ISSUE 8

PAINLESS

An innovative training network (ITN) on

Energy-autonomous portable access points for infrastructure-less networks

NEWSLETTER DATE
February. 2021

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

Painless targets a range of dissemination routes to promote self-powered networks and their paradigm-shifting applications towards coverage enriching and extension. Scientific Community: Awareness will be raised through a variety of methods especially conference, journal and magazine publications in well-esteemed venues and publishers.

PAINLESS Updates on workshops and webinars, collaborative work, upcoming events and special issues.

To realize a truly portable network for the access provisioning demands outlined above, a new generation of UAV-oriented signal processing, resource optimization and control technologies are required. We aim to leverage the variety of UAV solutions such as drones, balloons, high-altitude platforms, each with their own trade-offs in terms of energy efficiency, trajectory and coverage flexibility, and payload characteristics, to provide scenario-specific solutions that implement portable, off-the-grid network delivery in the future use cases.

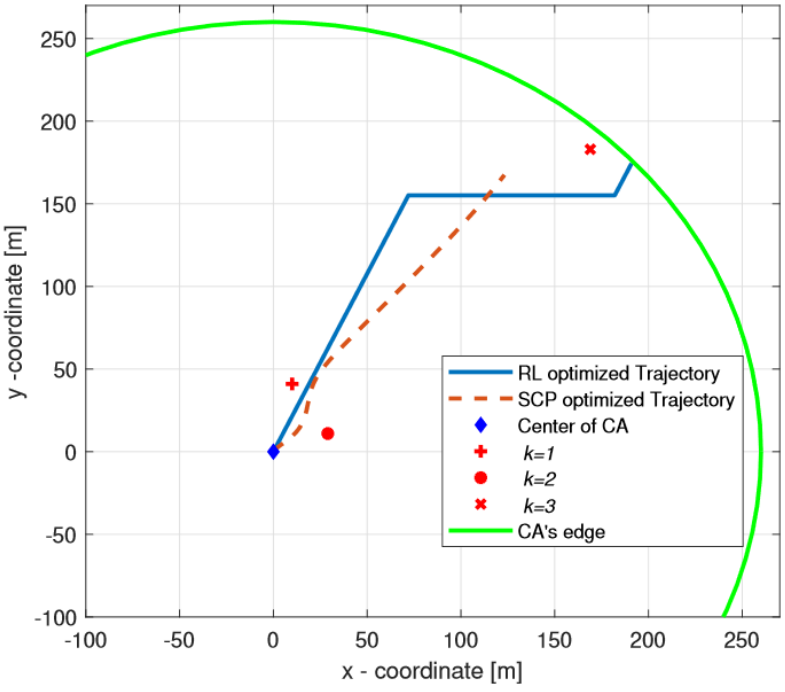
PAINLESS SG5 Updates

Igor Donevski, AAU
ESR#15

Nithin Babu, ALBA
ESR#10

FEDERATED LEARNING WITH DRONES AS ORCHESTRATORS AND LEARNERS AS GROUND ROBOT NODES: OPTIMAL TRAJECTORIES FOR MINIMUM STALENESS

The study group of proof of concept investigated the problem of scheduling transmissions for spatially scattered nodes that participate in a federated learning (FL) algorithm. The wireless links in this setting are provided by the drone that also acts as an orchestrator (coordinating the transmissions and the learning schedule within a predefined deadline). The drone can plan a trajectory that through its position, controls the distance and thereby the data rate to each node. Since the drone is targeted for FL networks, our goal is to achieve fairness in terms of learning staleness (the difference of computed epochs between different nodes). We use the learning epochs as a performance indicator by creating a new optimization criterion that is combining the average number of epochs and staleness into a more balanced optimization criterion that is agnostic to the FL implementation. To solve the complex trajectory planning optimization problem, we consider two methods: (1) successive convex programming (SCP) and (2) deep reinforcement learning (RL). First and foremost, drone-orchestrated FL outperforms an immobile deployment by providing improvements in the range of 57% to 87.7%. As shown below, RL-guided trajectories are generally superior to SCP provided ones for complex node arrangements since they can solve the problem in its original setting since they require no analytical approximations. Such RL systems have the potential to be upgraded for future testing of stochastic arrangements.



PAINLESS SG5 Updates

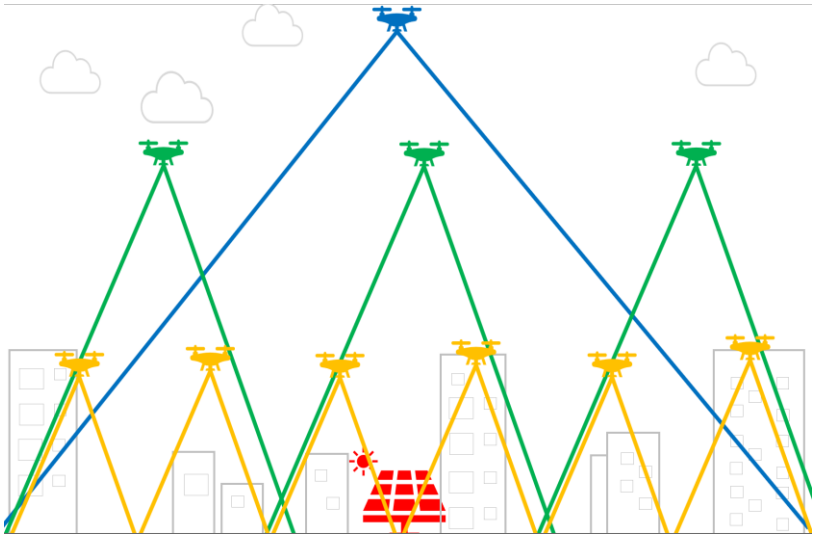
Igor Donevski, AAU
ESR#15

Marco Virgili, Lyra
ESR#8

Nithin Babu, ALBA
ESR#10

BUDGETING STANDALONE DRONE DEPLOYMENTS IN REMOTE AREAS: RELIABILITY TARGETS FOR THE WIRELESS COMMUNICATIONS SERVICES

The study group of proof of concept collaborated with the study group concerned with energy modelling, balancing and optimization to investigate the problem of finding optimal multi-drone deployment. In such a multi drone deployments the coverage of the area scales with the number of drones deployed in addition to which, the energy impact of such a system needs to be accounted. Since in such remote deployments, the drones would have to recharge from some central ground station, we employ power harvesting methods at the center of the coverage area to which the drone base stations go to recharge when their batteries become depleted. Modeling such drone deployments requires limiting the budget for the energy harvesting equipment as it directly impacts the performance of wireless service through the drone airtime. Therefore, we come to the problem of budgeting a multi-drone deployment that need to satisfy some quality of service (QoS) target, but also based on its energy performance and state of the art commercial drone models sustains the flight durations for some underlying weather conditions. We consider several novel solutions for the problem that tackle multi-parameter optimization problems among the lines of: Reinforcement Learning or Genetic Algorithms. As illustrated in the image below, there can be many combinations of deployments concerning the altitude, antenna beamwidth, size of coverage area, commercial drone model etc.



PAINLESS SG5 Updates

Constantinos Papadias,
The American College of Greece (ACG)

Keynote Speaker in EE-IOT Webinar 2020 in Conjunction with FIREMAN CHIST-ERA Consortium

Short Biography: Constantinos B. Papadias is the founding Executive Director of the Research, Technology and Innovation Network (RTIN) of The American College of Greece (ACG), in Athens, Greece, and a Professor of Information Technology at ACG's Deree College and Alba graduate school, since Feb. 1, 2020. He is also the Head of RTIN's Smart Wireless Future Technologies (SWIFT) Lab. He currently holds Adjunct Professorships at Aalborg University and at the University of Cyprus. He received the Diploma of Electrical Engineering from the National Technical University of Athens (NTUA) in 1991 and the Doctorate degree in Signal Processing (highest honors) from the Ecole Nationale Supérieure des Télécommunications (ENST), Paris, France, in 1995. He was a researcher at Institut Eurécom (1992-1995), Stanford University (1995-1997) and Bell Labs (as Member of Technical Staff from 1997-2001 and as Technical Manager from 2001-2006). He was also Adjunct Professor at Columbia University (2004-2005) and Carnegie Mellon University (2006-2011). He has published over 210 papers and 4 books and has received over 9500 citations for his work, with an h-index of 44. He has also made standards contributions and holds 12 patents. He has served as member of the IEEE Communications Society's Fellow Evaluation and Awards Committees, as well as an Associate Editor for various journals. He has acted as Technical Coordinator in several EU projects such as CROWN in the area of cognitive radio; HIATUS in the area of interference alignment; HARP in the area of remote radio heads and ADEL in the area of licensed shared access. He is currently the Research Coordinator of the European Training Network project PAINLESS on the topic of energy autonomous infrastructure less wireless networks and the Technical Coordinator of the EU CHIST-ERA project FIREMAN on the topic of predictive maintenance via machine type wireless communication systems. He is a Fellow of IEEE since 2013 and Fellow of the European Alliance of Innovation (EAI) since 2019. He was recently appointed member of Greece's sectorial scientific council of Engineering Sciences, which supports the country's National Council for Research and Innovation.

The talk is concerned with the topic of energy-efficient technologies for portable access points (PAPs), i.e. access points that are wirelessly connected both in the backhaul and in the access segment. The talk consists of three parts: 1) An overview of hybrid antenna arrays that are based on mutual coupling with active and passive elements, in order to provide advanced beam forming capabilities with low hardware complexity and power dissipation; 2) A presentation of recent results for the modelling of mmWave channels for the backhaul of the PAPs; and 3) Some recent results in the optimization of the trajectories of unmanned aerial vehicles (UAVs) that carry the PAPs in order to provide access in a given area and satisfy the requirements of wireless access in an energy efficiency fashion. Both theoretical and numerical results are presented for the above topics, as well as some over-the-air experiments.

Details are available on:
https://sites.google.com/view/ee-iot/virtual-workshop-2020

Upcoming Events and Journals by the PI Team:

1. [Special Issue] Wireless Powered Communications, led by Professor. Krikidis (UCY), in the IEEE Open Journal of the Communication Society OJComSoc, **Deadline - 30/03/2021**: https://www.comsoc.org/publications/journals/ieee-ojcoms/cfp/wireless-powered-communications-futurewireless-networks
2. [WPSN2021 Workshop] IEEE 3rd International Workshop on Wirelessly Powered Systems and Networks, led by Professor. Krikidis (UCY), **Deadline - 14/05/2021**: https://wpsn2021.github.io/index.html
3. [TeamUp5G Workshop] Ethics and Inclusiveness for Telecommunications Engineers, led by Professor. C. Masouros (UCL), **2-4 March 2021**: https://teamup5g.webs.tsc.uc3m.es/events/teamup5g-workshop-on-ethics-and-inclusiveness-for-telecommunications-engineers/