



I-2316 – THE HUMAN DIGITAL TWIN IN THE CYBER PHYSICAL ENTERPRISE

Temporary contract | 14+22+12 months | Full-time/40h | Belval



Are you passionate about research? So are we! Come and join us

The Luxembourg Institute of Science and Technology (LIST) (<https://www.list.lu>) is a Research and Technology Organization (RTO) active in the fields of materials, environment and IT. By transforming scientific knowledge into technologies, smart data and tools, LIST empowers citizens in their choices, public authorities in their decisions and businesses in their strategies.

You 'd like to contribute as PhD student? Join our IT for Innovation Services department

The IT for Innovative Services (ITIS) department, with its 100 researchers and engineers, focuses on the digital transformation of operations in organizations with traditional environments and digital ecosystems, with the aim of improving their performance and innovation capacity. The common thread throughout ITIS is to develop the most efficient use of big data to ensure the most appropriate decision-making processes. The department relies on the Data Analytics Platform: a hybrid infrastructure covering the entire range of data analytics activities. The platform is based on three pillars: a high-performance computing (HPC) infrastructure, a cognitive analytics pillar and an interactive visualization wall (Viswall).

This PhD project is part of a bilateral research project between ITIS, the Research Center for Automatic Control (CRAN <http://www.cran.univ-lorraine.fr> --University of Lorraine, CNRS) and the ORISUN enterprise, in France, dealing with applications of artificial intelligence for cognitive interoperability in cyber-physical enterprises: AI4C2PS. The candidate will be registered at the University of Lorraine (doctoral school *IAEM Lorraine*) as a PhD student and will be integrated in the HUMOD research group of ITIS and the ISET research department of CRAN. The main workplace will be in LIST offices in Esch/Alzette, Luxembourg, while some time will be spent in Nancy, France, in CRAN offices.

How will you contribute?

The introduction of Cyber-Physical Systems (CPS), together with advances in Information and Communication Technologies (ICT), has been the major driving force for the 4th industrial revolution. The 5th revolution calls now for a better integration of human and social / societal factors, transforming progressively CPS into Cyber-Physical-Social Systems (CPSS). A Cyber-Physical Enterprise (CPE) consists of autonomous and cooperative technical elements, humans and sub-organisations that are connected based on the context within and across all levels of the global organisation, from processes, through machines and up to enterprises and supply-chains networks. Today ontology-based solutions ensure that technological components (CPS) of a CPE share a common vocabulary and can reason on exchanged knowledge. However, this is not enough to build CPSS components, ensuring CPS and human agents understand each other enough to collaborate efficiently. The next generation of CPE must reach a satisfactory level of flexibility and efficiency that better integrates humans and give human-machine teams complete autonomy for some tasks including ad-hoc reconfigurations and non-predefined problem-solving.

In this context, you will address the research challenge of building a Human Digital Twin (HDT) based on ontological, neural and stochastic models, that is realistic enough to serve as a computational model for CPS adaptation to humans. The PhD objective is to build a theoretical framework for the HDT in industry and implement it as an intelligent software agent that can support human workers to collaborate with CPSS of an enterprise. Synchronous and asynchronous contexts will be both considered, where in the first the digital twin takes part of simulations for prediction objectives and in the latter the digital twin reflects the human state and behaviour. The work will focus on:

- 1- The cognitive aspects of human modelling and human-CPSS collaboration, exploring the theory of cognitive architectures.
- 2- Exploring HDT models combining Knowledge Reasoning and Representation with Artificial Neural Network -based Machine Learning, able to explain their state and behaviours (i.e., implementing explainable artificial intelligence).

Activities

- Participation to the AI4C2PS project as a full member, integrating the models, algorithms, and prototypes in collaboration with the project's team of researchers, participating to project's meeting and contributing to deliverables
- Presentation of papers at academic conferences
- Writing of research papers and publication of peer-reviewed journal articles

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- Write a PhD thesis in the field of computer engineering
- Participation to outreach activities of LIST and CRAN



Is Your profile described below? Are you our future colleague? Apply now!

You hold a Master's degree or diploma in computer science, cognitive science, engineering science (control), or data science.

This combined with a good knowledge and experience of user modelling or the modelling of human factors in industry 4.0, as well as good knowledge and experience of Artificial Intelligence methods including Machine Learning and Knowledge Representation and Reasoning.

You have a clear understanding of Cyber-Physical Systems and Digital Twin in industry; you have experienced the implementation of human agents in Multi-Agent Systems or human-in-the-loop control systems.

Finally, you are interested by cognitive systems and cognitive architectures, which you have maybe explored.

Good programming skills will be welcome.

Good level written and spoken English and good level written and spoken French (not mandatory, but strongly recommended)

Your LIST benefits

An organization with a passion for impact and strong RDI partnerships in Luxembourg and Europe that works on responsible and independent research projects;

Sustainable by design, empowering our belief that we play an essential role in paving the way to a green society;

Innovative infrastructures and exceptional labs occupying more than 5,000 square metres, including innovations such as our Viswall, high-scale incubators and top of the range 3D/4D printings that are part of our toolkit for excelling in all we do;

Multicultural and international work environment with more than 45 nationalities represented in our workforce;

Diverse and inclusive work environment empowering our people to fulfil their personal and professional ambitions;

Gender-friendly environment with multiple actions to attract, develop and retain women in science;

32 days' paid annual leave, 11 public holidays, flexible working hours, 13-month salary, statutory health insurance and access to lunch vouchers;

Personalized learning programme to foster our staff's soft and technical skills;

An environment encouraging curiosity, innovation and entrepreneurship in all areas.

Apply online

<https://www.list.lu/en/jobs/>

Your application must include:

- A motivation letter oriented towards the position and detailing your experience;
- Sketch of PhD project
- A scientific CV with contact details;
- List of publications (and patents, if applicable);
- Contact details of 2 references (optional).

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Application procedure and conditions:

- LIST is an equal opportunity employer and is committed to hiring and retaining diverse personnel. We value all applicants and will consider all competent candidates for employment without regard to national origin, race, colour, gender, sexual orientation, gender identity, marital status, religion, age or disability;
- Applications will be reviewed on an ongoing basis until the position is filled;
- An assessment committee will review the applications and select candidates based on guidelines that aim to ensure equal opportunities;
- The main criteria for selection will be the correspondence of the existing skills and expertise of the applicant with the requirements mentioned above.



PhD additional conditions:

- Supervisor at LIST: Dr. Yannick Naudet (yannick.naudet@list.lu)
- Supervisor at University of Lorraine: Pr. Hervé Panetto (herve.panetto@univ-lorraine.fr; <http://www.panetto.fr>)
- Work location: Luxembourg Institute of Science and Technology (LIST), Belval, Luxembourg, with some months to spend at CRAN, Nancy, France
- PhD enrolment: University of Lorraine, Doctoral School IAEM Lorraine, France

Candidates shall be available for starting their position in March 2023. Please note the universities costs are at the charge of the student.

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