

CALL 19-2024-1 RESEARCHER ON AI PROTOCOL LEARNING

Who are we looking for?

The Research Unit on Information and Signal Processing for Intelligent Communications (ISPIC) of the CTTC is searching for a skilled and highly motivated researcher to join a focused research project on AI and machine learning (ML) for communications.

The ambition of the ELEPHY project is to boost the development of a nascent research field at the intersection of AI and machine learning-aided communications engineering. While the traditional approach to communication systems design has been based on human-engineered schemes to reliably convey bit messages from one location to another over noisy or rate-limited links, some recent research directions have expanded this scope to a multi-party remote interaction game where the rules, semantics, costs and rewards are not fixed a priori, but negotiated and emerged on the fly.

The ELEPHY project will build upon recently proposed deep-learning (DL) and reinforcement learning (RL) concepts for end-to-end (E2E) learning of physical-layer (PHY) communication systems. The ambition of ELEPHY is to expand the scope of E2E learning to encompass the emergence of some basic medium access control (MAC) or higher-layer functionalities (e.g., retransmissions, addressing and identification, authentication, scheduling, routing, link establishment, CSI reporting, feedback schemes) by leveraging cooperative multi-agent learning.

ELEPHY aims to contribute towards a longterm vision which consists of a multi-party communication system in a dynamic environment (e.g., in the context of IoT, self-driving vehicles, sensor networks, or similar) in which the participating devices cooperatively learn an efficient machine language which emulates (and surpasses) the multiple functions of the L1/L2/L3 layer stack that have been traditionally designed by hand.

We expect the successful candidate to have solid knowledge of communication systems and AI/ML techniques, and be capable to pick up quickly on new tools, AI architectures and cutting-edge techniques.

The activity will mostly involve empirical research via simulations as well as theoretical study. The ISPIC lab has powerful computational resources, including multiple GPU-equipped workstations for simulations. Additional hardware experiments at the ISPIC labs (e.g., the development of an over-the-air proof-of-concept that demonstrates protocol emergence with multiple USRPs) may be considered too, depending on the profile of the candidate.

What do we offer?

- A full-time fixed-term contract is offered (2 years). Incorporation is expected as soon as possible. The salary will be determined according to the qualifications and work experience of the candidate.
- Annual gross salary will be according to the profile of the candidate
- Full-time contract: 7,5 h/day. Flexibility.
- **Expected professional category: R2.** Exceptional candidates may be considered even if they do not meet all the requirements. In this case the professional category will be based on the qualifications and experience of the applicant according

with CTTC professional categories procedure (<https://www.cttc.cat/wp-content/uploads/2022/02/CTTC-Professional-categories.pdf>).

- Prospective start date: December 2024.
- Continuous training, access to lab facilities, state of the art infrastructure and polyvalent working spaces, participation in conferences and scientific events, complementary skills development.
- **We have great benefits for employees:**
 - Paid time off: vacation (33 working days per year), holidays, sick and parental leave and more
 - Up to 3 days of Telework per week (2 fixed + 1 upon request). Other requests may be studied to accommodate special needs.
 - Flexible working hours for work-life balance
 - Tax-free optional benefits: restaurant ticket, nursery ticket, transport pass, private health insurance for employees and family.
 - Career path promotion (either professional category and/or annual gross salary)
 - Annual productivity upon performance
 - Possibility to complement the salary with personal grants

Qualifications and Experience

- We are looking for a highly skilled and motivated person who has a solid track record of high-quality publications and has demonstrated excellence in research. In addition to academic qualities, we expect the candidate to be willing to dive deep into recent literature to become productive in a rapidly evolving field, to be curious and investigative.
- **Required qualification/skills/experience:**
- Applicants should have a doctoral (PhD) degree. The degree must be in Telecommunications, Electrical Engineering, Computer Science or a closely related field.
- Solid knowledge of some elementary modern AI/ML tools such as deep learning or reinforcement learning
- Solid understanding of the fundamentals of PHY layer communications engineering
- Programming skills (e.g., Python, C++, Matlab)
- Solid publication record
- Ability to work autonomously and be an excellent team player
- **Other skills that are valuable, but not mandatory are:**
- Expert knowledge of PHY techniques (e.g., multiple-access techniques, beamforming, modulations, waveforms, error correction codes)
- Expert knowledge of MAC techniques (e.g., error detection and retransmission, medium reservation, flow control, quality of service, addressing and identification)
- Familiarity with PHY and/or MAC layer functions of some specific wireless standards such as, e.g., 3GPP 5G NR, IEEE 802.11 WiFi, NB-IoT, LoRaWAN, etc.
- Expert knowledge in certain AI/ML algorithms and architectures relevant for protocol learning (e.g., multi-agent reinforcement learning, RNNs, Explainable AI, cooperative game theory, etc.)
- Familiarity with machine learning frameworks such as TensorFlow or PyTorch
- Hands-on experience with hardware, proof-of-concept development
- Proficiency in code versioning (git)
- English skills

Even if you do not meet all the requirements, we encourage you to apply. The candidates' past performance but also future potential will be considered as criteria for selection.

How to apply?

All applications must include:

1. A complete CV, including a list and description of publications
2. Diplomas of academic degrees and academic records
3. Cover letter stating the motivation and suitability of the candidate
4. Links to any other scientific or technical contributions of the candidate (e.g., public code repositories) if applicable
5. The contact details of two potential referees (optional)

The application documents must be submitted in pdf format through this online application.

ONLY APPLICATIONS VIA WEB <https://www.cttc.cat/talent/careers/job-openings/> WILL BE TAKEN INTO CONSIDERATION.

CVs and any other information gathered during this process will be handled confidentially

Who are we?

- The Center Tecnològic de Telecomunicacions de Catalunya (CTTC) is a non-profit **public sector** research institution dedicated to fundamental and applied research activities, focused mainly on technologies related to the physical, data link and network layers of communication systems and Geomatics.
- CTTC received the “HR Excellence in Research” award in 2015 from the European Commission and successfully passed into the Award Renewal phase in 2023. This is a recognition of the Institute’s commitment to develop a Human Resources Strategy for Researchers ([HRS4R](#)), designed to bring the practices and procedures in line with the principles of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers ([Charter and Code](#)). Our institution's comprehensive analysis and HRS4R action plan meet all the requirements of progress and quality of our HR policies. CTTC promotes itself as a provider of a stimulating and favourable work environment for researchers.
- The CTTC is located in the beautiful Mediterranean Technological Park of Castelldefels, a science park that houses the Polytechnic University of Catalonia, research institutions, innovative companies and startups. The PMT-UPC is located 10 minutes' walk from the beach and the city center of Castelldefels, also close to childcare centers, public schools and the best international schools. It can be reached by car, train (RENFE) and various bus lines.
- We have 2 buildings on campus, with state-of-the-art facilities, comfortable work spaces, meeting rooms, and multipurpose spaces, as well as social spaces.

- The institute has a **multicultural environment** with more than 130 members (scientific, technical and administrative staff) from all over the world.

CTTC offers and promotes a diverse and inclusive environment and welcomes applicants regardless of age, disability, gender, national origin, race, religion, or sexual orientation.

The CTTC seeks to increase the presence of women in those areas where they are underrepresented and therefore explicitly encourages them to stand as candidates.

It is also committed to increasing the number of people with disabilities in its workforce and therefore encourages their applications.