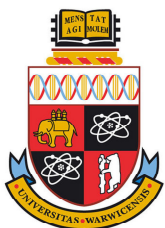# Warwick Secure and Intelligent Communications Workshop

Workshop Program

Friday, 28th July 2023, Coventry

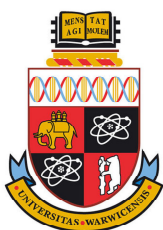School of Engineering
University of Warwick

WARWICK

GLOBAL RESEARCH PRIORITIES
CYBER SECURITY

Warwick Secure and Intelligent Communications Workshop

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Table of Contents

1 About the Workshop

Warwick secure and intelligent communications (WSIC) workshop will take place on 28th July 2023 at Space 43, Scarman, Warwick Conferences, University of Warwick. The workshop will consist of a keynote session featuring four talks, as well as a poster session. The poster session will showcase recent research findings on a wide range of topics related to AI, including, but not limited to, the following:

- AI-enabled communications
- AI-enabled security and cyber technology
- AI-related other technologies

The WSIC workshop is supported by the Cyber Security GRP (Global Research Priority) at the University of Warwick and hosted by the School of Engineering and WMG. It is free to all attendees, but online registration is required for head count.

The aim of this workshop is to foster interactions among various disciplines in the field of secure and intelligent communications, and to present an excellent platform to meet and share the latest research work. The WSIC workshop offers a unique opportunity for PhD students, post-docs, and research and teaching academics working in secure and intelligent communications or AI-related technologies to engage in discussions on emerging developments, concepts, and best practices, and to identify synergies and directions for broader and more profound applications of secure and intelligent communications.

2 Organizing Committee

Steering Committee

Prof. Gan Zheng, School of Engineering, University of Warwick

General Chairs

Dr Hua Yan and Dr Tianhua Xu, School of Engineering, University of Warwick

Technical Program Committee

Dr Subhash Lakshminarayana, School of Engineering, University of Warwick (Chair)

Dr Yongxu Zhu, School of Engineering, University of Warwick (Co-Chair)

Dr Yue Jin, WMG, University of Warwick

Dr Anita Khadka, Northeastern University London (was with WMG)

Dr Kai Shi, WMG, University of Warwick

Dr Hamidreza Arjmandi, School of Engineering, University of Warwick

Dr Lifeng Wang, Department of Electronic Engineering, Fudan University

Dr Bo Tan, Electrical Engineering, Tampere University

Finance Chair

Dr Tianhua Xu, School of Engineering, University of Warwick

Dr Hua Yan, School of Engineering, University of Warwick

3 Access

On-site Venue: Space 43, Scarman Conference Centre, University of Warwick, Scarman Rd Coventry, CV4 7AL, UK

Online access via Zoom:

https://zoom.us/j/99884424180?pwd=dFlzT21rMHNmSzgrSTFmVFZQMlVnZz09

Meeting ID: 998 8442 4180

Passcode: WSIC2023

4 Overall Schedule

Friday, 28 July 2023 (UK Time)	
09:00-09:45	Registration (with refreshment)
09:45-10:00	Welcome
10:00-10:45	*Keynote Talk 1*
10:45-11:15	Coffee/Tea Break, Posters and Networking
11:15-12:00	*Keynote Talk 2*
12:00-13:00	Lunch (self-service)
13:00-13:45	*Keynote Talk 3*
13:45-14:30	*Keynote Talk 4*
14:30-16:00	*Poster Session* (with Coffee/Tea and refreshment)
16:00-17:00	Freely Networking

5 Keynote Session (Space 43, Scarman Conference Centre)

5.1 Keynote schedule

Time (UK)	Speakers	Titles
10:00-10:45	Prof. Geoffrey Ye Li	*Deep Learning for Future Wireless Communications*
10:45-11:15	Coffee/Tea break, Posters and Networking	
11:15-12:00	Prof. Michail (Michalis) Matthaiou	*Cell-free massive MIMO for next generation multiple access*
12:00-13:00	Lunch (self-service)	
13:00-13:45	Prof. Shuang-Hua Yang	*Deep Learning based communications system with co-channel interference*
13:45-14:30	Prof. Walid Saad	*Understand Me If You Can: Reasoning Foundations of Semantic Communication Networks*

5.2 Keynote talks

Title: Deep Learning for Future Wireless Communications

Speaker: Professor Geoffrey Li
Intelligent Transmission and Processing Lab
Imperial College London

Abstract: Deep learning (DL) has great potential to break the bottleneck of the conventional communication systems. In this talk, we will present recent work in DL for future wireless communications, including physical layer processing and resource allocation, DL-enabled semantic communications, and the impact of wireless communications on federated learning.

DL can improve the performance of each individual (traditional) block in a conventional communication system or jointly optimize the whole transceiver. We can categorize the applications of DL in physical layer processing into with and without block processing structures. For DL based communication systems with block structures, we present joint channel estimation and signal detection based on a fully connected deep neural network, model-drive DL for signal detection. For those without block structures, we provide our recent endeavors in developing end-to-end learning communication systems.

Judicious resource (spectrum, power, etc.) allocation can significantly improve efficiency of wireless networks. The traditional wisdom is to explicitly formulate resource allocation as an optimization problem and then exploit mathematical programming to solve it to a certain level of optimality. Deep learning represents a promising alternative due to its remarkable power to leverage data for problem solving and can help solve optimization problems for resource allocation or can be directly used for resource allocation. As an example, we will briefly discuss how to use deep reinforcement learning for wireless resource allocation in vehicular networks.

At the end of this talk, we will also briefly discuss semantic communications and the impact of wireless communications on federated learning.

Prof. Geoffrey Ye Li (IEEE Fellow, IET Fellow) is currently a Chair Professor at Imperial College London, UK. Before joining Imperial in 2020, he was a Professor at Georgia Institute of Technology, USA, for 20 years and a Principal Technical Staff Member with AT&T Labs – Research (previous Bell Labs) in New Jersey, USA, for five years. He contributed orthogonal frequency division multiplexing (OFDM) for wireless communications, established a framework on resource cooperation in wireless networks, and introduced deep learning (DL) for communications. Dr. Geoffrey Ye Li was awarded IEEE Fellow and IET Fellow for his contributions to signal processing for wireless communications. He won the 2024 IEEE Eric E. Sumner Award and several prestigious awards from IEEE Signal Processing, Vehicular Technology, and Communications Societies, including 2019 IEEE ComSoc *Edwin Howard Armstrong Achievement Award.*

Title: Cell-free massive MIMO for next generation multiple access

Speaker: Prof. Michalis Matthaiou
ECIT Institute, Queen's University Belfast

Abstract: The next generation multiple access (NGMA) techniques are expected to achieve massive and ubiquitous access for a large number of devices and provide high spectral efficiency in ultra-dense networks. To meet these unprecedented mobile traffic demands, a paradigm shift from the conventional cellular networks towards distributed communication systems is required. Cell-free massive multiple-input multiple-output (CF-mMIMO) is considered as a practical and scalable embodiment of the distributed/ network MIMO systems, which inherits not only the key benefits from colocated massive MIMO systems, but also the macro-diversity gain from the distributed systems. In this seminar, we are going to provide an overview of current research efforts on the CF-mMIMO systems and their promising future application scenarios. Then, we elaborate on the new requirements for CF-mMIMO networks and propose a unifying framework for NGMA based on virtual full-duplex and CF-mMIMO.

Michalis Matthaiou (IEEE Fellow) is the Chair Professor of Communications Engineering and Signal Processing and Deputy Director of the Centre for Wireless Innovation (CWI) at Queen's University Belfast, U.K. Dr. Matthaiou and his coauthors received the IEEE Communications Society (ComSoc) Leonard G. Abraham Prize in 2017. He currently holds the ERC Consolidator Grant BEATRICE (2021-2026) focused on the interface between information and electromagnetic theories. He was awarded the prestigious 2018/2019 Royal Academy of Engineering/The Leverhulme Trust Senior Research Fellowship and also received the 2019 EURASIP Early Career Award. His team was also the Grand Winner of the 2019 Mobile World Congress Challenge. He is currently the Editor-in-Chief of Elsevier Physical Communication, a Senior Editor for IEEE Wireless Communications Letters and IEEE Signal Processing Magazine, and an Associate Editor for IEEE Transactions on Communications. He is an IEEE Fellow.

Title: DL-based communications system with co-channel interference

Speaker: Prof. Shuang-Hua Yang
University of Reading

Abstract: Deep learning has demonstrated significant potential for revolutionizing conventional communication systems. Numerous communication applications have embraced deep learning techniques. Nevertheless, channel impairments, such as co-channel interference, are unavoidable due to spectrum sharing and multiple access. These impairments are either difficult to mitigate or require sophisticated design to avoid. In this talk, I will introduce our research of using deep learning in communications system with co-channel interference. Specifically, two works will be presented, 1) deep learning-based signal detection for communications system with radar interference, and 2) knowledge distillation based semantic communication for multiple users.

Prof. Shuang-Hua Yang (SMIEEE, IET Fellow) is currently the Head of Department of Computer Science at the University of Reading (UoR), UK. Before joining UoR, he was serving as the Executive Deputy Dean of the Graduate School in SUSTech (Southern University of Science and Technology, China) and a chair professor in Computer Science between 2016 to 2022. He spent over two decades at Loughborough University in the UK. He joined Loughborough University in 1997 as a research assistant, and progressed to a research fellow in 1999, a lecturer in 2000, a senior lecturer in 2003, a professor in 2006, and Head of Department of Computer Science in 2014. His educational history originated in China where he received a BSc in 1983, an MSc in 1986, both from the Petroleum University and a PhD in 1991 from Zhejiang University. He was awarded a Doctor of Science degree, a higher doctorate degree, in 2014 from Loughborough University to recognize his scientific achievement in his academic career. In the same year he was selected as a Fellow of the Institute of Engineering and Technology (IET).

Title: Understand Me If You Can: Reasoning Foundations of Semantic Communication Networks

Speaker: Prof. Walid Saad

Virginia Tech Research Center

Abstract: For decades, the wireless link between transmitter and receiver has been seen as a mere bit pipe whose goal is to faithfully reconstruct the exact transmitted signal at the receiver, without paying attention to the meaning or effect of the source message. This classical design may excel in delivering high communication rates and low bit-level errors, but its limitations become apparent when faced with the challenge of transmitting massive data streams for connected intelligence, Internet of Senses, or holographic applications, where the message intent and effectiveness must be considered, and extremely stringent requirements for reliability and latency must be met, often simultaneously. In this regard, the concept of semantic communication, in which the meaning of the source messages is incorporated in the design of a communication link, has recently emerged as a promising solution. However, despite a recent surge of efforts in this area, remarkably, the research landscape is still limited to basic constructs in which even the very definition of "semantics" remains ambiguous. In this talk, we seek to remove this ambiguity and present a bold, forward-looking vision on how to build and design semantic communication networks from the ground-up. In particular, we opine that major breakthroughs in semantic communications can only be made by equipping the communication nodes with the capability to exploit information semantics at a fundamental level (from the data structure and relationships) which enables them to build a knowledge base, reason on their data, and engage in a form of communication using a machine language, similar to human conversation, with the capability to deduce meaning from the data in a manner akin to human reasoning. Towards this goal, we introduce our holistic vision for semantic communications that is firmly grounded in rigorous artificial intelligence (AI) and causal reasoning foundations, with the potential to revolutionize the way information is modeled, transmitted, and processed in communication systems. We show how, by embracing semantic communication through our proposed vision, we can usher in a new era of knowledge-driven, reasoning wireless networks that are more sustainable and resilient than today's data-driven, knowledge-agnostic networks. We also shed light on how this framework can create AI-native networks - a key requirement of future wireless systems. As a key step towards enabling this paradigm shift, we present our recent key results in this area, with foundations in AI, theory of mind, and game theory, that showcase how the proposed approach for semantic communications can reduce the volume of data circulating in a network while improving reliability, two critical requirements for emerging wireless services, such as connected intelligence and digital twins. We conclude with a discussion on future opportunities in this exciting area.

Walid Saad (S'07, M'10, SM'15, F'19) received his Ph.D degree from the University of Oslo, Norway in 2010. He is currently a Professor at the Department of Electrical and Computer Engineering at Virginia Tech, where he leads the Network sciEnce, Wireless, and Security (NEWS) laboratory. He is also the Next-G Wireless Faculty Lead at Virginia Tech's Innovation Campus. His research interests include wireless networks (5G/6G/beyond), machine learning, game theory, security, UAVs, semantic communications, cyber-physical systems, and network science. Dr. Saad is a Fellow of the IEEE. He is also the recipient of the NSF CAREER award in 2013, the AFOSR summer faculty fellowship in 2014, and the Young Investigator Award from the Office of Naval Research (ONR) in 2015. He was the (co-)author of eleven conference best paper awards at IEEE WiOpt in 2009, ICIMP in 2010, IEEE WCNC in 2012, IEEE PIMRC in 2015, IEEE SmartGridComm in 2015, EuCNC in 2017, IEEE GLOBECOM (2018 and 2020), IFIP NTMS in 2019, IEEE ICC (2020 and 2022). He is the recipient of the 2015 and 2022 Fred W. Ellersick Prize from the IEEE Communications Society, and of the IEEE Communications Society Marconi Prize Award in 2023. He was also a co-author of the papers that received the IEEE Communications Society Young Author Best Paper award in 2019, 2021, and 2023. Other recognitions include the 2017 IEEE ComSoc Best Young Professional in Academia award, the 2018 IEEE ComSoc Radio Communications Committee Early Achievement Award, and the 2019 IEEE ComSoc Communication Theory Technical Committee Early Achievement Award. From 2015-2017, Dr. Saad was named the Stephen O. Lane Junior Faculty Fellow at Virginia Tech and, in 2017, he was named College of Engineering Faculty Fellow. He received the Dean's award for Research Excellence from Virginia Tech in 2019. He was also an IEEE Distinguished Lecturer in 2019-2020. He has been annually listed in the Clarivate Web of Science Highly Cited Researcher List since 2019. He currently serves as the Editor-in-Chief for the IEEE Transactions on Machine Learning in Communications and Networking.

6 Poster Session (Space 43, Scarman, Warwick conferences)

No.	Presenters	Affiliation	Titles
1	Mr. Tertsegha Anande	University of Warwick	*Enhanced Modelling for Improved Learning Performance*
2	Dr. Cenqin Jin	University of Warwick	*Kalman Filter in Optical Fibre Communications for Compensation of Phase and Amplitude Noise*
3	Dr. Xueyun Gu	University of Warwick	*Channel-Estimation-Aware Joint Radar-Communications Designs*
4	Mr. Chenchen Qiu	University of Warwick	*Spatial downscaling of precipitation using an AI-based method*
5	Ms. Dyan Agustika	University of Warwick	*Optimisation of Feedforward Neural Network Parameter for Pepper Yellow Leaf Curl Virus Detection*
6	Mr. Zelin Gan	University of Cambridge	*Maximising Throughput: Meta-Heuristics Versus Neural Networks*
7	Dr. Mykyta Shevchenko	UCL	*Maximising Throughput: Meta-Heuristics Versus Neural Networks*
8	Dr. Wenxiu Hu	University of Warwick	*One-Dimensional and High-Dimensional Non-Coherent Detection Methods for Ultraviolet Communications*
9	Dr. Zhuangkun Wei	Cranfield University	*TAS-S RS-2C: Threat Analysis of current Physical Layer Security on Communication Surfaces of Autonomous Systems*
10	Mr. I N.K. Wardana	University of Warwick	*Optimising TinyML Using Binary Weight Network and Meta-Learning for a Low-cost Air Quality Monitoring Device*
11	Dr. Hua Yan	University of Warwick	*Energy Modeling for UAV Intelligent Communications*
12	Mr. Congchao Bian	Hohai University	*Deep learning inmagnetic resonance image reconstruction*
13	Mr. Yexiang Chen	University of Warwick	*Moving Target Defense against Adversarial False Data Injection Attack*
14	Dr. Yue Jin	University of Warwick	*Decentralized Multi Agent Cooperative Policy Optimization*