, in December 2006. In August 2017, he joined the Department of Electrical Engineering and Computer Science, Embry-Riddle Aeronautical University, Daytona Beach, FL, where he is currently an Assistant Professor and the Director of the Security and Optimization for Networked Globe Laboratory (SONG Lab, [www.SONGLab.us](http://www.SONGLab.us)). He has served as an Associate Technical Editor for IEEE Communications Magazine (2017-present), an Associate Editor for IEEE Internet of Things Journal (2020-present) and IEEE Journal on Miniaturization for Air and Space Systems (J-MASS) (2020-present), and a Guest Editor for IEEE Journal on Selected Areas in Communications (J-SAC), IEEE Internet of Things Journal, IEEE Network, IEEE Transactions on Industrial Informatics, IEEE Sensors Journal, IEEE Transactions on Intelligent Transportation Systems, and IEEE Journal of Biomedical and Health Informatics. He is the editor of six books, including Big Data Analytics for Cyber-Physical Systems: Machine Learning for the Internet of Things, Elsevier, 2019, Smart Cities: Foundations, Principles and Applications, Hoboken, NJ: Wiley, 2017, Security and Privacy in Cyber-Physical Systems: Foundations, Principles and Applications, Chichester, UK: Wiley-IEEE Press, 2017, Cyber-Physical Systems: Foundations, Principles and Applications, Boston, MA: Academic Press, 2016, and Industrial Internet of Things: Cybermanufacturing Systems, Cham, Switzerland: Springer, 2016. He is the author of more than 100 articles. His research interests include cyber-physical systems, cybersecurity and privacy, internet of things, edge computing, AI/machine learning, big data analytics, unmanned aircraft systems, connected vehicle, smart and connected health, and wireless communications and networking. His research has been featured by popular news media outlets, including IEEE GlobalSpec's Engineering360, Association for Unmanned Vehicle Systems International (AUVSI), USA Today, U.S. News & World Report, Fox News, Forbes, The Washington Times, WFTV, and New Atlas. Dr. Song is a senior member of ACM and an ACM Distinguished Speaker. Dr. Song was a recipient of the Best Paper Award from the 12th IEEE International Conference on Cyber, Physical and Social Computing (CPSCom-2019), the Best Paper Award from the 2nd IEEE International Conference on Industrial Internet (ICII 2019), the Best Paper Award from the 19th Integrated Communication, Navigation and Surveillance technologies (ICNS 2019) Conference, the Best Paper Award from the 6th IEEE International Conference on Cloud and Big Data Computing (CBDCOM 2020), and the Best Paper Award from the 15th International Conference on Wireless Algorithms, Systems, and Applications (WASA 2020).

**Abstract:** Quickest detection, which refers to real-time detection of abrupt changes in the behavior of an observed signal or time series as quickly as possible after they occur, is essential to enable safety,



security, and dependability of cyber-physical systems (CPS). Real-Time Machine Learning (RTML) has the potential to achieve quickest detection. However, Machine learning lacks the necessary mathematical framework to provide guarantees on correctness. The integration of machine learning with quickest detection not only creates new research opportunities with major societal implications, but also poses new research challenges in safety, security, and dependability. In this lecture, I will present a comprehensive survey of existing literature in the emerging area of real-time machine learning for quickest detection, identify the challenges, and evaluate the trends. I will also introduce our research findings in this area.



## Plenary Speech 3: An Optimized Byzantine Fault Tolerance Algorithm for Consortium Blockchain



*Prof. Zhihan Lv*

*School of Data Science and Software Engineering, Qingdao University, China*

**Biography:** Dr. Zhihan Lv, ACM Distinguished Speaker, IEEE Senior Member and British Computer Society Fellow. He received joint PhD. degree from Ocean University of China and the University of Paris. He has served as a research engineer at the French National Research Center in France, a postdoctoral fellow at Umeå University in Sweden, a experienced researcher at the FIVAN Foundation in Spain, a postdoctoral fellow at University College London in UK, a postdoctor at the University of Barcelona in Spain, and an research assistant professor at the Chinese Academy of Sciences. He was a Marie Curie Fellow in European Union's Seventh Framework Program LANPERCEPT. He has published more than 270 high-quality papers in virtual reality, Internet of Things, big data and other fields, in which 43 papers were published in the top journal IEEE/ACM Transactions.

Research in recent years has been published in IEEE TII, IEEE TITS, IEEE TFS, IEEE TSMC, IEEE TETC, IEEE TBD, IEEE JSAC, IEEE JSTSP, IEEE IOTJ, IEEE COMMAG, IEEE Network, ACM TOMM, ACM TOIT, ACM TIST, and conferences such as ACM MM, ACM CHI, ACM Siggraph Asia, ICCV, IEEE Virtual Reality. Published more than ten highly cited papers and one hot paper.

He won the "Best idea" award in the UMINOVA academic business competition in Sweden, the grand prize in the "Challenge Cup" entrepreneurial plan competition in China, the "Chunhui Cup" award in the innovation and entrepreneurship competition for Chinese overseas students, the third prize in the China "Challenge Cup" extracurricular academic technology competition, the third prize of Shandong Province Graduate Student Outstanding Scientific and Technological Innovation Achievement Award, the third prize of Shandong Province Higher Education Institution Humanities and Social Science Outstanding Achievement Award, and the 2020 Qingdao University Outstanding Graduate Supervisor Award.

Dr. Zhihan Lv served as editorial board member of journals, including Plos one, IEEE Access, IET Image Processing, KSII Transactions on Internet and Information Systems, and Neurocomputing. Served as the Lead Guest Editor of several well-known journals, including IEEE Transactions on Industrial Informatics, IEEE Network, IEEE Transactions on Intelligent Transportation Systems, IEEE Sensors, IEEE Consumer Electronics Magazine, IEEE Communications Standards Magazine, IEEE Journal of Biomedical and Health Informatics, Future Generation Computer Systems, Neurocomputing and Applications, Neurocomputing, etc., organized more than 40 special issues. Served as the vice chair and TPC members of ACM IUI 2015-2021, IEEE INFOCOM 2020 workshop, ACM MobiCom 2020 workshop, IEEE VTC2017-Fall, IEEE CHASE Workshop 2016, 2017, IEEE/CIC WIN Workshop 2016, ISAIR2021. In 2018, he won the IEEE Access Outstanding Associate Editor Award.

Dr. Zhihan Lv has reviewed more than 260 manuscripts for high-level journals and conferences, including IEEE TMM, ACM TOMM, IEEE TII, IEEE TBD, IEEE TMC, IEEE TLT, IEEE TETC, IEEE TC, IEEE TVCG, IEEE TITS, IEEE/ACM TCBB, ACM TOIT, IEEE Network, IEEE MultiMedia, IEEE IOTJ and other journals and ACM MUM, ACM CHI, ACM DIS, IEEE EuroVis, ACM UIST, ACM MobileHCI, ACM CHIPLAY, ACM CSCW, ACM SUI, ACM ITS, IEEE VAST, IEEE VR, ACM IUI, IEEE 3DUI, ACM TVX, ACM Creativity & Cognition, ACM EICS, ACM IDC, IEEE ICSIPA, GI, IEEE ITSC, IEEE Sensors, ACM ACI, ACM VRST, ACM ISS, ACM HRI and other conferences. He is the reviewer of the Swiss National Natural Science Foundation.

**Abstract:** According to different application scenarios of blockchain system, it is generally divided into public chain, private chain and consortium chain. Consortium chain is a typical multi-center blockchain, because it has better landing, it is supported by more and more enterprises and governments. We analyze the advantages and problems of PBFT algorithm for the application scenarios of the consortium chain. In order to be more suitable for consortium chains, we propose a new optimized consensus algorithm based on PBFT. Aiming at the shortcomings of PBFT, such as the inability to dynamically join nodes, low multi-node consensus efficiency, and primary master node selection, our optimized algorithm has designed a hierarchical structure to increase scalability and improve consensus efficiency. The simulation results show that compared with PBFT and RAFT, our new consensus algorithm increases the data throughput while supporting more nodes, and effectively reducing the consensus delay and the number of communication times between nodes.

## Plenary Speech 4: Context-Sensitive Control of Adaptation: Self-Modelling Networks for Human Mental Processes Using Mental Models Applied to Model Organisational Learning



*Prof. Jan Treur & Gülay Canbaloğlu*

*Prof. Jan Treur, Social AI Group, Vrije Universiteit Amsterdam, Netherlands*

*Gülay Canbaloğlu, Researcher & Ph.D. candidate, Delft University of Technology, Netherlands*

**Biography:** Jan Treur works as a full professor in Artificial Intelligence. He is an internationally well-recognized expert in human-directed AI and cognitive and social modelling. The research of Jan Treur during the past 10 years concerns both fundamental and application-directed aspects of human-directed AI. This covers methods and techniques for modelling and analysis of human-directed AI approaches in a number of application areas, including Cognitive and Social modelling and simulation. He has been and still is active both by author and PC member roles in practically all relevant conferences and journals in these AI and application areas. Currently his research has mostly a multidisciplinary focus and addresses Network-Oriented Modeling approaches based on adaptive temporal-causal networks to model cognitive, affective and social interactions, with two books about this published in 2016 and 2020. Applications cover multi-order adaptive network models for mental and social simulation and human-aware or socially aware AI systems and virtual agents. More details can be found at URL [https://www.researchgate.net/profile/Jan\\_Treur](https://www.researchgate.net/profile/Jan_Treur).

Gülay Canbaloğlu combines her studies in Computer Engineering, Sociology and AI at the prestigious private Koç University in Istanbul with her work as researcher and Ph.D. candidate for the Safety and Security Science group at Delft University of Technology under supervision of prof. Jan Treur and dr. Peter Roelofsma. Her research focusses on computational modelling of organizational learning with special application to learning of just safety culture in health care organizations. Part of her research is conducted in collaboration with dr. Anna Wiewiora from the School of Management of Queensland University of Technology in Brisbane. In her recent work, she reached an important achievement by successfully using self-modeling networks to obtain suitable computational models of complex organizational learning processes. More details can be found at URL <https://www.researchgate.net/profile/Guelay-Canbaloglu-2>.

**Abstract:** Within their mental and social processes, humans often learn, adapt and apply specific mental models of processes in the world or other persons as a kind of blueprints. In this presentation, it is discussed how analysis of this provides useful inspiration for the development of new computational approaches from a Machine Learning and Network-Oriented Modeling perspective. Three main elements are: applying a mental model as a form of internal (mental) simulation, developing and revising a mental model by some form of adaptation, and exerting control over this adaptation in a context-sensitive manner. This concept of controlled adaptation relates to the Plasticity Versus Stability Conundrum from neuroscience. The presented analysis has led to a three-level computational architecture for controlled adaptation. It is discussed and illustrated by examples of

applications how this three-level computational architecture can be specified based on a self-modeling network and used to model controlled learning and adaptation processes based on mental models in a context-sensitive manner. The abovementioned is joint work with Raj Bhalwankar and Laila van Ments; a Springer Nature book about it will be available in December 2021. Recently, as an important next step it has been found out by Gülay Canbaloglu how the very challenging topic of computational modeling of complex multilevel organisational learning can be addressed. After a number of published papers this year, another Springer Nature book focussing fully on the latter topic will appear in 2022.

## Plenary Speech 5: Novel Developments and Contributions in Industry 4.0 For Smart Manufacturing, AI, Data Analytics and Security



*Prof. Victor Chang*

*Data Science and Information Systems, Teesside University, UK*

**Biography:** Prof. Victor Chang is currently a Full Professor of Data Science and Information Systems at the School of Computing, Engineering and Digital Technologies, Teesside University, Middlesbrough, UK, since September 2019. He was a Senior Associate Professor, Director of Ph.D. (June 2016- May 2018) and Director of MRes (Sep 2017 - Feb 2019) at International Business School Suzhou (IBSS), Xi'an Jiaotong-Liverpool University (XJTLU), Suzhou, China, between June 2016 and August 2019. He was also a very active and contributing key member at Research Institute of Big Data Analytics (RIBDA), XJTLU. He was an Honorary Associate Professor at University of Liverpool. Previously he was a Senior Lecturer at Leeds Beckett University, UK, between Sep 2012 and May 2016. Within 4 years, he completed Ph.D. (CS, Southampton) and PGCert (Higher Education, Fellow, Greenwich) while working for several projects at the same time. Before becoming an academic, he has achieved 97% on average in 27 IT certifications. He won a European Award on Cloud Migration in 2011, IEEE Outstanding Service Award in 2015, best papers in 2012, 2015 and 2018, the 2016 European special award and Outstanding Young Scientist 2017. He is a visiting scholar/Ph.D. examiner at several universities, an Editor-in-Chief of IJOICI & OJBD journals, former Editor of FGCS, Associate Editor of TII & Information Fusion, founding chair of two international workshops and founding Conference Chair of IoTBDS and COMPLEXIS since Year 2016. He is the founding Conference Chair for FEMIB since Year 2019. He published 3 books as sole authors and the editor of 2 books on Cloud Computing and related technologies. He gave 18 keynotes at international conferences. He is widely regarded as one of the most active and influential young scientist and expert in IoT/Data Science/Cloud/security/AI/IS, as he has experience to develop 10 different services for multiple disciplines.

**Abstract:** There are important elements to enable successful Industry 4.0, including the choice of advanced technologies and their interplay for different types of smart manufacturing. This keynote is focused on the overview, discussion and detailed technologies on the recent development in Industry 4.0 for smart manufacturing, data analytics, AI and security. There are three parts to this talk. First, it will be on the overview and general understanding of the Industrial Internet of Things (IIoT) for the Supply Chain. Second, it will elaborate on the choice and use of different advanced technologies and examples. Third, future trends will be discussed. This keynote will describe how key aspects for each part, and explain their relation, and suitable examples and recommendations for each section, and the entire topic collectively. The interplay between smart manufacturing, AI, data analytics, and security will be crucial for Industry 4.0 development.

## Plenary Speech 6: Micro-Edge Learning for IntelliSensing: A Data Science Perspective



*Prof. Antonio Liotta*

*Faculty of Computer Science, Free University of Bolzano, Italy*

**Biography:** Antonio Liotta is Full Professor at the Faculty of Computer Science, Free University of Bolzano (Italy), where he teaches Data Science and Computer Networks. Antonio's passion for artificial intelligence, has driven his academic career through the meanders of artificial vision, e-health, intelligent networks and intelligent systems. Antonio's team is renowned for his contributions to micro-edge intelligence and miniaturized machine learning, which have significant potential in harnessing data-intensive systems, for instance in the context of smart cities, cyber-physical systems, Internet of Things, smart energy, and machine learning with humans in the loop. He has led the international team that has recently made a breakthrough in artificial neural networks, initiating a new research strand on [sparse neural networks for embedded learning](#). Antonio was the founding director of the Data Science Research Centre at the University of Derby. He has set up several cross-border virtual teams, and has been credited with over 350 publications involving, overall, more than 150 co-authors. Antonio is Editor-in-Chief of the [Springer Internet of Things book series](#), and associate editor of several prestigious journals. He is co-author of the books [Networks for Pervasive Services: six ways to upgrade the Internet](#) and [Data Science and Internet of Things](#).

Find More about Prof. Antonio Liotta at [LinkedIn](#) || [Twitter](#) || [Google Scholar](#)

**Abstract:** The Internet of Things, the idea that the physical world around us can be digitized, monitored and controlled, is fascinating as it complex. IoT is a mix of smart and dumb 'things', a digital ecosystem that keeps growing in size and complexity, generating a vast variety of incomplete, unstructured data. IoT is emerging as one of the biggest big-data problems at hand but is unlike any other data science projects. It is a complex spatio-temporal problem, whereby data sources are heterogeneous, unreliable, unreliably connected, and often hard to correlate. So how can we make sense of IoT data? How can we avoid turning it into an unpredictable mess? In this talk, I explore the missed potential of Cloud-based IoT systems, whereby the sensed data is transferred pretty much unprocessed to the Cloud. I argue that to make significant insights from IoT data, we need to initiate intelligent processes at the micro-edge (at the sensor nodes). By means of recent pilot studies, I illustrate the value of shallow learning and other lightweight learning methods, which may be employed to improve data quality and address communication and energy bottlenecks in typical IoT systems. I advocate an extensive use of embedded machine learning to perform a range of data analysis tasks at the very edge of the IoT, employing intelligent processes for tasks such as data cleaning, missing-data management, compression, anomaly detection, and for self-tuning the data collection itself. All-in-all, this talk is about going from 'cloud-based IoT' to 'intelligent IoT', where learning and sensing take place concurrently.



## Plenary Speech 7: Neural Differential Equations, Control and Machine Learning



*Prof. Enrique Zuazua*

*Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany  
Fundación Deusto, Bilbao, Basque Country, Spain  
Universidad Autónoma de Madrid, Spain*

**Biography:** Enrique Zuazua Iriondo (Eibar, Basque Country – Spain, 1961) dual PhD in Mathematics – University of the Basque Country & Université Pierre et Marie Curie, holds a Chair in Applied Analysis – Alexander von Humboldt Professorship at FAU-Friedrich–Alexander University, Erlangen–Nürnberg (Germany). He leads the research project “DyCon: Dynamic Control”, funded by the ERC – European Research Council at Deusto Foundation, University of Deusto – Bilbao (Basque Country, Spain) and the Department of Mathematics, at UAM – Autonomous University of Madrid where he holds secondary appoints as Professor of Applied Mathematics (UAM) and Director of CCM – Chair of Computational Mathematics (Deusto). His fields of expertise in the area of Applied Mathematics cover topics related with Partial Differential Equations, Systems Control and Machine Learning, led to some fruitful collaboration in different industrial sectors such as the optimal shape design in aeronautics and the management of electrical and water distribution networks.

With an important high impact on his work (h-index = 43) he has mentored a significant number of postdoctoral researchers and coached a wide network of Science managers. He holds a degree in Mathematics from the University of the Basque Country, and a dual PhD degree from the same university (1987) and the Université Pierre et Marie Curie, Paris (1988). In 1990 he became Professor of Applied Mathematics at the Complutense University of Madrid, to later move to UAM in 2001. He has been awarded the Euskadi (Basque Country) Prize for Science and Technology 2006 and the Spanish National Julio Rey Pastor Prize 2007 in Mathematics and Information and Communication Technology and the Advanced Grants by the European Research Council (ERC) NUMERIWAVES in 2010 and DyCon in 2016. He is an Honorary member of the of Academia Europaea and Jakiunde, the Basque Academy of Sciences, Letters and Humanities, Doctor Honoris Causa from the Université de Lorraine in France and Ambassador of the Friedrich-Alexandre University in Erlangen-Nuremberg, Germany.

He was an invited speaker at ICM2006 in the section on Control and Optimization. From 1999-2002 he was the first Scientific Manager of the Panel for Mathematics within the Spanish National Research Plan and from 2008-2012 he was the Founding Scientific Director of the BCAM – Basque Center for Applied Mathematics. He is also a member of the Scientific Council of a few international research institutions such as the CERFACS in Toulouse, France, and member of the Editorial Board in some of the leading journals in Applied Mathematics and Control Theory.

**Abstract:** We discuss Neural Ordinary Differential Equations (NODEs) from a control theoretical perspective to address some of the main challenges in Machine Learning and, in particular, data classification and Universal Approximation. More precisely, we adopt the perspective of the simultaneous control of systems of NODEs. For instance, in the context of classification, each item to



be classified corresponds to a different initial datum for the Cauchy problem of the NODE. And all the solutions corresponding the data under consideration need to be driven to the corresponding target by means of the same control. We present a genuinely nonlinear and constructive method, allowing to estimate the complexity of the control strategies we develop. The very nonlinear nature of the activation functions governing the nonlinear dynamics of NODEs under consideration plays a key role. It allows deforming half of the phase space while the other half remains invariant, a property that classical models in mechanics do not fulfill. This very property allows to build elementary controls inducing specific dynamics and transformations whose concatenation, along with properly chosen hyperplanes, allows achieving our goals in finitely many steps. We also present the counterparts in the context of the control of neural transport equations, establishing a link between optimal transport and deep neural networks.

This is a joint work by Domènec Ruiz-Balet.

## Part III E-Poster Presentations

### Online Poster Guidelines

- ✚ All E-Posters will be demonstrated on the official conference website.
- ✚ Participants could view and share their comments on the website. If you have any questions on E-posters, kindly contact conference secretary for assistance.
- ✚ Signed and stamped electronic presentation certificate would be issued via e-mail after the presentation is delivered.

### List of Posters

Please get access of the e-posters via <http://www.academicconf.com/poster?confname=mlis2021>

ML1279	Developing a modified version of generative adversarial network to predict the potential anti-viral drug of COVID-19 <i>Dr. Md. Sadek Hossain Asif, University of Buenos Aires, Argentina</i>
ML1340	Effective intrusion detection using data augmentation with generative adversarial network <i>Dr. Uneneibotejit Otokwala, Robert Gordon University, UK</i>
ML1348	A new approach of data and knowledge-based prediction for greenhouse gas “methane” in paddy field <i>Dr. Yuto Morishita, Meiji University, Japan</i>
ML1380	A basal ganglia-inspired spiking neural network model for reinforcement learning <i>Miss Arum Kim, Korea Institute of Science and Technology, South Korea</i>
ML1381	A pointwise evaluation metric to visualize errors in machine learning surrogate models <i>Dr. Seyed Shayan Sajjadinia, Free University of Bozen-Bolzano, Italy</i>
ML1390	An effective deep neural network architecture for cross-subject epileptic seizure detection in EEG data <i>Dr. Imene Jemal, Universit�� du Qu��bec, Canada</i>

## Abstracts of Poster Presentations

### **ML1279: Developing a modified version of Generative Adversarial Network to predict the potential anti-viral drug of COVID-19**

Md. Sadek Hossain Asif

*Notre Dame College, Dhaka, Bangladesh*

*Corresponding E-mail: asifsadek509@gmail.com*

**Abstract.** The advancements of computer science and its related fields are making our tasks easier in almost every scientific and non-scientific field. The use of machine learning in the field of drug discovery and development is accelerating so fast and helping us to discover anti-viral drugs for devastating viruses like coronavirus. The author will discuss using a deep reinforcement learning model 'ORGAN' which is a modified version of Generative Adversarial Network for predicting the potential anti-viral of coronavirus. The author used the deep reinforcement learning model (ORGAN) to generate potential candidates' drugs, with a  $\lambda$  of 0.2 and epochs of 240 and a sample set of 6400, 10 good sample SMILES were generated and the Solubility or LogP of these samples is 0.7098. Then using the coronavirus as a target, all the good samples of SMILES were bounded and the drug with the highest binding affinity (Most negative value) is C18H15CIN4O2 also known as **Olutasidenib** which can be the potential anti-viral drug of coronavirus.

**Keywords:** deep reinforcement learning, generative adversarial network, policy gradient, corona virus

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- [3] A. Gupta, A. T. Müller, B. J. H. Huisman, J. A. Fuchs, P. Schneider, and G. Schneider, "Generative Recurrent Networks for De Novo Drug Design," Mol. Inform., vol. 37, no. 1, Jan. 2018.

### **ML1340: Effective intrusion detection using data augmentation with generative adversarial network**

Uneneibotejit Otokwala

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**Abstract.** Effective detection of cyber-attacks are always hampered by insufficient data which often leads to overfitting and biasness during classification. While some data augmentation strategies have been used to increment the size of the minority class(es) in an imbalanced dataset; often the structure of the generated data points does not follow the underlying distribution of the original dataset and thus does not improve classification. Using Generative Adversarial Network (GAN) technique, we generated synthetic data values from the class subsets which were then combined with the individual

subsets to form the new augmented training dataset. Upon the fitting of a model, the result of the model on binary and multiclass datasets show an improvement in overall accuracy, sensitivity, and specificity of the GAN augmented datasets over the unaugmented dataset.

**Keywords:** intrusion detection, data augmentation, generative adversarial network

### **ML1348: A new approach of data and knowledge-based prediction for greenhouse gas “methane” in paddy field**

Yuto Morishita<sup>1,\*</sup>, Ryota Kishaba<sup>1</sup>, Liya Ding<sup>1</sup>, Kosuke Noborio<sup>2</sup> and Sunchai Phungern<sup>2</sup>

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**Abstract. Aims:** Methane, one of the greenhouse gases, is generated in paddy field during rice cultivation where is closely related with Human Life. In addition, Greenhouse effect of Methane is approximately twenty-four times as big as that of carbon dioxide and leads to “Global Warming”. From these points of view, we need an early alarm for methane occurrence to help reduce methane against “Global Warming”.

**Methods:** We capture the trend of weather and soil data observed in paddy field by statistical method “STL Analysis” and fit these data to polynomial regression with use of the moving windows. We then expand calculated polynomial regression for a few days ahead to find the difference between the actual trend data and predicted values using polynomial regression. With further analysis, possible relation patterns are expected to be found between such changing trends and Methane occurrence.

**Results:** We could estimate the time of methane emission in advance and provide notice to farmers a few hours ahead.

**Conclusions:** With the notice in advance, farmers can take possible protective action to reduce the emission of methane. Besides the practical benefit, this study also explores a new methodology of prediction by combining human knowledge of decision with measurement data from the domain where the relation between environment factors and target of prediction is of accumulated cause-effort type rather than point-to-point association.

### **ML1380: A basal ganglia-inspired spiking neural network model for reinforcement learning**

Arum Kim<sup>1,2</sup>, Inho Kim<sup>1</sup>, Joon Young Kwak<sup>1</sup>, Jongkil Park<sup>1</sup>, YeonJoo Jeong<sup>1</sup>, Suyoun Lee<sup>1</sup>, Jong Keuk Park<sup>1</sup>, and Jaewook Kim<sup>1,\*</sup>

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**Abstract. Aims:** Although the increasing demand for on-chip edge intelligence has motivated algorithmic research on the spiking neural networks (SNNs), it is still challenging to obtain practical SNN models that can be converted to large-scale neuromorphic processors. In this work, we propose a hardware-friendly SNN model inspired by the basal ganglia, a specific brain region involved in reinforcement learning (RL).

**Methods:** First, we adopt the functional architecture of the basal ganglia which consists of direct, indirect, and hyper-direct pathways. Second, we develop a synaptic learning rule based on dopamine-modulated spike-timing-dependent plasticity (STDP) that occurs between the prefrontal cortex and striatal D1 (StrD1). Third, we simulate the proposed SNN model using MATLAB and verify its functionality with RL-based lane change scenarios.

**Results:** The simulation results show that the proposed SNN model can successfully learn to select proper actions without collision in lane change situations. It is also shown that for a global reward signal, the synaptic weights are selectively potentiated or depressed according to the frequency of the post-synaptic neurons (StrD1).

**Conclusions:** Our work suggests that the SNN model mimicking the architecture of the basal ganglia and its dopamine-dependent synaptic plasticity will play a crucial role in realizing energy-efficient RL processors in the future.







**Acknowledgements:** This research was supported by National R&D Program through the National Research Foundation of Korea (NRF) funded by Ministry of Science and ICT (2021M3F3A2A01037808).

**ML1381** To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.

**ML1390** To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.

# Part IV Oral Presentations

## Online Oral Presentation Guidelines

-  Online Oral Presentation will be conducted via Microsoft Teams Meeting.
-  All presenters are requested to reach the Online Session Room prior to the schedule time and complete their presentation on time.
-  **All presentation times are shown in China Standard Time (GMT+8:00).**
-  If a presenter is not able to show up via Teams, the session chair / conference secretary will play the pre-recorded video presentation during his/her scheduled presentation time, if listeners have questions about the presentation, please contact the conference secretary to forward the questions.
-  If a presenter cannot show up on time or have problem with internet connection, the session chair has the right to rearrange his/her presentation, and let the next presentation start.
-  Signed and stamped electronic presentation certificate would be issued via e-mail after presentation.

## Best Oral Presentations Selection

The session chair will select one best presentations from his/her session based on the following criteria:

- ✓ Research Quality
- ✓ Presentation Performance
- ✓ Presentation Language
- ✓ PowerPoint Design
- ✓ **Effective Communications**

## Best Oral Presentations Award

The Best Oral Presenter from each session will receive an official certificate and a free registration to the MLIS 2022.

## Session 1\_Data Mining and Analytics

**Session Time: 08:30-12:40 November 10th, 2021 (China Standard Time (UTC/GMT+8:00))**

**Session Room Link: <http://www.academicconf.com/teamslink?confname=MLIS2021>**

**Session Chairs:**

**8:30-10:20 Prof. Jon-Lark Kim, Sogang University, Republic of Korea**

**10:35-12:40 Prof. Jalil Rashidinia, Iran University of Science and Technology, Iran**

08:30-08:45	ML1395	Evaluation, analysis, and treatment of educational risks in migration of presential teaching for remote <i>Dr. Renan Silveira Holtermann, University of Brasilia, Brazil</i>
08:45-09:00	ML1226	The larger the better: Analysis of a scalable spectral clustering algorithm with cosine similarity <i>Dr. Guangliang Chen, San Jose State University, USA</i>
09:00-09:15	ML1295	Fractional powers approach of operators for abstract evolution equations of third order in time <i>Dr. Lucas Araújo Santos, Federal Institute of Paraíba, Brazil</i>
09:15-09:30	ML1347	Challenges in cross-frequency coupling and its application in electrophysiological data <i>Dr. Chien-Hung Yeh, Beijing Institute of Technology, China</i>
09:30-09:50	ML1363	Machine learning methods elucidating good and bad of social media data <i>Dr. Richi Nayak, Queensland University of Technology, Australia</i>
09:50-10:05	ML1353	Managing study stress of university students through personality traits <i>Dr. Xinyue Liu, University of Wollongong, Australia</i>
10:05-10:20	ML1278	High payload QR-based data hiding using secured-compressed watermark in polar domain <i>Dr. Indrarini Dyah Irawati, Telkom University, Indonesia</i>
10:20-10:35	<b>BREAK</b>	
10:35-10:55	ML1328	Multi-class learning problems based on error-correcting output codes <i>Prof. Jon-Lark Kim, Sogang University, Republic of Korea</i>
10:55-11:10	ML1276	Chained digital signature for the improved video integrity verification <i>Dr. Linju Lawrence, APJ Abdul Kalam Technological University, India</i>
11:10-11:25	ML1378	Dist frequent next neighbours: A distributed Galois lattice algorithm for frequent closed item set extraction <i>Dr. Noumi Sandji Naomie Sandra, Cheikh Anta Diop University of Dakar, Senegal</i>
11:25-11:40	ML1260	About strong dependence of the complexity of analysis random 3-CNF on the ratio of numbers of clauses to variables <i>Dr. S. I. Uvarov, Institute of control Science RAS, Moscow, Russia</i>



11:40-11:55	ML1218	<a href="#">Design and synthesis of reversible logic based multifunctional block</a> <i>Dr. Manisha Govindrao Waje, G.H. Rasoni College of Engineering and Management, India</i>
11:55-12:10	ML1311	<a href="#">A new stochastic operational matrix for solving nonlinear stochastic differential equations driven by variable-order fractional Brownian motion</a> <i>Dr. Tahereh Eftekhari, Iran University of Science &amp; Technology, Iran</i>
12:10-12:25	ML1349	<a href="#">Person retrieval in surveillance using textual query</a> <i>Dr. Mehul S. Raval, Ahmedabad University, India</i>

## Abstracts of Oral Session 1

### **ML1395: Evaluation, analysis, and treatment of educational risks in migration of presential teaching for remote**

Renan Silveira Holtermann\*, Ricardo Matos Chaim

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**Abstract.** This paper presents a study on the risk management process in an educational environment during 2020, when the pandemic of the new coronavirus began. The analysed institution had to migrate its teaching model from the presential format to the remote mode. Thus, aiming to comprehend the context in which it was inserted, the risk management process proposed by ISO 31,000 was applied. Its process was also relevant to evaluate, analyse, treat, and monitor the educational environment throughout this migration. The analysed environment is a private Higher Education Institution (HEI) and at this time, many uncertainties and questions had arisen about the maintenance of its educational services. In addition, ensuring student's satisfaction is crucial for the company success and its financial health which includes maintain students registered and active in the institution. Thus, to understand this complex system, elements of the dynamics of systems were used to identify the risks related in this environment. Additionally, the Mosler's Method was used to measure these risks, providing input data for the analysis and treatment steps, which allowed the organization to work directly on crucial topics and organize feasible solutions. Finally, a structured questionnaire was applied to students enrolled in stricto sensu postgraduate courses, aiming to understand their levels of satisfaction in the adaptations made.

**Keywords:** risk management, covid-19, educational management, ISO 31,000, system dynamics

**ML1226 To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

### **ML1295: Fractional powers approach of operators for abstract evolution equations of third order in time**

Lucas Araújo Santos

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**Abstract.** In this work, we study third-order linear evolution equations in time, in the sense of the theory of strongly continuous one-parameter semigroups, and their approximations of fractional order via the theory of the fractional powers of closed and densely dened operator and Balakrishnan type formula. As applications, we present approximations of the Moore-Gibson-Thompson type equations with fractional damped.

**Keywords:** fractional approximations, third order linear evolution equations in time, Moore-Gibson-Thompson type equations, fractional powers

**ML1347: Challenges in cross-frequency coupling and its application in electrophysiological data**  
Chien-Hung Yeh

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*Corresponding E-mail: nzdiw1120@gmail.com*

**Abstract. Aims:** Past studies infer the critical role of cross-frequency coupling (CFC) in functional activities. Here, we show how irregular oscillations could produce artificial CFC, as well as investigate the buried CFCs from the electrophysiological data.

**Methods:** We first introduce a set of adaptive methods for assessing CFC, of which the cycle-based frequency scattering process plus the empirical mode decomposition eliminate the detection of artificial CFC. On the other side, considering the need for electrophysiological studies to lock the target components in certain frequencies, an advanced approach, named the masking phase-amplitude coupling, was used to measure physiological interactions across multiple frequency bands.

**Results:** We validated the reliabilities and limitations of the proposed methods using nonlinear and nonstationary synthetic signals with varying challenges, follows by direct use of the real electrophysiological recordings, mainly the electroencephalogram, to explore the functional neural interactions underneath.

**Conclusions:** We suggest our introduced CFC methods as a set of useful tools in quantifying cross-frequency interactions.

**Keywords:** cross-frequency coupling, nonlinear signal, electrophysiological data, masking decomposition

**Acknowledgments:** I acknowledge the National Natural Science Foundation of China (Grant No. 62001026), and the Beijing Institute of Technology Research Fund Program for Young Scholars (Grant No. 3050012221909).

**ML1363: Machine learning methods elucidating good and bad of social media data**  
Richi Nayak

*Development and Diversity, School of Computer Science; Applied Data Science, Centre for Data Science; Science and Engineering Faculty, Queensland University of Technology, Australia*

*Corresponding E-mail: r.nayak@qut.edu.au*

**Abstract.** The proliferation of social media has created new norms in society. Incidents of abuse, hate, harassment and misogyny are widely spread across the social media platforms. Simultaneously, social media platforms facilitate sharing meaningful ideas and thoughts. In this talk, I will explore the ‘bad’ and ‘good’ of social media and present two novel applications with innovative machine learning methods. The first application will be ‘Twitter Misogynist Abuse Detection’ with a progressive Transfer Learning-based Deep Learning approach. The second application will be ‘Emergent Trend Discovery’ with a rank-centred clustering approach. Outcomes of these applications boost the social media monitoring capability and can assist policymakers and government to focus on key issues.

**ML1353: To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

**ML1278: To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

**ML1328: Multi-class learning problems based on error-correcting output codes**

Jon-Lark Kim

*Math Department, Sogang University, Republic of Korea*

*Corresponding E-mail: ctryggoggo1@gmail.com*

**Abstract.** The multi-class classification problem is one of the important problems in machine learning. The common method to solve a multi-class classification problem is to decompose it into multiple binary problems. Dietterich and Bakiri in 1995 introduced the error-correcting output codes (ECOC) for this problem. The simplest decoding method, Hamming decoding, was employed to obtain a multi-class decision. In this presentation, we overview various ECOC methods and describe our recent work on ECOC based on Hadamard matrices.

**ML1276: To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

**ML1378: To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

**ML1260: To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

**ML1218: Design and synthesis of reversible logic based multifunctional block**

Manisha Govindrao Waje

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**Abstract.** In the era of emerging trends quantum dot cellular automata has become very popular because of its extremely small size. In this paper logically reversible  $4 \times 4$  block is proposed. This block is designed and simulated using Quantum Dot Cellular Automata technology. This QCA based  $4 \times 4$  block named Reversible multifunction block is capable to generate different reversible functions like OR, AND, XOR, XNOR, Full Subtractor, Full Adder, Half Subtractor, Half Adder, code Converters like Gray to Binary and Binary to Gray, Pass Gate, Set, Reset and complement, by changing the inputs at different instants. Reversible Multifunction Block constituted of thirteen reversible functions. Performance and comparative analysis of this new design shows that using single block or single Gate, multiple functions can be generated whereas if we wish to design all these functions separately too many number of gates are required. This  $4 \times 4$  reversible Multifunction Block is proved to be efficient in the literature. The proposed design is synthesized and implemented using QCADesigner 2.3 and RCviewer tools.

**Keywords:** (QCA) quantum dot cellular automata, reversible multifunction block, QCA cell, quantum cost, reversible logic

#### **ML1311: A new stochastic operational matrix for solving nonlinear stochastic differential equations driven by variable-order fractional Brownian motion**

Tahereh Eftekhari\* and Jalil Rashidinia

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*\*Corresponding E-mail: t.eftekhari2009@gmail.com*

**Abstract.** In this paper, we present a new stochastic operational matrix to approximate solutions of nonlinear stochastic differential equations driven by variableorder fractional Brownian motion. Also, the convergence of the new method is analyzed. Finally, the efficiency of the new method is confirmed by solving two test problems. The obtained results are compared with other existing numerical methods used for solving these problems.

**Keywords:** Variable-order fractional Brownian motion, stochastic differential equations, stochastic operational matrix, convergence analysis

#### **ML1349: Person retrieval in surveillance using textual query**

Hiren Galiyawala, Mehul S Raval\*

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*\*Corresponding E-mail: mehul.raval@ahduni.edu.in*

**Abstract. Aims:** Retrieve a person based on soft biometrics – Gender, Height, Cloth Colour, Cloth type from the unconstrained surveillance videos.

**Methods:** 1. Train a deep neural network (DNN) model for each soft biometric (SB) to detect a person. Place DNN models in cascade for retrieving the target person. 2. Use DNNs for each SB and derive their probabilities scores for every detected person. Fuse the probabilities for each person and select target with highest score. 3. Use single DNN to derive probability score for every SB for each detected person in the frame. Fuse the scores and identify the best matching target.

**Results:** Average IoU:1. 0.569 2. 0.591 3. 0.667. **Conclusions:** Persons can be retrieved with good accuracy over complex video sequences.

**Keywords:** computer vision, deep neural networks, soft biometrics, person retrieval

**Acknowledgements:** Authors would like to thank NVIDIA for grant of K200 GPU.

**References:** Galiyawala, H., Raval, M.S. Person retrieval in surveillance using textual query: a review. *Multimed Tools Appl* 80, 27343–27383 (2021).

## Session 2\_ Machine Learning and Application

**Session Time: 13:30-20:00 November 10th, 2021 China Standard Time (UTC/GMT+8:00)**

**Session Room Link: <http://www.academicconf.com/teamslink?confname=MLIS2021>**

**Session Chairs:**

**13:30-16:20 Assoc. Prof. Shyamala Doraisamy, Universiti Putra Malaysia, Malaysia**

**16:30-20:00 Assoc. Prof. R. S. Hegadi, Central University of Karnataka, India**

13:30-13:50	ML1243	<b>Machine listening and its applications</b> <i>Assoc. Prof. Shyamala Doraisamy, Universiti Putra Malaysia, Malaysia</i>
13:50-14:10	ML1400	<b>Predictive analytics</b> <i>Assoc. Prof. R. S. Hegadi, Central University of Karnataka, India</i>
14:10-14:30	ML1407	<b>Why deep learning cannot ever match human intelligence?</b> <i>Prof. Danko Nikolic, Frankfurt Institute for Advanced Studies, Germany</i>
14:30-14:50	ML1264	<b>Explaining deep learning with adversarial attack</b> <i>Dr. Naveed Akhtar, University of Western Australia, Australia</i>
14:50-15:05	ML1341	<b>The DDoS attacks detection through machine learning and statistical methods in SDN</b> <i>Dr. Afsaneh Banitalebi Dehkordi, Payame Noor University, Iran</i>
15:05-15:20	ML1309	<b>Repeated burst errors: Detection and correction</b> <i>Dr. Rashmi Verma, University of Delhi, India</i>
15:20-15:35	ML1313	<b>Using machine learning to predict tumor size of cancer</b> <i>Dr. Ophir Nave, Jerusalem College of Technology, Israel</i>
15:35-15:50	ML1249	<b>The presence of 'subjectivity' and 'group identity' in automated hate speech detection</b> <i>Dr. Ziqi Zhang, University of Sheffield, UK</i>
15:50-16:05	ML1377	<b>Sequence-in-sequence learning for SOH estimation of lithium-ion battery</b> <i>Dr. Thien Pham, Vietnam National University, Vietnam</i>
<b>16:05-16:30 BREAK</b>		
16:30-16:45	ML1354	<b>An adaptive network model of the role of the gut-brain axis in parkinson's disease</b> <i>Dr. Korinzia Toniolo, University of Bologna, Italy</i>
16:45-17:00	ML1320	<b>Efficient estimation of finite mixtures of Mallows models with the Spearman distance</b> <i>Dr. Cristina Mollica, Sapienza Università di Roma, Italy</i>
17:00-17:20	ML1258	<b>Task execution control in an assembly line via deep reinforcement learning</b> <i>Dr. Francesco Liberati, University of Rome "La Sapienza", Italy</i>

17:20-17:40	ML1294	<a href="#">Improving flow-induced vibration energy harvesting using machine learning</a> <i>Dr. Daniil Yurchenko, Heriot-Watt University, UK</i>
17:40-17:55	ML1346	<a href="#">Domain adaptation for document image binarization via domain classification</a> <i>Dr. Jorge Calvo-Zaragoza, University of Alicante, Spain</i>
17:55-18:15	ML1342	<a href="#">Global optimization in machine learning: Metaheuristic vs. deterministic approaches</a> <i>Dr. Dmitri E. Kvasov, University of Calabria, Italy</i>
18:15-18:30	ML1284	<a href="#">Data-driven regularization for linear inverse problems</a> <i>Dr. Andrea Aspri, University of Pavia, Italy</i>
18:30-18:45	ML1216	<a href="#">Linked open data applications: Principles, examples, issues, and trends</a> <i>Dr. Leila Zemmouchi-Ghomari, Ecole Nationale Supérieure de Technologie, Algeria</i>
18:45-19:00	ML1262	<a href="#">Intuitive contrasting map for antonym embeddings</a> <i>Dr. Ivan P. Yamshchikov, LEYA Laboratory, Yandex and Higher School of Economics, Russia</i>
19:00-19:15	ML1268	<a href="#">DYPLODOC: Dynamic plots for document classification</a> <i>Dr. Ivan P. Yamshchikov, LEYA Laboratory, Yandex and Higher School of Economics, Russia</i>
19:15-19:30	ML1273	<a href="#">Educational sentiment analysis using machine learning approaches</a> <i>Dr. Amit Thakkar, Charotar University of Science and Technology, India</i>
19:30-19:45	ML1275	<a href="#">CNN-based optical character recognition for isolated printed Gujarati base characters and handwritten numerals</a> <i>Dr. Sanket B. Suthar, Charotar University of Science and Technology, India</i>
19:45-20:00	ML1321	<a href="#">Transfer learning based model for prediction of skin cancer</a> <i>Dr. Meenakshi Sumeet Arya, SRM Institute of Science and Technology, India</i>

## Abstracts of Oral Session 2

### ML1243: Machine listening and its applications

Shyamala Doraisamy

*Faculty of Computer Science and Information Technology, Universiti Putra Malaysia  
Honorary Research Fellow, School of Computer Science, College of Science, University of Lincoln,  
United Kingdom*

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**Abstract.** Research on machine listening is on the rise with the advancements of artificial intelligence and sound processing technologies, alongside the increasing collections of digital sound recordings



and sound sensor data. Machine listening is a field encompassing research on a wide range of tasks and methods such as speech recognition, audio content recognition, audio-based search, content-based music analysis, signal processing and auditory modelling. This talk will present an overview of machine listening followed by discussions of several past projects on music and health informatics. An ongoing machine listening project on tyre-road sound interactions towards improving vehicle safety systems will also be discussed.

#### **ML1400: Predictive analytics**

R. S. Hegadi

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*Corresponding E-mail: rshegadi@gmail.com*

**Abstract.** Predictive analytics is the application of statistical techniques and machine-learning algorithms to predict the future outcome of a business or an event with the help of a large volume of historical data of that business. Predictive analytics is one of the major research advancements which is extensively used in recent days for predicting future occurrences based on past events. Even though the concept of predictive analytics is around for a decade, many organizations are getting benefits of predictive analytics in recent time due to reasons such as increased competitiveness in the business, a growing volume of data, better methods in extracting information from the large volume of the data, reduced cost of hardware and software systems, more and more open-source software, and tough economic conditions. Many organizations have turned to predictive analytics to find solutions for numerous business challenges such as detecting fraud, optimizing the market campaign, improving operations, and reducing risk in the business. In this talk will understand what is predictive analytics? How is it transforming our lives? And other related questions would be addressed with suitable examples.

#### **ML1407: Why deep learning cannot ever match human intelligence?**

Danko Nikolic

*Danko Nikolic, Frankfurt Institute for Advanced Studies, Germany*

*Corresponding E-mail: Danko.Nikolic@gmail.com*

**Abstract.** There is generally an expectation that by growing bigger and bigger deep learning models we may be able to develop AI that matches human intelligence. I show, in a quantitative way, evidence that this is not possible. The discrepancy is too big between the amount of intelligence deep learning can realistically achieve and the amount of intelligence it would need to acquire if it is to become a match for a human. The crux of the evidence is based on one hand, on the assessments of the number of different categories that an adult can accurately deal with and on the other hand, on the amount of resources (RAM, FLOPS, training samples) needed to match that. We will have to develop an entirely new type of technology

#### **ML1264: Explaining deep learning with adversarial attacks**

Naveed Akhtar

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*Corresponding E-mail: navid.915@gmail.com*

**Abstract.** Deep visual models are susceptible to adversarial perturbations to inputs. Although these signals are carefully crafted, they still appear noise-like patterns to humans. This observation has led to the argument that deep visual representation is misaligned with human perception. In this talk, we will slightly counter-argue by providing evidence of human-meaningful patterns in adversarial perturbations. We will introduce an attack that fools a network to confuse a whole category of objects (source class) with a target label. Our attack also limits the unintended fooling by samples from non-sources classes, thereby circumscribing human-defined semantic notions for network fooling. We will demonstrate that our attack not only leads to the emergence of regular geometric patterns in the perturbations, but also reveals insightful information about the decision boundaries of deep models. Exploring this phenomenon further, we will alter the 'adversarial' objective of our attack to use it as a tool to 'explain' deep visual representation. We will show that by careful channeling and projection of the perturbations computed by our method, we can visualize a model's understanding of human-defined semantic notions.

**Keywords:** explainable AI, deep learning, adversarial attacks, adversarial examples, cnn, computer vision

#### **ML1341: The DDoS attacks detection through machine learning and statistical methods in SDN**

Afsaneh Banitalebi Dehkordi\*, Mohammad Reza Soltanaghaei and Farsad Zamani Boroujeni

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**Abstract.** The distributed denial-of-service (DDoS) attack is a security challenge for the software-defined network (SDN). The different limitations of the existing DDoS detection methods include the dependency on the network topology, not being able to detect all DDoS attacks, applying outdated and invalid datasets and the need for powerful and costly hardware infrastructure. Applying static thresholds and their dependency on old data in previous periods reduces their flexibility for new attacks and increases the attack detection time. A new method detects DDoS attacks in SDN. This method consists of the three collector, entropy-based and classification sections. The experimental results obtained by applying the UNB-ISCX, CTU-13 and ISOT datasets indicate that this method outperforms its counterparts in terms of accuracy in detecting DDoS attacks in SDN.

**Keywords:** distributed denial-of-service attacks, software-defined networks, highvolume DDoS attack, low-volume DDoS attack, network security

#### **ML1309: Repeated burst errors: Detection and correction**

Rashmi Verma

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**Abstract. Aims:** Repeated burst error was introduced by Dass and Verma in 2008. The article deals

with the construction of linear codes capable of detecting and correcting repeated burst errors. The aim of this article is to present an easy and new method for the construction of a parity-check matrix of a repeated burst error correcting linear code.

**Methods/ Results:** An upper bound for a linear code capable of correcting repeated burst errors has been obtained by the technique used to establish Varsharmov-Gilbert-Sacks bound by constructing a parity-check matrix for the requisite code. This technique not only ensures the existence of such a code but also gives a method for constructing such a code. Further, an algorithm has been proposed for constructing a parity-check matrix for any linear code over  $GF(q)$  capable of detecting and correcting 'm-repeated burst error of length b or less'. Codes based on the proposed algorithm have been illustrated.

**Conclusions:** The synthesis method for the codes using the technique to establish Varsharmov-Gilbert-Sacks bound is cumbersome and to the best of our knowledge, there is no systematic way to construct a parity-check matrix for a burst error correcting linear code. The proposed algorithms for the construction of a parity-check matrix for a repeated burst error detecting/ correcting linear code given by Dass and Verma in 2012 and 2017 for binary codes and non-binary codes respectively replaces the cumbersome synthesis procedure involving unwieldy computations to construct a parity-check matrix for the requisite code saving all the computational task.

**Keywords:** error correcting code, burst error, repeated burst error, parity-check matrix

**Acknowledgements:** The research work has been carried out under the supervision of Prof. B.K. Dass, Department of Mathematics, University of Delhi, Delhi, India.

### **ML1313: Using machine learning to predict tumor size of cancer**

OPhir Nave

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**Abstract.** In this study, we combine a mathematical model with machine learning (ML) to predict tumour sizes in breast cancer. Our study is based on clinical data. To accurately predict tumour size for each woman individually, we solved our customized mathematical model for each woman from the clinical data, then added the solution vector of the dynamic variables in the model (in machine learning language, these are called features) to the clinical data and used a variety of machine learning algorithms. We compared the results obtained with and without the mathematical model and showed that by adding specific features from the mathematical model we were able to better predict tumour size for each woman.

**Keywords:** mathematical model, cancer, machine learning

### **ML1249: The presence of 'subjectivity' and 'group identity' in automated hate speech detection**

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**Abstract.** Automated hate speech detection has garnered significant attention in both research and practice over the last decade, as the emergence and spread of cyberhate remains a major challenge in maintaining a healthy online space. Hate speech detection is typically cast as a supervised classification task, and despite remarkable progress in this field, existing methods still suffer from several limitations. One of the typical issues is the presence of prediction 'bias', where a classifier tends to over emphasize the keywords that indicate the 'group identity' of people, such as 'muslin', and 'immigrants'. This often leads to false positive predictions. In this work, we argue that group identity needs to be examined in the context of a message when classifying hate speech. And one of such contextual clues is 'subjectivity', the extent to which a text expresses a personal opinion. We introduce a modified BERT structure that seamlessly combines these two features in the task of hate speech detection, and evaluate our method on an extensive set of hate speech datasets representing different nature of hate and data sizes. We show that our method brings consistent improvement over state of the art.

**Keywords:** hate speech, BERT, deep learning, classification

**ML1377 To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

**ML1354 To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

**ML1320: Efficient estimation of finite mixtures of mallows models with the spearman distance**

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**Abstract.** The class of Mallows models (MMs) occupy a central role in the literature for the analysis and learning of preferences from a sample of ranking data. The MMs rely on the distance notion over the set of permutations but, despite the wide range of possible metrics, the choice is typically limited to the Kendall or Cayley distances, due to the related analytical simplifications. In this work, we go beyond these conventional few options and explore the formal properties of the MM with the Spearman distance, also referred to as theta-model. The attractive feature of this model is its correspondence with the restriction of the normal distribution over the permutation set such that, similarly to the gaussian density, the theta model enjoys a convenient closed-form expression for the critical estimation of the modal ranking. This means that, differently from the MMs with the other metrics, an efficient and accurate inferential procedure can be developed, where the computational burden of inferring the discrete parameter is significantly reduced. Additionally, an efficient estimation within the finite mixture framework is realized via the EM algorithm, for enlarging the applicability of theta-models to samples of rankings characterized by a group structure. Finally, an application to a real-world dataset endorsing our proposals in the comparison with competing mixtures of ranking models is provided.

**Keywords:** ranking data, mallows models, spearman distance, EM algorithm

### **ML1258: Task execution control in an assembly line via deep reinforcement learning**

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**Abstract.** This paper presents a deep reinforcement learning approach for optimally controlling the execution of a set of integration tasks in an assembly line. The work is inspired by the problem of optimizing the assembly of a space vehicle at a launch base, to increase the launch rate. The main goal of the controller is to ensure that the tasks are executed in the minimal time, while satisfying all the existing constraints. A comparison with an advanced alternative control approach based on model predictive control is made. Proof of concept simulations are presented to show the effectiveness of the proposed solution.

**Keywords:** industry 4.0, assembly line control, factory optimization, industrial machine learning

### **ML1294: Improving flow-induced vibration energy harvesting using machine learning**

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**Abstract. Aims:** To study how machine learning approach can improve the energy harvesting from wind induced vibrations.

**Methods:** Three different wake galloping piezoelectric energy harvesters are used to study their galloping response. Each harvester comprises a bluff body with square, triangular and circular cross-section. The bluff bodies are placed upstream of the air flow, which velocity spans within 2.9-14.5m/s. A rectangular parallelepiped bluff body mounted on a cantilever beam and attached with a piezoelectric sheet is placed downstream. Using machine learning technology, the present work selected different parameters as input features, and trained two machine learning models to predict the amplitude of the vortex-induced vibration of the two cylinders and the output voltage and vibration displacement of the piezoelectric energy harvester for wake galloping vibrations.

**Results:** Three machine learning algorithms were tested, namely Decision Tree Regression, Random Forest and Gradient Boosted Regression Tree. The results indicate that the GBRT model exhibits the best performance in predicting both root mean square voltage and maximum displacement.

**Conclusions:** This study demonstrates the promising application potential of ML in the field of piezoelectric energy harvesting and how ML can help in predicting and optimizing the performance of such devices.

**Acknowledgements:** This work was supported by the National Natural Science Foundation of China (Grant No.: 51977196), and China Postdoc-toral Science Foundation (2020T130557).

**ML1346** To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.

## **ML1342: Global optimization in machine learning: Metaheuristic vs. deterministic approaches**

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**Abstract.** Numerical global optimization plays an important role in algorithmic configuration to improve the generalization ability of machine learning techniques. Because of the high computational cost involved in this decision-making process, the main goal is to develop efficient global optimization algorithms that produce reasonably good and guaranteed solutions with a limited budget of function evaluations. The objective function in this case can be black-box, multiextremal, and non-differentiable thus precluding the use of descending schemes with derivatives. Derivative-free methods can be therefore particularly suitable to tackle these challenging global optimization problems and can be either of deterministic or stochastic (and particularly, metaheuristic) nature. Some of the methods of these two groups are briefly surveyed and their application in the machine learning field is discussed.

**Keywords:** expensive global optimization, deterministic methods, metaheuristics, comparison

## **ML1284: Data-driven regularization for linear inverse problems**

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**Abstract.** In this talk, I will speak about some recent results on the study of linear inverse problems under the premise that the forward operator is not at hand but given indirectly through some input-output training pairs. We show that regularisation by projection and variational regularisation can be formulated by using the training data only and without making use of the forward operator. I will provide some information regarding the convergence and stability of the regularised solutions. Moreover, we show, analytically and numerically, that regularization by projection is indeed capable of learning linear operators, such as the Radon transform. This is a joint work with Yury Korolev (University of Cambridge), Otmar Scherzer (University of Vienna and RICAM), and Leon Frischauf (University of Vienna).

**Keywords:** data-driven regularization, regularization by projection, inverse problems

## **ML1216: Linked open data applications: Principles, examples, issues, and trends**

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**Abstract.** Data on the web is a resource that needs to be interpreted automatically to be useful in web applications. This aim can be achieved if data complies with appropriate practices regarding models and languages that are formal and widely standardized. This is the objective of the Linked Open Data initiative managed by the World Wide Web consortium and Tim Berners Lee, the inventor of the web. Linked Data is based on the four principles founded on conventional web technologies and semantic

web technologies. The lecture will present linked data applications' principles, success stories, issues, and future trends.

**Keywords:** linked open data, web applications

**ML1262 To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

**ML1268 To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

### **ML1273: Educational sentiment analysis using machine learning approaches**

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**Abstract. Aims:** Sentiment analysis is one of the sub-field of data mining that helps to detect sentiment of a person. Analyzing and examining textual data quantifies the global societies feelings or attitude towards their belief and perception. Along with product review, healthcare domain, sentiment analysis also widely applied in the education domain where online feedback data obtained from stakeholders via social media are extracted, processed, analyzed and evaluated. Sentiment analysis provides many benefits like utilizing education insight information to achieve improved education quality and services. In this paper, sentiment analysis tools, methods and technology related to higher education are discussed. Experiments on education datasets containing 11541 sentiment samples were classified and their results were compared between NB [Naïve Bayes Classification algorithm] and SVM [Support Vector Machine]. SVM outperform NB sentiment classification algorithm.

**Methods:** Naïve Bayes Classification Algorithm, Support Vector Machine.

**Results:** Experiment results for performing sentiment analysis are performed using machine learning algorithms like Naïve Bayes Classification Algorithm and Support Vector Machine.

**Conclusions:** Every facet of Education sector brings positive changes in the world. This paper highlights the significance of Sentiment Analysis in the Education Domain where people have to deal with massive amount of data. The reviews use can create opportunities for people to publicly voice their opinion. With the involvement of sentiment analysis tools, technologies and methodologies Education System and its each and every aspect can be improved.



Table 1. Performance of NB and SVM on Education Reviews

Performance Measurement	Sentiment Classification	
	Algorithm	SVM
	NB	
CA	85.71	91.65
P	0.87	0.92
R	0.86	0.92
F1	0.83	0.91

Notes: CA – Accuracy P-Precision R-Recall F1-F1 Score

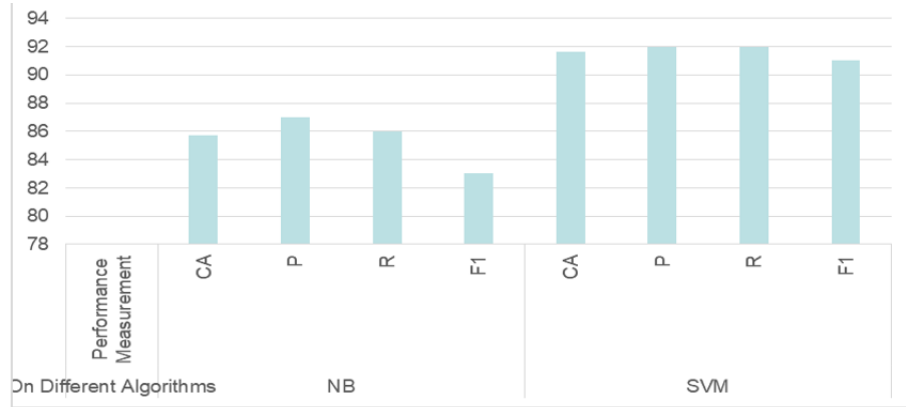


Fig. 3. Performance Measurement and Comparison of NB and SVM.

**Acknowledgments:** The writers would like to thank Principal and Dean of Faculty of Technology and Engineering, Head of U & P U. Patel Department of Computer Engineering, CSPIT Charotar University of Science and Technology, Changa for their continuous suggestions, encouragement, guidance and support in undertaking the research work. We express our special acknowledgments to the Management for their moral support and never-ending encouragement.

#### ML1275: CNN-based optical character recognition for isolated printed Gujarati base characters and handwritten numerals

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**Abstract. Aim:** As per the report from the census of India Gujarati is the 7th most used language in India for communication. OCR development for Indic languages is very challenging because of the variety of shapes of characters, complex character sets, and presence of modifiers. However, for complex languages like Gujarati, these techniques don't always yield accurate results. The aim of this work is to develop robust OCR for Gujarati printed characters and handwritten numerals.

**Methods:** The use of various deep learning techniques in OCR reduces the number of steps performed

in traditional methods and is able to classify characters with high accuracy. In this work, two customized CNN models have proposed to perform character recognition on Gujarati printed characters and handwritten numerals.

**Results:** Experimental analysis has been carried out on well-segmented Gujarati printed base characters and handwritten numerals. Total 39 printed Characters, 34 consonants, 5 vowels and 0 to 9 handwritten numerals are considered. Results obtained using deep learning methods are compared with traditional methods used by various authors on the similar kind of dataset. On average the proposed CNN model achieves an 18.29 % improvement in accuracy and compared to other existing algorithms for printed Gujarati characters and the second proposed CNN model achieves a 7.60 % improvement in accuracy and compared to other existing algorithms for handwritten Gujarati Numerals.

**Conclusions:** Due to the large and diversified dataset and use of deep learning proposed CNN architecture achieves promising results in terms of overall accuracy obtained, when compared with other traditional algorithms available in the literature for the Gujarati language.

**Acknowledgements:** The authors would like to acknowledge Ms. Archana Vyas, Assistant Professor, D.D.U for sharing dataset for Gujarati handwritten numerals. Also like to thank Principal and Dean of Faculty of Technology and Engineering, Head of Department of Information Technology, CSPIT Charotar University of Science and Technology for their suggestions and guidance.

### **ML1321: Transfer learning based model for prediction of skin cancer**

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**Abstract. Aim:** To design a Transfer Learning model for prediction of Skin Cancer.

**Method:** Classification and Segmentation of Skin lesions are crucial in diagnosing malignant melanoma tumors. The previously used deep learning techniques are still complicated on options like boundaries identification, presence of artifacts and with restricted datasets. We propose a framework for detection of carcinoma by effective skin lesion segmentation and classification exploitation FCN primarily based on pre-trained architectures available in Tensorflow. The pretrained models such as VGG16, LeNet and ResNet will be tweaked and tuned so as to ensure that the accuracy of skin cancer detection is enhanced. Multiple pre-trained CNN models will be compared for the given problem and the one giving the most promising results will be deployed for testing the unseen samples. The model consists of two stages: the first stage concentrates on an encoder-decoder fully convolutional network (FCN) to identify the lesion complex features with the encoder technique and to learn the lesion border details with the decoder.

**Results:** The second stage proposes a transfer learning model wherein a pre-trained network will be used for the given problem and through hyperparameter tuning, the accuracy of the prediction model will be enhanced. The proposed framework will be applied on ISIC2019 dataset and it is estimated that the detection accuracy will be more than 95%.

**Keywords:** Skin lesion, convolutional neural networks, transfer learning, melanoma

## Session 3\_Neural Networks, IoT and Digitalization

**Session Time: 08:30-12:40 November 11th, 2021 China Standard Time (UTC/GMT+8:00)**

**Session Room Link: <http://www.academicconf.com/teamslink?confname=MLIS2021>**

**Session Chair: Dr. Renyou Xie, Northwestern Polytechnical University, China**

8:30-8:45	ML1232	Ergonomic workstation: Configuration of space from the analysis of physical movement of computer users in a public company <i>Dr. Ana Paula Lima Costa, Ministério da Economia, Brazil</i>
8:45-9:05	ML1402	Information security awareness to facilitate digital transformation <i>Dr. Hamed Taherdoost, University Canada West, Canada</i>
9:05-9:25	ML1287	Energy-based dropout and pruning of deep neural networks <i>Dr. Hojjat Salehinejad, University of Toronto, Canada</i>
9:25-9:40	ML1254	Advancing digital security through artificial intelligence <i>Dr. Michael Botros Shenouda, Industrial R&amp;D, Canada</i>
9:40-9:55	ML1335	Quantum infrastructure and economics <i>Dr. Kazuki Ikeda, University of Saskatchewan, Canada</i>
9:55-10:10	ML1265	Artificial intelligence role in pricing and trading of electricity and other clean energy sources <i>Dr. Michael Botros Shenouda, Industrial R&amp;D, Canada</i>
10:10-10:30	ML1364	Intelligence-empowered vehicular networking and computing <i>Dr. Liang Zhao, Shenyang Aerospace University, China</i>
10:30-10:40	<b>BREAK</b>	
10:40-10:55	ML1225	Causal reasoning model based on medical knowledge graph for disease diagnosis <i>Dr. Ze Xu, Huaqiao University, China</i>
10:55-11:10	ML1261	Discussion about the encrypted DNS hosted in internal CPE <i>Dr. Lanlan Pan, Guangdong OPPO Mobile Telecommunications Corp. Ltd., China</i>
11:10-11:30	ML1370	IoT development: Challenges and opportunities <i>Dr. S. Balakrishnan, Sri Krishna College of Engineering and Technology, India</i>
11:30-11:45	ML1385	Application of artificial neural network in development of multi-model ensemble classifier for avalanche hazard prediction over Himalaya <i>Ms. Prabhjot Kaur, Defence Geoinformatics Research Establishment, India</i>
11:45-12:05	ML1314	AI enabled green 5G and 6G communications <i>Dr. T.P. Fowdur, University of Mauritius, Mauritius</i>
12:05-12:20	ML1271	TinyML: A groundbreaking shift for the internet of things <i>Dr. Ramón J. Sánchez Iborra, San Javier Air Force Academy, Spain</i>

## Abstracts of Oral Session 3

### **ML1232: Ergonomic workstation: Configuration of space from the analysis of physical movement of computer users in a public company**

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**Abstract. Aims:** Considering that the occupation of a space follows a planning process, this study demonstrates that, for jobs of computer users who operate information systems, the layout and the amount of physical space must be established from the systematic knowledge of the activities performed, and configured with ergonomic data for dimensioning the space.

**Methods:** An ergonomic analysis was carried out of user jobs that used Electronic Information Systems in a public company. It started with a survey of the physical space, followed by the collection of information about the functions performed and activities developed. Subsequently, users were systematically observed using the iSEE method (postural analysis software). The combination of information made it possible to identify the relationship between users and the work space, and to configure the space necessary to carry out activities properly.

**Results:** The activities were briefly and generally described by the executors, showing themselves to be insufficient to properly configure an ergonomic workplace. The ergonomic analysis revealed aspects of the users' interaction with the computers that were not noticed by the users, but that influenced the execution of their tasks. It was observed that inadequate furniture and layout negatively influenced the functionality of the workspace, reflecting on the performance of activities.

**Conclusions:** The space must be provided to facilitate the execution of activity. Existing work situations should be used to clarify the conditions for carrying out future activity. The workspace design process must be based on the human system, in which ergonomics contributes and supports.

**Keywords:** office space, project methodology, workplace, office plan

### **ML1402: Information security awareness to facilitate digital transformation**

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**Abstract.** The world is gone digital and more businesses are shifting to digital versions day in day out. Today, concentration on digital transformation seems to be a must for businesses to stay in the tough competition. As the pace of changes in the digital world is accelerated apparently, the appeal to shift from traditional platforms to digital ones is also increasing dramatically. As most of the businesses are harmonized with the digital transformation flux, potential vulnerabilities due to digitalization of systems have broadened as well.

### **ML1287: Energy-based dropout and pruning of deep neural networks**

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**Abstract.** Dropout is a well-known regularization method by sampling a sub-network from a larger deep neural network and training different sub-networks on different subsets of the data. Inspired by the dropout concept, we will discuss EDropout as an energy-based framework for pruning neural networks in classification tasks. In this approach, a set of binary pruning state vectors (population) represents a set of corresponding sub-networks from an arbitrary original neural network. An energy loss function assigns a scalar energy loss value to each pruning state. The energy-based model (EBM) stochastically evolves the population to find states with lower energy loss. The best pruning state is then selected and applied to the original network. Similar to dropout, the kept weights are updated using backpropagation in a probabilistic model. The EBM again searches for better pruning states and the cycle continues. This procedure is a switching between the energy model, which manages the pruning states, and the probabilistic model, which updates the kept weights, in each iteration. The population can dynamically converge to a pruning state. This can be interpreted as dropout leading to pruning the network. From an implementation perspective, unlike most of the pruning methods, EDropout can prune neural networks without manually modifying the network architecture code. We have evaluated the proposed method on different flavors of ResNets, AlexNet,  $l_1$  pruning, ThinNet, ChannelNet, and SqueezeNet on the Kuzushiji, Fashion, CIFAR-10, CIFAR-100, Flowers, and ImageNet data sets, and compared the pruning rate and classification performance of the models. The networks trained with EDropout on average achieved a pruning rate of more than 50% of the trainable parameters with approximately <5% and <1% drop of Top-1 and Top-5 classification accuracy, respectively.

### **ML1254: Advancing digital security through artificial intelligence**

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**Abstract.** The presentation is focused on the key role that the Artificial Intelligence (AI) is currently playing in advancing digital security. Traditional cybersecurity techniques are becoming less capable

of defending themselves against the growing capabilities of cyber-attacks. Here is where we need the machines to learn how to become autonomous and defend themselves, a job well-suited for AI. In the beginning, we will present different types of security attacks, and the existing methods that have been used to defend against each of these attacks. Then, we will present how different approaches of machine learning can help solve this problem. It will include applications of AI in security of networks, devices' security (e.g., malware detection), security of Internet of Things (IoT) systems, and the security of a system of robots. Finally, we will discuss future ways that can further extend the use of AI in improving security.

**Keywords:** artificial intelligence, cyber-security, network security, security of IOT systems, malware detection

### **ML1335: Quantum infrastructure and economics**

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**Abstract.** I present a discussion of some fundamental questions of economics in the era of quantum technology, which require a treatment different from economics studied thus far in the literature. A study of quantum economic behavior will become the center of attention of economists in the coming decades. My scope includes incentive contracts, market design, and the foundation of quantum game theory. In particular a generic quantum protocol of the principal agent relation is formulated in a framework of quantum games. Recent progress in quantum technologies allow us to control quantum platforms for various usages, including quantum information processing, quantum simulation and quantum communication. In this regard, however, practical economic benefits from quantum technology should be addressed in a different framework of quantum information. In my talk, I propose a blueprint of a future network system based on quantum information technology.

### **ML1265: Artificial intelligence role in pricing and trading of electricity and other clean energy sources**

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**Abstract.** Artificial neural networks ability to approximate non-linear functions and forecasting their future values has proven to be quite valuable in trading of electricity and other renewable sources. For example, in price bidding, artificial intelligence (AI) techniques are quite effective in price forecasting for both producers and customers. In this presentation, we will discuss more aspects of applications of AI in trading of this sector of energy. We will start by discussing different traditional pricing methods, and why dynamic pricing is emerging as an attractive alternative to these methods. We then focus on

two main areas of dynamic pricing that witnessed increasing benefits from applying AI methods. These areas are: Forecasting of future demand and prices, and ways of setting up prices especially for retail market. For each area, we present the factors that yield it a computationally involved problem, then we present the methods used prior to AI application (including convex optimization approaches), and finally we present the benefits harvested by AI application to each area.

**Keywords:** Artificial Intelligence, Machine Learning, Electricity Pricing, Trading of Renewable Energy, Convex Optimization Approaches in Energy Trading

#### **ML1364: Intelligence-empowered vehicular networking and computing**

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**Abstract.** Vehicular networks (VNs) have been studied profoundly aiming to provide the efficient connectivity among vehicles and infrastructures to access to various of applications in which such networks can support all types of services in the internet of vehicles (IoV). Over the past two decades, VANET (vehicular ad-hoc network) has been studied to connect the vehicles in wide areas with its multi-hop connectivity. However, traditional VANET still faces challenges to enable intelligent networking and communication with its decentralized nature in which individual vehicle lacks the ability to collect and compute such large amount of data. Hence, learning algorithms and dedicated networking architecture should be applied to improve the networking quality. In this talk, the speaker will present the AI-enabled vehicular networking techniques and the related architectures, in the aspects of routing metrics, protocol switching, adaptive routing, softwarized VN, and digital twin-based VN.

**ML1225 To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

#### **ML1261: Discussion about the encrypted DNS hosted in internal CPE**

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**Abstract.** Traditional internal CPE in home network does not support the encrypted DNS. IETF Adaptive DNS Discovery work group specifies new DHCP/RA options to discover encrypted DNS servers. We discuss about some issues of the encrypted DNS service offered by the internal CPE. This can be helpful to import suitable trust anchor for IoT products.

**Keywords:** DNS, CPE, anchor, DHCP, RA, IoT

### **ML1370: IoT development: Challenges and opportunities**

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**Abstract.** According to India Internet of Things (IoT) Market Forecast & Opportunities, 2020, IoT market in India is projected to grow at a CAGR over 28% during 2015 - 2020. IoT is being rapidly brought into use across diverse industry verticals to reduce operational and manpower costs, and increase operational efficiency. Consumer electronics, automotive & transportation, BFSI (Banking, Financial Services and Insurance), home & building, energy & utilities, retail, supply chain & logistic sectors, and manufacturing are the key emerging application areas where IoT technology is majorly being adopted. However, Indias IoT market is highly fragmented with numerous players operating across the value chain. With growing need for connectivity among devices, systems and services using variety of protocols and domains; automating business processes; and real-time monitoring & tracking of services and systems, Internet of Things (IoT) technology has been gaining increasing market traction over the last few years. In the IoT concept, a Thing can be any natural or man-made object that can be assigned an IP address and provided an ability to transfer data over a network.

### **ML1385: Application of artificial neural network in development of multi-model ensemble classifier for avalanche hazard prediction over Himalaya**

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**Abstract.** Artificial neural network (ANN) is a powerful machine learning tool based on the functioning of human neural system. In the present study, the ANN has been used for development of an independent as well as multi-model classifier for avalanche hazard prediction in Great Himalayan region of North-West Himalayas. A comparative study of development of multi-model ensemble using ANN and Akaike information criterion (AIC) based model weighted average technique has been carried out. Individual classifiers used for development of ensemble include Hidden Markov model (HMM), nearest neighbor (NN), artificial neural network (ANN) and snow cover model-HIM-STRAT. Individual classifiers have been developed using snow and meteorological data of past 25 winters from 1994-2021. Comparison of these two approaches of ensemble development is carried out by computing Heidke skill score (HSS), percent correct (PC), probability of detection (POD), bias and false alarm rate (FAR). The ANN based ensemble model has shown promising scores as compared to that of AIC based model weighted average scheme. The HSS, PC and FAR of ANN based ensemble has been found 0.29, 0.755 and 0.64 respectively.



**Keywords:** multi-model ensemble, avalanche forecasting, artificial neural networks

**Acknowledgements:** The authors acknowledge Director DGRE for supporting this work. Author duly acknowledge field data collection teams of DGRE for their continuous efforts.

#### **ML1314: AI enabled green 5G and 6G communications**

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**Abstract.** To meet the exponentially increasing requirements of bandwidth, throughput, latency and jitter, cellular technologies have experienced a progressive evolution from the 1st generation (1G) to the 5th generation (5G). However, with the incorporation of new hardware to support additional applications and devices, the energy consumption of mobile networks has experienced a proportional rise from one generation to the next. A significant demarcation from the conventional trend in energy consumption is expected to be introduced by 5G which already consumes four times more energy than 4G. Moreover, the amount of user data is predicted to be four times more in 2025 than the current data volume on current mobile networks, as per a Mobility Report by Ericsson. Consequently, energy efficiency is a major concern in 5G in contrast to earlier generations. In parallel, the conceptualization of 6G has already begun with the prospect of connecting everything, providing ubiquitous sensor integration, communication, computation, and control, as well as transmission over mmWave and THz bands. Such a network evolution will lead to further densification of cells as it will require massive deployment of tiny cells that will overlay on the existing macro cellular networks. 6G will therefore exert an unprecedented pressure on energy efficiency and sustainability due to its high network and technical complexity. In order to address the energy efficiency issues in 5G and future 6G networks, several machine learning techniques can be employed. For example, in 5G, machine learning techniques can be employed to optimize the processes at the core network, access network and edge network, hence improving the overall energy efficiency. In 6G, AI based techniques can effectively improve energy efficiency by applying them to the three service classes being proposed for 6G, namely, Cellular Network Communications (CNC), Machine Type Communications (MTC), and Computation Oriented Communications (COC). In this presentation, a review of the most important AI and machine learning techniques, that can be applied to enhance energy efficiency in 5G and future 6G networks, will be performed.

#### **ML1271: TinyML: A groundbreaking shift for the internet of things**

Ramón J. Sánchez Iborra

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**Abstract.** The dawn of the Tiny Machine Learning (TinyML) paradigm has brought a new wave of capabilities to new and already deployed Internet of Things (IoT) infrastructures. It permits to embed powerful ML mechanisms within resource-limited end-devices, hence evolving these elements into truly intelligent units. Besides, the conjunction of TinyML and edge-computing architectures paves the way for the development of distributed-intelligence systems. This talk presents these concepts and contextualizes them in a realistic use case based on Smart Agriculture. The experimental results show the validity of the proposal, which permits to reduce IoT device's energy consumption and response latencies at the time of improving the security and privacy of sensed data.

**ML1372: Integration of renewable energy resources into active distribution network through explainable AI (XAI)**

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**Abstract.** Explainable AI has been introduced to guide various industrial process involving complex human behaviours, which aims to interpret what, why and how the solution produced by deep learning system for engineering practitioners. This talk will present research on how to achieve an explainable model by different techniques from a data-driven perspective. Moreover, how to apply XAI for energy system will be presented by the integration of renewable energy resource. Specifically, a large-scale efficient computational algorithm will be discussed while game theoretical models will be highlighted for challenging issues including demand side management, demand response of EV management, multi-energy trading mechanism design and distributed renewable energy integration in the smart grid.

## Session 4\_ AI Application and Intelligent System

**Session Time: 13:30-19:10 November 11th, 2021 China Standard Time (UTC/GMT+8:00)**

**Session Room Link: <http://www.academicconf.com/teamslink?confname=MLIS2021>**

**Session Chairs:**

**13:30-15:35 Prof. Gyu Myoung Lee, Liverpool John Moores University, UK**

**16:15-19:10 Dr. Paweł Gora, University of Warsaw, Poland**

13:30-13:50	ML1369	<b>Evolution of belief rule based expert systems</b> <i>Dr. Mohammad Shahadat Hossain, University of Chittagong, Bangladesh</i>
13:50-14:10	ML1398	<b>Otoacoustic Emission as a viable biometric for person identification</b> <i>Dr. Shahina A, Anna University, India</i>
14:10-14:30	ML1280	<b>Object and traffic light recognition model development using multi-GPU architecture for autonomous bus</b> <i>Miss. Jheanel Estrada, Technological Institute of the Philippines-Manila, Philippines</i>
14:30-14:45	ML1344	<b>Webliometric indicators as elements of the AI technique of estimation of the language teacher's net proficiency</b> <i>Dr. Elena Provotorova, Peoples' Friendship University of Russia, Russia</i>
14:45-15:00	ML1291	<b>Utilizing digital traces of mobile phones for understanding social dynamics in urban areas</b> <i>Dr. Boaz Lerner, Ben-Gurion University of the Negev, Israel</i>
15:00-15:20	ML1316	<b>Intelligent biomedical applications with a case study of cervical cancer diagnosis</b> <i>Dr. Swati Shinde, Pimpri Chinchwad College of Engineering, India</i>
15:20-15:35	ML1297	<b>FTR-base expert system for power generation units</b> <i>Dr. Naftaly Menn, AMS-Advanced Measurement Systems Ltd, Israel</i>
15:35-16:15	<b>Break</b>	
16:15-16:35	ML1389	<b>Artificial intelligence and algorithmic information dynamics in medicine</b> <i>Dr. Hector Zenil, The Alan Turing Institute, UK</i>
16:35-16:55	ML1326	<b>A functional source separation algorithm to enhance error-related potentials monitoring in noninvasive brain-computer interface</b> <i>Dr. Camillo Porcaro, National Research Council, Italy</i>
16:55-17:10	ML1339	<b>Enhancing unsupervised language grounding through feedback</b> <i>Oliver Roesler, University of Reading, UK</i>
17:10-17:25	ML1343	<b>Heterogeneous face recognition</b> <i>Dr. Debotosh Bhattacharjee, Jadavpur University, India</i>
17:25-17:45	ML1397	<b>Challenges for trustworthy artificial intelligence of things</b> <i>Dr. Gyu Myoung Lee, Liverpool John Moores University, UK</i>
17:45-18:05	ML1247	<b>Spatio-temporal crime predictions in smart cities: Applications, achievements and challenges</b> <i>Dr. Eugenio Cesario, University of Calabria, Italy</i>

18:05-18:20	ML1393	<a href="#">A statistical mechanics perspective on neural networks and learning machines</a> <i>Dr. Adriano Barra, University of Salento, Italy</i>
18:20-18:35	ML1337	<a href="#">Traffic signal setting problem using graph neural networks and metaheuristics</a> <i>Dr. Paweł Gora, University of Warsaw, Poland</i>
18:35-18:50	ML1388	<a href="#">Multi-class imbalanced corporate bond default risk prediction based on the OVO-SMOTE-Adaboost ensemble model</a> <i>Dr. Jingmei ZHU, Tianjin University of Finance and Economics, China</i>
18:50-19:10	ML1256	<a href="#">Gaining-sharing knowledge based algorithm for solving optimization problems: A novel nature-inspired algorithm</a> <i>Dr. Ali Wagdy Mohamed, Cairo University, Egypt</i>

## Abstracts of Oral Session 4

### ML1369: The evolution of belief rule based expert systems

Mohammad Shahadat Hossain

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**Abstract.** Belief Rule Based Expert Systems (BRBESs) are widely used in diverse domains, especially where uncertainty is considered as a critical issue. This talk will present the evolution of BRBESs methodology starting from knowledge representation, inference and learning by taking into account the complexity of the problems of diverse domains. This will demonstrate the scope and challenges of integration of BRBESs with deep learning as well as with evolutionary optimization algorithms. This integration can be considered as fundamental either to develop intelligent decision technologies or to make AI systems more explainable, by ensuring a balance between accuracy and explainability. Results from our ongoing research will be presented to demonstrate the applicability of our approaches.

### ML1398: Otoacoustic Emission as a viable biometric for person identification

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**Abstract.** Biometrics, which have become integrated with our daily lives, could fall prey to

falsification attacks. For example, the fingerprint of a user can be easily forged using cheap and readily available gelatin and mould. Researchers at McAfee, the cyber security firm, have been able to trick the facial recognition system to falsely recognise the image of person A that is presented to the system, as that of person B by using an image translation algorithm known as CycleGAN. This could lead to security concerns. In this talk I will be discussing the feasibility of using Otoacoustic Emissions (OAE) as a viable biometric modality that is robust to falsification attacks. Otoacoustic Emissions are generated by the human cochlea in response to an external sound stimulus. I will be discussing how, using both the raw 1D OAE signals as well as the 2D time-frequency representation of the signal using Continuous Wavelet Transform (CWT), we achieve state-of-the-art results in real time, with the added advantage of robustness to falsification attacks.

**ML1280** To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.

**ML1344** To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.

**ML1291: Utilizing digital traces of mobile phones for understanding social dynamics in urban areas**

Boaz Lerner

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**Abstract.** Understanding land use in urban areas, from the perspective of social function, is beneficial for a variety of fields, including urban and highway planning, advertising, and business. However, big cities with complex social dynamics and rapid development complicate the task of understanding these social functions. In this paper, we analyze and interpret human social function in urban areas as reflected in cellular communication usage patterns. We base our analysis on digital traces left by mobile phone users, and from this raw data, we derive a varied collection of features that illuminate the social behavior of each land use. We divide space and time into basic spatiotemporal units and classify them according to their land use. We categorize land uses with a leveled hierarchy of semantic categories that include different levels of detail resolution. We apply the above methodology to a dataset consisting of 62 days of cellular data recorded in nine cities in the Tel Aviv district. The methodology proved beneficial with an accuracy rate ranging from 84% to 91%, dependent on land-use label resolution. In addition, analyzing the results sheds light on some of the limitations of relying solely on cellular communication as a data resource. We discuss some of these problems and offer applicable solutions.

**Keywords:** land use, computational social science, mobile phone data, urban computing, classification,

smart cities, machine learning

**ML1316: Intelligent biomedical applications with a case study of cervical cancer diagnosis**

Swati Vijay Shinde

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**Abstract.** AI is extensively used in healthcare domain for diagnosis of nearly all kind of diseases. Sufferings from different diseases like cancer, diabetes, etc. has been increasing continuously. Due to the availability of healthcare data and affordable computational power, it has been possible to apply different AI algorithms in medical imaging applications. In Machine learning, particularly deep learning enables computers to see and recognize objects in images. This ability of deep learning is extremely useful to solve computer vision problems specifically in medical imaging. These images provide clues for diagnosis and prognosis of different diseases and also decide the further treatment plan. The session will give insights into the different biomedical applications of Machine Learning with a case study on Cervical Cancer Diagnosis.

**Keywords:** machine learning, deep learning, medical imaging, bio-medical applications, cervical cancer

**ML1297 To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.**

**ML1389: Artificial intelligence and algorithmic information dynamics in medicine**

Hector Zenil

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Unit of Computational Medicine, Center for Molecular Medicine, SciLifeLab and the Karolinska Institute, UK*

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**Abstract.** In this talk, I will explain how current approaches of machine, and deep learning based on traditional statistics and information theory fail to capture fundamental properties of our world and are ill-equipped to deal with high-level functions such as inference, abstraction, and understanding, they are fragile and can easily be deceived. In contrast, we will explore recent attempts to combine symbolic and differentiable computation in a form of unconventional hybrid computation that is more powerful and may eventually display and grasp these higher-level elements of human intelligence. In particular, I will introduce the field of Algorithmic Information Dynamics and that of Algorithmic Machine Intelligence based on the theories of computability and algorithmic probability, and how these approaches promise to shed light on the weaknesses of current AI and how to attempt to circumvent some of their limitations.

**Keywords:** information theory, AI, medicine, randomness, dynamical systems

**ML1326: A functional source separation algorithm to enhance error-related potentials monitoring in noninvasive brain-computer interface**

Camillo Porcaro

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**Abstract.** An Error related Potential (ErrP) can be noninvasively and directly measured from the scalp through electroencephalography (EEG), as response, when a person realizes they are making an error during a task (as a consequence of a cognitive error performed from the user). It has been shown that ErrPs can be automatically detected with time-discrete feedback tasks, which are widely applied in the Brain-Computer Interface (BCI) field for error correction or adaptation. In this work, a semi-supervised algorithm, namely the Functional Source Separation (FSS), is proposed to estimate a spatial filter for learning the ErrPs and to enhance the evoked potentials. EEG data recorded on six subjects were used to evaluate the proposed method based on FFS algorithm in comparison with the xDAWN algorithm. FSS- and xDAWN-based methods were compared also to the Cz and FCz single channel. The single-trial classification was considered to evaluate the performances of the approaches. (Both the approaches were evaluated on the single-trial classification of EEGs.) The results presented using the Bayesian Linear Discriminant Analysis (BLDA) classifier, show that FSS (accuracy 0.92, sensitivity 0.95, specificity 0.81, F1-score 0.95) overcomes the other methods (Cz - accuracy 0.72, sensitivity 0.74, specificity 0.63, F1-score 0.74; FCz - accuracy 0.72, sensitivity 0.75, specificity 0.61, F1-score 0.75; xDAWN - accuracy 0.75, sensitivity 0.79, specificity 0.61, F1-score 0.79) in terms of single-trial classification. The proposed FSS-based method increases the single-trial detection accuracy of ErrPs to both single-channel (Cz, FCz) and xDAWN spatial filters.

**Keywords:** brain computer interface (BCI), electroencephalography (EEG), error-related potential (ERRP), functional source separation (FSS), P300, spatial filter

**ML1339: Enhancing unsupervised language grounding through feedback**

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**Abstract.** Proper natural language understanding is essential for natural and efficient communication between humans and artificial agents. However, understanding natural language is non-trivial and requires proper grounding mechanisms to link words to corresponding perceptual information. There exist a variety of grounding approaches that either utilize supervised or unsupervised learning

techniques. Supervised approaches are usually sample efficient but depend on the support of a tutor, while unsupervised approaches avoid this dependency but are less sample efficient and often also less accurate. Therefore, this presentation describes an online grounding framework that combines both learning paradigms to enable artificial agents to utilize the support from a tutor, when available, without depending on it. The presented framework is evaluated through a simulated human-agent interaction scenario and compared to an unsupervised grounding framework. The obtained results show that combining both paradigms increase both the sample-efficiency as well as the accuracy of purely unsupervised grounding, while it ensures that the framework is still able to learn, when no supervision is available.

**Keywords:** language grounding, cross-situational learning, interactive learning, human-agent interaction

### **ML1343: Heterogeneous face recognition**

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**Abstract.** When the face images of the query and the gallery are captured from different cameras or sensors like visible light vs. near-infrared or visible light vs. thermal, this face recognition process is termed heterogeneous face recognition. Recent advancement of modern cameras generates face images of different visual modalities. Early face recognition systems only consider photographs of the same modality, i.e., visible light (VIS). With the advancement of modern image capturing sensors, there is a massive change in the current image modality. The uses of these modern cameras are increased due to multimedia applications and security and law enforcement requirements. Thermal infrared (TIR) cameras are used to capture body heat for liveness detection. Therefore, it is advantageous at night for the forest department to observe animals and essential for the military to target enemies. It is also used to detect plant diseases in agriculture. On the other hand, sketches are instrumental in security and law enforcement because sometimes it may so happen that there are no available fingerprints. No available DNA samples and devices have captured poor-quality images of a crime. Then, in such situations, face sketches generated by interviewing the eyewitness are the only solution. Near-infrared cameras are used to capture faces at night for illumination invariant face recognition. Therefore, it is also used in forest departments as well as military services. One of the significant problems in HFR is the potential for differences in modality between query and gallery images. Here, we have considered only two scenarios of HFR, i.e., NIR-VIS matching and sketch-photo matching. Since we have only considered the two scenarios of HFR, i.e., sketch-photo and NIR-VIS, the significant problems of these two HFR scenarios are the variations of illumination, contrast, and the presence of high-frequency edge and texture information. To overcome these problems, a modality-invariant framework for HFR is used. Different common modality-invariant local feature extraction techniques using gradient domain, wavelet domain, and local gravitational force domain are proposed in this talk. These domains provide



illumination-invariant image representation and confine the high-frequency edge and texture features. Then, some local edge-preserving texture features (using some novel handcrafted binary patterns) are extracted as the final common modality-invariant feature for HFR. It is also found that the deep learning techniques for HFR can be improved with smaller shallow networks and small sample size data, providing some appropriate handcrafted features to the CNN. The generalization problem of deep learning, i.e., different task-specific CNNs, can be solved using a suitable continual learning mechanism.

**Keywords:** face recognition, deep learning, feature extraction, machine learning

### **ML1397: Challenges for trustworthy artificial intelligence of things**

Gyu Myoung Lee

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**Abstract.** Artificial Intelligence (AI) and Internet of Things (IoT) are very important technologies for the future and there are a lot of research activities to combine AI and IoT, called AIoT (Artificial Intelligence of Things). Furthermore, data is becoming essential to support AI based solutions with human interactions. In this regard, this talk introduces key concepts, features and characteristics of human centric AIoT in data driven networking point of view. From AIoT research, many researchers have identified that there are security, privacy and trust concerns to realize human-centric AIoT. To cope with negative effects of AIoT, it's necessary to address trustworthy AIoT. Therefore, this talk presents key challenges for realizing trustworthy AIoT and discuss next steps for future research.

### **ML1247: Spatio-temporal crime predictions in smart cities: Applications, achievements and challenges**

Eugenio Cesario

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**Abstract.** Steadily increasing urbanization is causing significant economic and social transformations in urban areas, posing several challenges related to city management and services. In particular, in cities with higher crime rates, effectively providing for public safety is an increasingly complex undertaking. To handle this complexity, new technologies are enabling police departments to access growing volumes of crime-related data that can be analyzed to understand patterns and trends, and ultimately support more effective crime prevention. This talk presents an overview about how data-driven predictive approaches can support police officers to forecast crimes in urban areas, aimed at increasing the efficient deployment of police resources within a given territory. Then, it presents a multi-step algorithm, based on spatial analysis and auto-regressive models, to automatically detect

high-risk crime regions in urban areas and to reliably forecast crime trends in each region. The experimental evaluation, performed on two real-world datasets collected in the cities of Chicago and New York City, shows good accuracy in spatial and temporal crime forecasting over rolling time horizons.

### **ML1393: A statistical mechanics perspective on neural networks and learning machines**

Adriano Barra

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**Abstract.** In this short talk I will present a streamlined overview on the statistical mechanical approach to infer and quantify emergent capabilities shown by artificial neural networks and learning machines. I will try to put emphasis on the methodology, the perspective and the interests that raise within this approach and, eventually, I will deepen a crucial skill that dense networks share, namely their spontaneous ability to sacrifice memory storage in order to enhance signal detection in a noisy environment far beyond the standard limits. Minimal References: [1] E. Agliari, A. Barra, P. Sollich, L. Zdeborova, Machine learning and statistical physics: theory, inspiration, application, Journal of Physics A: Special 2020 (2020). [2] E. Agliari, F. Alemanno, A. Barra, M. Centonze, A. Fachechi, Neural networks with a redundant representation: detecting the undetectable. Physical Review Letters, 124(2), 028301 (2020).

**Keywords:** statistical mechanics, Hopfield networks, Restricted Boltzmann machines, dense networks

### **ML1337: Solving traffic signal setting problem using graph neural networks and metaheuristics**

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**Abstract.** In this talk, I will present the results of my research on the application of graph neural networks and metaheuristics to solve the Traffic Signal Setting problem. This combinatorial optimization problem is proven to be NP-hard even for relatively simple traffic models, while at the same time, it is important from a perspective of traffic engineering. Therefore, the standard way to solve it is by using metaheuristics like genetic algorithms or CMA-ES. However, such algorithms require time-consuming evaluations using traffic simulations in order to evaluate the efficiency of signal settings accurately. Therefore, in order to speed them up, I train surrogate models to approximate the outcomes of simulations very fast and with sufficient accuracy. Graph neural networks, in which the topology of connections between neurons is inferred from the road network structure graph, give especially good results in this application, especially in terms of generalization to unseen signal settings close to local minima found by metaheuristics.

**Keywords:** traffic signal setting problem, metaheuristics, graph neural networks, traffic optimization

**ML1256: Gaining-sharing knowledge-based algorithm for solving optimization problems: A novel nature-inspired algorithm**

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**Abstract.** This talk presents a novel nature-inspired algorithm called Gaining Sharing Knowledge based Algorithm (GSK) for solving optimization problems over continuous space. The GSK algorithm mimics the process of gaining and sharing knowledge during the human life span. It is based on two vital stages, junior gaining and sharing phase and senior gaining and sharing phase. The present work mathematically models these two phases to achieve the process of optimization. In order to verify and analyze the performance of GSK, numerical experiments on a set of 30 test problems from the CEC2017 benchmark for 10, 30, 50 and 100 dimensions. Besides, the GSK algorithm has been applied to solve the set of real-world optimization problems proposed for the IEEE-CEC2011 evolutionary algorithm competition. A comparison with 10 state-of-the-art and recent metaheuristic algorithms are executed. Experimental results indicate that in terms of robustness, convergence and quality of the solution obtained, GSK is significantly better than, or at least comparable to state-of-the-art approaches with outstanding performance in solving optimization problems especially with high dimensions.

**Keywords:** evolutionary computation, global optimization, meta-heuristics, nature-inspired algorithms, population based algorithm

**ML1388** To avoid repeatability issues, this abstract will be available after the full paper is published in the conference proceedings.

# Part V Acknowledgements

On behalf of the MLIS 2021 Organizing Committee, we would like to take this opportunity to express our sincere gratitude to our participants. Without their support and contributions, we would not be able to hold the conference successfully in this special year. We would also like to express our acknowledgements to the Technical Program Committee members who have given their professional guidance and valuable advice as reviewers. Below are the lists of the Technical Program Committee members. For those who contribute to the success of the conference organization without listing the name here, we would love to say thanks as well.

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