

Newsletter

Number 3, December 2022

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COST CA20120 ACTION



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EDITOR'S ADDRESS

Dear reader,

it's time to announce the third issue of the INTERACT Newsletter!

Before letting you going through these pages, I would like to thank all the INTERACT community who gave me the opportunity to represent the INTERACT's Young Researchers; Margot for having supported me behind the scene and all people I met during each meeting.

We close this first year giving the floor to Yang Miao and Vittorio degli Esposti, who will tell us their experience as Young and Senior Researchers, respectively.



Francesca Conserva
University of Bologna, Italy

The January meeting in Dubrovnik will close a year that, most probably, all of us were waiting for: we almost got rid of online platforms and we came back to share physically the COST spirit.

Enjoy the reading!

ABOUT COST

This COST Action aims at contributing to the societal transformation, by developing the next generation of radio communication networks, 6G.

The Intelligence-Enabling Radio Communications for Seamless Inclusive Interactions (INTERACT) vision is to go beyond the capabilities of the 5G and to make the radio network itself intelligent, meaning aware, adaptive and parsimonious.

Challenges include:

- 1) Fundamental research in the fields of antennas and propagation, signal processing and localization, network architectures and protocols, to design intelligent-enabling radio communications;
- 2) Exploitation of Machine Learning tools for the implementation of many aspects of this network intelligence;
- 3) Collecting real-world data and making them available to the research community by building the INTERACT datasets.

This COST action started in October 2021 and ends in October 2025.

JOINT WORKSHOP COST INTERACT & 6G JIC HUAWEI-TEAM ON "ENABLING TECHNOLOGIES FOR 6G"



September 19th, 2022 - UPV Campus, Valencia (Spain).

3rd MCM & Technical Meeting - Valencia 2022



Some of the participants at the 3rd MCM & Technical Meeting.



Our Chairman tasting the typical Vegetarian paella of Valencia.

CHAIRMAN'S ADDRESS

"IN MANY WAYS"

I am writing this as the first year of INTERACT draws to a close. It has been a rich year, in many ways. It has been a real pleasure to gradually replace virtual meetings with physical ones, to see you, to discuss, to exchange. I was really (and pleasantly) surprised to see how involved everyone is. There is really an incredible quality in this community.

Then the summer was off the charts in many ways. And the world seems to be going crazy in many ways. There are questions about the responsibility of digital. IT can help us (IT for green) as a famous French astronaut explained very recently. Satellites that permanently scan the whole earth with great precision allow us to understand global warming. But IT consumes so much and devours so much (not so green IT). Satellites or not? 6G or not? Let's hope the questions will not arise but we will probably have to make efforts and integrate more explicitly these dimensions in our thinking.

Finally, this year also marks a stop. Francesca will be stepping down from her role as a representative of young researchers. She has contributed, in many ways, to the successes of this first year, being involved in the dissemination and especially in this Newsletter. A sometimes tedious and surely thankless job, but a great success with the third issue under your eyes. Thanks, Francesca, for your involvement.

And, as she says, enjoy the reading!



INTERVIEW WITH A YOUNG RESEARCHER: YANG MIAO



ASSISTANT PROFESSOR AT UNIVERSITY OF TWENTE, 4TU FEDERATION (NETHERLANDS)

She is a part-time Marie Curie Individual Fellow in KU Leuven, Belgium. Yang studied at Tokyo Institute of Technology in Japan for the master and PhD degrees during which she visited Aalto University and Chalmers University of Technology.

After graduation, she firstly moved to Europe as a Postdoc in Belgium (with Claude Oestges and shortly with Wout Joseph); then to Shenzhen, China, for a start-up (I left quickly and went back to Academia).

She is currently active in the INTERACT COST Action as co-chair of the SWG on ISAC.

What are your favourite areas of interest and research?

I am very interested in electromagnetic waves; how to transmit them, receive them and retrieve information from them. All communication and radar systems are based on engineering electromagnetics.

What was your motivation to become a researcher?

I love research, because I enjoy the process of defining a problem, motivate why we need to solve this, find solution(s), and make discussions on the pros and cons, advantage and limitations. As a researcher, it is fairly easy to connect to another researcher in the other corner of the globe and do interesting things together. I enjoy collaborating on multi-disciplinary and inter-disciplinary projects, where people with complementary expertise gather together and create socially and technologically important impact. I also enjoy enhancing my skills in a focused area and within a focused community like the COST Action INTERACT.

What is the “next big thing” in the wireless communication area?

For me, the “next big thing” is the integration of intelligent sensing and communication. On the one hand, it is crucial for enabling the reliable high-speed communication, on the other hand, communication signals and systems with higher bandwidth, smaller wavelength, multi-antenna array and beamforming can sense accurately the environment and the people/machine present in it. There are many open challenges, though.

My current favourite TVseries is...

“Alice in Borderland”, the earlier Japanese version of the Squid Game; well, they are both about survival in dangerous games. The season 2 of BORDERLAND is coming this December.

I’m most passionate about...

Food and traveling. I love to travel around the world, experience exotic culture and scenery, eat local food and learn to cook it. I have a resolution to travel to 3 new countries each year, so that I can make it to 150 countries by the age of 70.

In few words, I consider myself to be...

Adventurous and open-minded. I was born in China. I left since 2010, then shortly went back for 1 year in 2018. The favourite part of China to me is the diversity in culinary and culture. I hope that people can reserve more the traditional, regional, and beautiful culture even in the industrial process. It will be a pity if, e.g., Peking Opera and Sichuan Opera of Face Changing are gone, and people all listen to pop music.

My favourite quote is...

from Buddha: “What you think, you become. What you feel, you attract. What you imagine, you create.” So, be positive.

INTERVIEW WITH A SENIOR RESEARCHER: VITTORIO DEGLI ESPOSTI



ASSOCIATE PROFESSOR AT UNIVERSITY OF BOLOGNA (ITALY)

Vittorio Degli-Esposti is with the Department of Electrical Engineering of the University of Bologna. He has been Visiting Professor at Aalto University, Finland, and Tongji University, China, in 2006 and 2013, and Director of Research at Polaris Wireless Inc., USA, in 2015-2016.

He is Associate Editor of the Journals IEEE Transactions on Vehicular Technology and Radio Science and Chair of the Propagation Working Group of the European Association on Antennas and Propagation (EurAAP) and co-Chair of WG1 of COST Action 20120 "Interact". He is author or co-author of over 150 peer-reviewed technical papers and co-inventor of 7 international patents in the fields of applied electromagnetics, radio propagation and wireless systems.

What are your favourite areas of interest and research?

Applied electromagnetics, radio and optical propagation, scattering from natural and artificial surfaces and media, wireless systems, artificial intelligence applied to the topics above.

What is the "next big thing" in the wireless communication area?

Ahaha... 10-million-dollar question... I would say what is called distributed intelligence. The possibility of a system to perceive, use or derive a model, to predict. Machine learning will be a useful tool to bring research and innovation to a new level. But the danger is to lose insight and to create disparity between those who can use it and those who can't.

Considering the innovations in the scientific world in the last 20 years, which was the most remarkable one, which one didn't get the attention it deserved, and which one finished with a "dead end"?

Speaking about my area, probably MIMO transmission: the possibility to exploit multiple paths using multiple antennas. As for the dead end, my opinion is that there is no such thing in research. If a given research is well done and creates knowledge, then it is worth it and will become useful sooner or later.

What was your motivation to be part of COST INTERACT?

To be part of the most important research community in Europe in propagation and wireless systems and to get to know better my home, Europe.

My favourite book is...

"The book of disquiet" by Fernando Pessoa

My favourite or personal quote is ...

"If you cannot explain it to a 6-year-old, you don't understand it yourself" (Einstein)

My favourite holiday is ...

With a few friends in a beautiful Mediterranean island

I consider myself to be...

Spartan and a bit nerd

Is there anything else you like to share?

Yet another Sunday afternoon working at my laptop: better go play the piano now...



WG1 - Radio Channels & SWG1.1 - THz

WG1 and sub-WG1 THz had 6 and 1 sessions, respectively. Main lines of research that emerged from the sessions were: studies on diffuse scattering, including measurement and modelling at various frequencies; antenna, propagation and channel modeling for MIMO, massive MIMO and cell-free, distributed MIMO, with specific focus on channel hardening, channel estimation and channel aging; propagation and channel modeling for vehicular applications, including channel sounding and emulation; channel measurements and modeling for indoor and in-cabin environment. Interesting combinations of measurements and ray tracing prediction were proposed for channel simulation.

SWG1.2 - Reflective Intelligent Surfaces

Valencia meeting brought the election of the two co-Chairs of the "Scattering and propagation models for reconfigurable intelligent surfaces" (RIS), that was finally activated. In this regard, we had some contributions dealing with hardware testbed and propagation/system studies for reconfigurable intelligent surfaces.

WG2 - Signal Processing and Localization & SWG2 ISAC

WG2 had three sessions with TDs spanning from localisation and positioning; coding, demodulation schemes and evaluation of their performance; signal detection; to the implementation of communication transceivers. Two chairs were selected for the SWG on ISAC, namely, Yang Miao and Carsten Smeenk.

WG3 - Network Architectures and Protocols

In Valencia, WG3 sessions revolved around several topics, such as the possibility to boost network safety using ML to mitigate the attacks, UAV repeaters to minimize eavesdropping chances for critical and military applications, and introducing and investigating functional safety in industrial wireless communications. Also, there were papers on the design of ground gateways for satellite IoT and the performance of UAV-aided vehicular networks. Resources assignment in multilink and multi-RAT communication and efficient broadcasting techniques were also discussed.

HA1- Datasets

HA1 discussed the status of the datasets collection and the joint submission of datasets to a special issue of communications magazine.

VT1 - Health and Well-Being & SWG(VT1) - EMF

VT1 sessions covered a lot of interesting topics. In particular, there was a joint session with SWG EMF. Themes dealt with: coupling between antenna near-field and a lossy host body with the use of a simple canonical host phantom; numerical analysis aimed at characterising various types of biological tissues from the electromagnetic point of view; analysis of the system loss and depolarisation in Body Area Networks for Body-to-Infrastructure communications based on a measurement campaign in an indoor environment; effect of the underlying error in Bluetooth proximity estimation on the accuracy of the exposure decisions in an automatic contact tracing system; a method for reducing artifacts from the ECG signal recorded by capacitive electrodes (cECG) in moving subjects.

VT2 - Transportation

In Valencia, VT2 hosted discussions related to: the problem of expanding the measurements and results achieved for low velocities to very high speeds; hardware-in-the-middle concept to approximate the real behavior of the V2X channel. Also: ways of extrapolating the measurements and tests done in low-frequency bands to the higher-frequency bands.

VT3 - Industrial Automation

VT3 sessions dealt with the use of reinforcement learning to optimize scheduling for maximizing throughput in MANET scenarios; the problem of enabling intra-machine communication in an Industrial Internet of Things scenario using Terahertz frequencies; further 5G developments to support industrial networks and identifies gaps that need further attention before a roll-out of 5G takes place at the manufacturing sites.

VT4 - Smart Building and Cities

VT4 sessions hosted talks about the development of a time and frequency synchronization module for NB-IoT; the development of a comprehensive 3D simulator for examining the probability of Line of Sight in urban environments that use built-up parameters to create different city environments; proposal of using sniffers for monitoring dense multi-channel multi-hop IEEE 802.15.4 wireless sensor networks.

SELECTED SCIENTIFIC TOPIC:

MACHINE LEARNING ENHANCED ENTROPY-BASED TECHNIQUES FOR NETWORK ANOMALY DETECTION

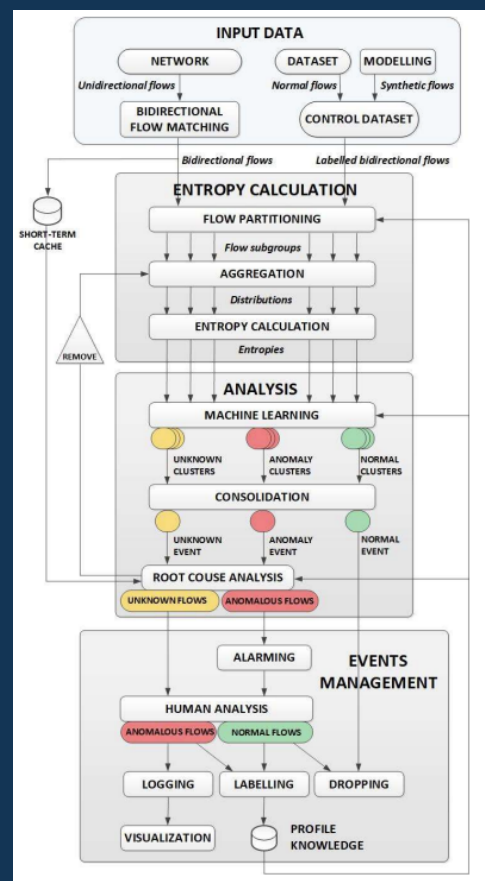
This research focuses on the network behavior analysis and represents a comprehensive flowbased anomaly detection proposal, which is based on the combined machine learning and entropy-based anomaly detection techniques. The entropy-based analysis can capture the behavior of the biggest contributors, and of a large number of minor appearances in the feature distribution, and is applied for easier detection of the rare traffic patterns. Then, the range of the machine learning algorithms can be applied in order to process the detected unusual traffic.

The comprehensive architecture (doi:10.4316/AECE.2021.04006) for network behaviour analysis and traffic anomaly detection based on collected NetFlow data (see the figure) encompass a number of building blocks which provide a real-time anomaly/attack detection. The approach relies on the understanding of the legitimate traffic behavior characteristics, apply the entropy-based preprocessing, obtain an adequate set of features, enhance the analysis by the application of the enhanced, sophisticated machine learning algorithms, and then use them to efficiently detect the anomalous traffic patterns and deviations that could cause performance issues or indicate a breach. This approach allows the detection of the unknown threats, zero-day attacks, and suspicious behavior while providing the performance optimization.

VALENTINA TIMCENKO, SLAVKO GAJIN

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Flow-based anomaly detection architecture.

SELECTED SCIENTIFIC TOPIC:

PROBABILITY OF LINE OF SIGHT EVALUATION IN URBAN ENVIRONMENTS USING 3D SIMULATOR

Unmanned Aerial Vehicles (UAV) communications offer various advantages over terrestrial communications due to mobility and high Probability of Line of Sight (PLOS). Estimating the PLoS from UAV to ground users at a certain distance or inclination angle in different urban environments is essential for designing various applications. The existing PLoS models have limited applicability or cannot be generalized to any environment, as they are derived for a specific subset of possible 3D city geometries. Therefore, we present a three-dimensional (3D) city simulator to estimate PLoS from UAV to ground users for arbitrary UAV height, user height, location, and distance. The simulator results can be generalized using built-up parameters for any city environment.

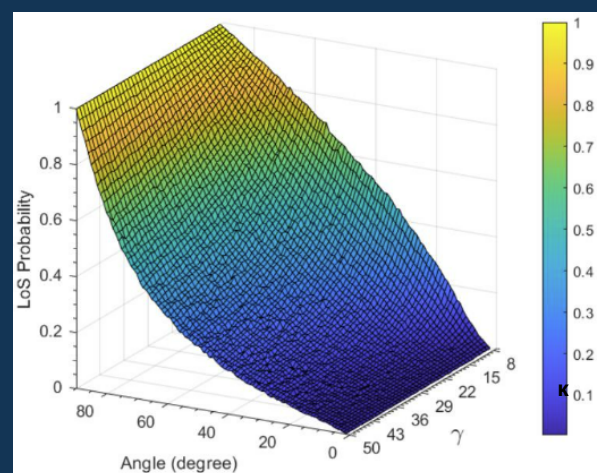
Furthermore, we develop a scalable and lightweight geometry-based simulator using random user locations to validate the 3D simulator results. Lastly, we analyze the impact of different UAV locations on PLoS for street coverage.

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Results show that the PLoS is highly related to the user locations, inclination angle between UAV and users, UAV altitude, and city layout. Therefore, no specific UAV location can provide better coverage, which thus requires a real-time predicting tool. Hence, the 3D city simulator is a promising tool for analysing the coverage by providing accurate PLoS for various practical settings and distinct environments.

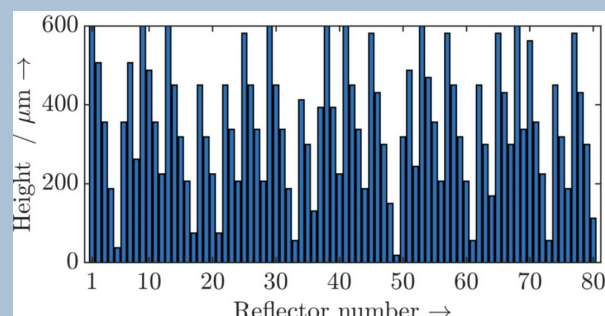


SELECTED SCIENTIFIC TOPIC:

TERAHERTZ BEAM STEERING USING A MEMS-BASED REFLECTARRAY CONFIGURED BY A GENETIC ALGORITHM

In order to compensate free-space attenuation at terahertz frequencies, high antenna gain is necessary. One solution which also allows beamsteering are passive reflectarrays. They do not need complex feeding networks as well as associated electronics and are compatible with any terahertz source. The only disadvantage is that reflectarrays use a free-space concept and can hardly be integrated. In order to compensate free-space attenuation at terahertz frequencies, high antenna gain is necessary. One solution which also allows beamsteering are passive reflectarrays. They do not need complex feeding networks as well as associated electronics and are compatible with any terahertz source. The only disadvantage is that reflectarrays use a free-space concept and can hardly be integrated. An optimised reflectarray with a 5-bit micromechanical actuator system for a carrier frequency of 300 GHz is presented. Each of the 80 reflectors has dimensions 300 micrometers x 5000 micrometers and can be displaced vertically by 600 micrometers. The actuator positions are optimized by a genetic algorithm with different fitness functions in order to maximize the directivity in a certain direction while keeping the sidelobe level to a minimum.

The optimised height function shows partly some sawtooth-like shape but is not periodical as a "blazed grating". The figure shows an example of a corresponding optimised height function. Furthermore, theoretical results are compared with measurements for a fixed reflectarray.



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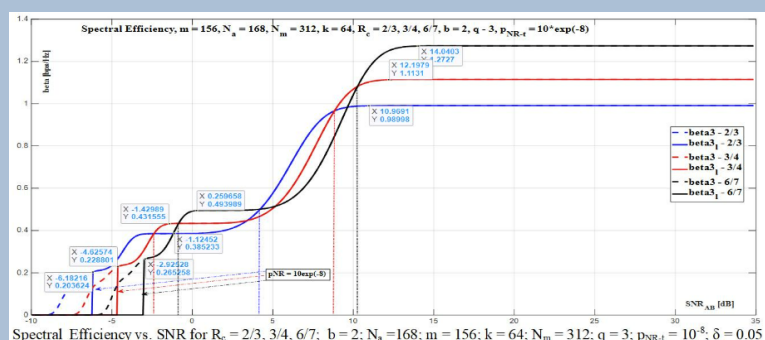
X. LIU , L. SCHMITT , B. SIEVERT, J. LIPKA, C. GENG, K. KOLPATZECK, D. ERNI, A. RENNINGS, J. C. BALZER, M. HOFFMANN, A. CZYLWIK

SELECTED SCIENTIFIC TOPIC:

THEORETICAL PERFORMANCE ANALYSIS OF A HARQ ALGORITHM WITH LIMITED IR THAT USES RATELESS AND FEC CODING

The paper presents a theoretical analysis of the performance provided by a generic Incremental Redundancy (IR) HARQ algorithm which uses rateless and FEC coding to recover a message of m data blocks, each of them containing k bits. The limited IR is obtained by providing additional rateless symbols in q retransmissions at most, so that the total number of symbols sent would not exceed 2^*m . It derives the expressions of the message non-recovery probability p_{NR} , the average number of rounds A_{avg} needed to ensure a target p_{NR-t} , the average spectral efficiency \bar{b} and the average coding rates, in an OFDMA generic structure over a Rayleigh block-faded channel.

The impacts of some parameters, i.e., the number N_a of symbols sent in the initial round, the maximum number of retransmissions, the overhead d and the FEC code's coding rate R_c , upon performance are evaluated by numerical results. These results show that the algorithm could ensure small p_{NR-t} values at very low SNRs with a small average number of attempts, by changing adaptively the algorithm's parameters according to the channel's SNR. The SNR thresholds depend on the R_c and modulation b that are used, and on N_a . The concatenation of rateless and FEC codes could be a viable option for the PHY layer of the URLL communications, since they could provide very small error-rates and small average delays at low and high SNRs, and ensure good spectral efficiency at high SNRs, while requiring moderate implementation complexity.



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INTERACT PODCASTS

In September 2022, we introduced, for the first time, the INTERACT podcasts, which are now live! The idea is to disseminate INTERACT achievements in a more vivid and interactive form on a two-monthly basis. Each episode will be focused on specific research topics, presented in a popular-science style and in the form of a discussion.

In our first episode, our host Prof. Adrian Kliks (Poznan University of Technology, Poland) dives deep into the INTERACT action and its objectives with our chairman Prof. Laurent Clavier (IMT Nord Europe, France).

In our second episode, Prof. Adrian Kliks talks with Dr. Conchi Garcia Pardo, which is an expert in electromagnetic field exposure and measurements and the co-chair of our EMF SWG.

We would like to thank our guests and Adrian Kliks for their time to make this podcast possible.

FOLLOW OUR PODCASTS ON YOUR FAVOURITE PLATFORM!



First Episode with Prof. Laurent Clavier (IMT Nord Europe, France)



Second Episode with Dr. Conchi Garcia Pardo (UPV, Spain)



FACTS & FIGURES

Signatory Countries:

35

COST Cooperating Members:

1

COST Partner Members:

1

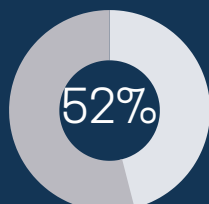
International Partners:

5

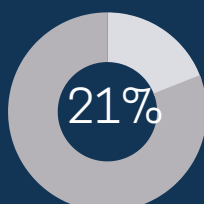
Institutions (University/ Industry/ Research Infrastructures/Enterprises) currently participating:

251

Young Researchers



Women



Presented TDs in Valencia



Meetings per year



INTERACT Action's Members



Participating per meeting

147
91 on site
56 remotely

Training School/Day completed

