

# PAINLESS

An innovative training network (ITN) on  
Energy-autonomous portable access points for  
infrastructure-less networks

NEWSLETTER DATE  
May 2020



*This project has received funding from  
the European Union's Horizon 2020  
research and innovation programme  
under grant agreement No 812991*

## Inside this issue

PAINLESS and WINDMILL School Speakers  
and Overview

## PAINLESS RESEARCH PROJECTS' UPDATES

### **PAINLESS has recently conducted its third Summer School Virtually In collaboration with WINDMILL**

#### Hosted by AAU in Aalborg

*Several world-renowned speakers  
took part in our school to discuss the  
state of the art in wireless  
communications & the mathematical  
tools underpinning it. Our School was  
well received with over 300  
registered attendants from across  
the globe. Please check out our  
video recordings on our website and  
on youtube to catch up on what  
PAINLESS & WINDILL are up to!*

## 3<sup>rd</sup> Summer School Speakers



**Petar Popovski (Aalborg University)**

**PETAR POPOVSKI (Fellow, IEEE)** received the Dipl.-Ing. and M.Sc. degrees in communication engineering from the University of Sts, and the Cyril and Methodius in Skopje and the Ph.D. degree from Aalborg University in 2005, where he is a Professor with Aalborg University, where he heads the Section on Connectivity. His research interests are in the area of wireless communication and communication theory.

Professor Popovski provided a comprehensive overview on Challenges and Possibilities for Wireless Connectivity on the Path beyond 5G.

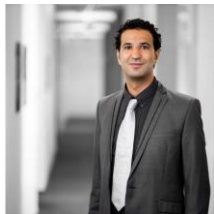


**Christian Raffelsberger (Lakeside Labs)**

**Christian Raffelsberger** is senior Researcher and Project Manager in Lakeside Labs. Christian's expertise is ad hoc networks, 5G, delay-tolerant networks, multimedia communications, and disaster management. He holds a master and doctoral degree in informatics from U Klagenfurt. Before joining Lakeside Labs, Christian gained experience in a large European project.

**Aymen Fakhreddine** is senior Researcher in Lakeside Labs. Aymen's expertise is in wireless communications, networking, and localization. His current emphasis is on cellular-connected drone systems. He holds a doctoral and master degree in telematic engineering from the University Carlos III Madrid (Spain) and a master degree in wireless communication systems from École Supérieure d'Électricité (Centrale Supélec) in Paris (France).

Aymen and Christian provided a lecture on AV Communication Challenges.



**Aymen Fakhreddine (Lakeside Labs)**

**David Gesbert (Fellow, IEEE)** is a Professor and head of the Communications Systems Department of EURECOM. He is also heading the Foundations and Algorithms group. He has been named in the Thomson-Reuters List of Highly Cited Researchers in Computer Science. He is a Board member for the OpenAirInterface (OAI) Software Alliance. Since 2015, he is the holder of an Advanced ERC grant on the topic of Smart Device Communications. Since early 2019, he heads the Huawei-funded Chair on Advanced Wireless Systems Towards 6G Networks. Since 2020, he holds a 3IA Chair funded on the topic of AI for future IoT Networks.

David provided a lecture on Learning from the Sky: Robot Aided Mapping, Radio Access and Localization



**David Gesbert (Eurecom)**

**Elisabeth de Carvalho** received the Ph.D. degree in electrical engineering from Telecom ParisTech, France. She was a Post-Doctoral Fellow with Stanford University, Stanford, CA, USA, and then with industry in the field of DSL and wireless LAN. Since 2005, she has been an Associate Professor with Aalborg University. Her main expertise is in signal processing for MIMO communications, with recent focus on massive MIMO, including channel measurements, channel modelling, beamforming, and protocol aspects.

Elisabeth introduced WINDMILL Project.



**Elisabeth de Carvalho (Aalborg University)**

### 3<sup>rd</sup> Summer School Speakers



**Christos Masouros (University College London)**

**Christos Masouros** is currently a full professor in the Department of Electrical and Electronic Engineering, University College London. His research fields include wireless communications, interference mitigation and exploitation, MIMO and multi-carrier communications, and communication and radar coexistence.

Christos Introduced PAINLESS Project.



**Tamas Kerekes (Aalborg University)**



**Ioannis Krikidis (University of Cyprus)**

**Tamas Kerekes (Senior Member, IEEE)** received Ph.D. degree in analysis and modeling of transformerless PV inverter systems from the Department of Energy Technology, Aalborg University, in 2009. He is currently as an Associate Professor with Aalborg University. His research interests include grid connected renewable energy systems focusing on different grid forming and grid following control algorithms for power electronic converters for renewable energy systems with storage solutions.

**Ioannis Krikidis (Fellow, IEEE)** is an associate Professor in the Department of Electrical and Computer Engineering at the University of Cyprus. He is the director of the IRIDA Research Centre for Communication Technologies and the Mobile Communications and Networking (MCN) laboratory, which conduct research in the broad area of communication theory, communication signal processing, wireless communication and networks. His research focus is on Wireless Communications.

Tamas and Ioannis provided a lecture on Machine learning.



**Dennis Sherwood (Silver Bullet)**

**Dennis Sherwood** education was as a scientist, reading physics at Clare College, Cambridge, followed by taking an MPhil at the Department of Molecular Biophysics and Biochemistry at Yale University, and a PhD in biology at the University of California at San Diego. Dennis is also a Sloan Fellow, with distinction, of London Business School. Dennis's passion for creativity and innovation led him to found *Silver Bullet* in 2001. Dennis provided a course entitled "Yes, you too can be creative!"



**Gert Spender-Andersen (Aalborg University)**

**Gert Spender-Andersen** is Special consultant in AAU Innovation, Aalborg University. Gert has more than 25 years of experience being an entrepreneur.

Gert provided a lecture entitled "From Research to business"

## Samples of the ESRs Presentations

Recording

View

windmill

# "Integrating Wireless Communication Engineering and Machine Learning"

abbreviated - WindMill

Unmute Stop Video Participants 45 Chat Share Screen Record Reactions Leave

Zoom Meeting

Participants: Jimmy Jessen..., Christos Maso..., shirin goshtas..., Elisabeth de Carv..., Mahshid, Tamas Kerekes, Cristian Jesús...

Recording

### illustrative scenario that combines mMTC and URLLC

a device generates two message types

- individual update, independent of others
- alarm-type message, correlated for all sensors

K. Stern, A. E. Kalør, B. Soret, and P. Popovski, "Massive Random Access with Common Alarm Messages", in Proc. IEEE ISIT, Paris, France, July 2019.

PAINELESS and WINDMILL Summer School, May 5, 2021 15

Participants: Jimmy Jessen..., Christos Masou..., Petar Popovski, Elisabeth de Car..., mnavarro, Matteo Zecchin, shirin goshtas...



## PAINLESS Research projects' Updates

Zoom Meeting   You are viewing David Gesbert's screen   View Options

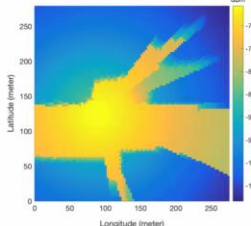
Recording

## Placement/path design scenarios

- Scenario 1: UAV as cellular relay
- Scenario 2: "Smart" IoT data harvesting
- Scenario 3: UAV-aided mesh connectivity

Map information can be **too much** information !

Single user-drone radio map



Participants: 43   Chat   Share Screen   Record   Reactions

Unmute   Start Video

ENG 15:03 05/05/2021

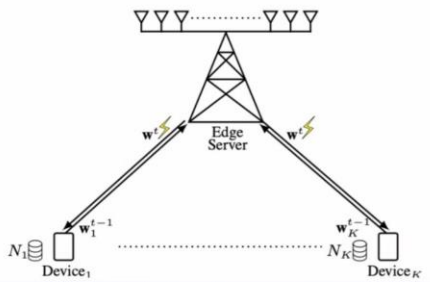
Jimmy Jessen...   Christos Masou...   David Gesbert   NITHIN BABU   Xavier Mestre   salman.mohe...   Muhammad...

Leave

REC

## WPC and Machine Learning

- 1 A new design methodology- from "Model and Optimize" to "Learning"
  - Mathematical models are too simplistic e.g., impedance mismatching, parasitic effects, frequency/modulation product (IM2), etc.
  - Optimize TX/RX without intermediate blocks/models etc (e.g. autoencoders).
- 2 Useful tool to solve complicated optimization problems
  - nonlinearities associated to the rectification process
- 3 WPC is also an enabler for ML algorithms
  - e.g., WPC and federated learning



I. Krikidis (ECE/UCY)   Wireless Powered Communications   PAINLESS Summer School, May 5-6, 2021   9 / 9

Ioannis Krikidis' screen

## PAINLESS Research projects' Updates

REC

TeamPlayingUncertainties [Compatibility Mode] - PowerPoint

FileHomeInsertDesignTransitionsAnimationsSlide ShowReviewViewTell me what you want to do...

CutCopyPasteFormat PainterClipboard

LayoutResetNew SlideSectionSlides

26Font


Text DirectionAlign TextConvert to SmartArt

Shape FillShape OutlineShape EffectsArrangeQuick StylesDrawing

Thumbnails

## Coordinate among elements of a network


### =Team playing



05/05/2021 -EURECOM CM-p 1

EURECOM

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Zoom Meeting    You are viewing Dennis Sherwood's screen    View Options

Eloise de Carv...    Dennis Sherwood    Marco Virgili    Jimmy Jessen ...    Igor Donevski    Torsten Sherw...

Recording

## *The three fundamental principles of creativity*

- 1 Observation
- 2 Curiosity
- 3 Permission

Windows taskbar: Windows logo, Search, Task View, File Explorer, Microsoft Edge, Word, PowerPoint, Teams, OneDrive, Outlook, Chrome, Firefox, VLC, Zoom, System tray (Network, Volume, Bluetooth, Battery, Time: 10:30 AM, Date: 10/30/2024)

## PAINLESS Research projects' Updates

**Target Scenario**

A self-backhauled portable base station is mounted on a UAV and is positioned above the affected area.

Backhaul link

Backhaul node

FBS

Rural area

Malfunction in terrestrial network

Excessive demand

Wifi

Dial in

Join Audio

Start Video

Share

Participants

More

**Cognition-based networking**

- Scalable learning framework network optimization
- Cell-free massive MIMO
  - Ideally, all the APs servers all UEs
- Selecting an optimal number of APs to serve UEs
  - Subset Selection Problem
- Determinantal Point Processes (DPPs)
  - Diversity-favorable (quality-diversity trade-off)
  - Input-driven (Machine learning)

AP 1

user k'

AP 2

user 1

user k

CPU

AP m

AP M

Source: Ngo, Hien Quoc, et al. "Cell-free massive MIMO versus small cells." *IEEE Transactions on Wireless Communications* 16.3 (2017): 1834-1850.

Recording

You are viewing salman.mohebiganjabadi@unipd.it's screen

View Options

Christos Masou...

Jimmy Jessen

Muhammad

Anay Deshpande

shirin goshtas

Roberto Pereira

Matteo Zecchin

Parham Kazemi

Cristian Jesús

Marco Virgili

David Gesbert

salman mohebiganjabadi

sobhi

Muhammad J.

Mateus Mota

Chien-Cheng Wu

Unmute

Start Video

Participants

Chat

Share Screen

Record

Reactions

## PAINLESS Research projects' Updates







**1) Performance Analysis of Wireless Mesh Backhauling Using Intelligent Reflecting Surfaces.**  
**2) IRS-Assisted UAV Communications with Imperfect Phase Compensation.**



ESR 6: Mohammad Al-Jarrah,  
 the School of Electrical and Electronic Engineering,  
 University of Manchester, Manchester M13 9PL, U.K.  
 (e-mail: mohammad.aljarrah@manchester.ac.uk).

Supervisor: Prof. Emad Alsusa,  
 the School of Electrical and Electronic Engineering,  
 University of Manchester, Manchester M13 9PL, U.K.  
 (e-mail: e.alsusa@manchester.ac.uk).







## An Overview of Federated Learning: Do UAVs Fit In?

Igor Donevski  
May, 2021



This project has received funding from the European Union's  
 Horizon 2020 research and innovation programme under the  
 Marie Skłodowska-Curie grant agreement No 812991





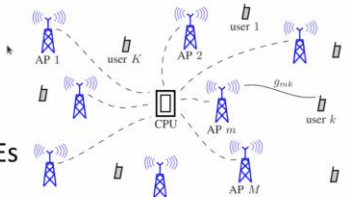


## PAINLESS Research projects' Updates

Recording You are viewing salman.mohebiganjabadi@unipd.it's screen View Options

## windmill Cognition-based networking

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Source: Ngo, Hien Quoc, et al. "Cell-free massive MIMO versus small cells." IEEE Transactions on Wireless Communications 16.3 (2017): 1834-1850.

Participants: 46

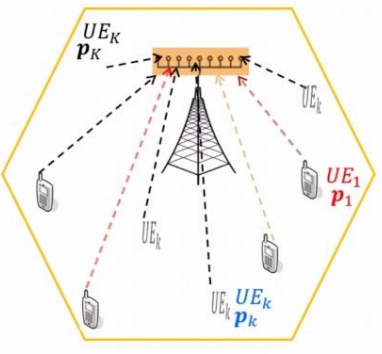
Unmute Start Video Chat Share Screen Record Reactions Leave

Participants: Jimmy Jessen..., Christos Masou..., Muhammad..., Anay Deshpande..., shirin goshtas..., Roberto Pereira..., Matteo Zecchin..., Parham Kazemi..., Cristian Jesus..., Marco Virgili..., David Gesbert, salman mohebig..., sobhi, Muhammad J., Mateus Mota, Chien-Cheng Wu

REC PowerPoint Slide Show - 2\_min presentation.pptx - PowerPoint

## windmill Channel Charting

- Channel Chart (CC):** Maps CSI acquired from UEs in a cell into a low-dimensional map that captures the local geometry of the true UE location in space.
- Basic principle: High dimensional CSI depends on UE location



Slide 2 of 8

Display Settings