Approximate Signal Analysis in Smart Sensors

Basic information:
Applications are invited for 15 full-time PhD student positions (called Early Stage Researchers or ESR) for PhD degrees for 36 months. The positions are offered within the Approximate Computing for Power and Energy Optimisation (APROPOS) International Training Network action of the highly appreciated EU-funded Marie Skłodowska Curie grants. The positions are fully funded for a 36-month period. You can choose your position in one of 14 top-level universities and companies in Europe and complement your experience within periods from 3 to 9 months of cross-sector secondments by working with the highly committed industrial partners of the action. You are encouraged to apply for up to three positions within APROPOS network if you believe your profile is suitable for multiple topics. A separate application is needed for each position in case you apply for multiple positions.

APROPOS is an international, multidisciplinary and multi-sectorial training network programme on approximate computing. APROPOS is funded by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska Curie grant agreement No. 956090.

The ESR-specific project is described below. Please read the description carefully before applying. We recommend you choose the position you apply for based on your technical profile and desired technical expertise, rather than based on the hosting location, as all positions involve high-level research mobility.

Project information:
APROPOS will train 15 Early Stage Researchers to tackle the challenges of future embedded and high-performance computing by using disruptive methodologies. Following the current trend, by 2040 computers will need more electricity than the world energy resources can generate. On the communications side, energy consumption in mobile broadband networks is comparable to datacentres. To make things worse, Internet-of-Things will soon connect 20 to 50 billion devices through wireless networks to the cloud.
APROPOS aims at decreasing energy consumption in both distributed computing and communications for cloud-based cyber-physical systems. We propose adaptive Approximate Computing to optimize energy-accuracy trade-offs. Luckily, in many parts of the global data acquisition, transfer, computation, and storage systems there exists the possibility to trade off accuracy to either less power or less time consumed – or both. As examples, numerous sensors are measuring noisy or inexact inputs; the algorithms processing the acquired signals can be stochastic; the applications using the data may be satisfied with an "acceptable" accuracy instead of exact and absolutely correct results; the system may be resilient against occasional errors; and a coarse classification or finding the most probable matches may be enough for a data mining system. By introducing a new dimension, accuracy, to the design optimization, the energy efficiency can even be improved by a factor of 10x-50x.
APROPOS will train the spearheads of the future generation to cope with the technologies, methodologies, and tools for successfully applying Approximate Computing to power and energy saving. The training, in this first ever ITN addressing approximate computing, is to a large extent done by researching energy-accuracy trade-offs on circuit, architecture,

software, and system-level solutions, bringing together world leading experts from European organizations. In addition, we will provide network-wide and local trainings on the substance and on the complementary skills needed in both industrial and academic work life.

ESR Host Unit: TU Wien (TUW), Vienna, Austria

ESR 13 Objectives:
- Hardwar/software co-design of an Approximate Signal Analysis in Smart Sensors (ASAS) unit for preventive maintenance, where level of approximation and abstraction can be set using approximation knobs and operation conditions
- Study and select suitable machine learning algorithm and accelerators for ASAS.
- Design validation using simulations and FPGA-based implementation
- Study and understand trade-offs in the operation of an ASAS node
- Design methodology for ASAS nodes

ESR Expected Results:
A design methodology for ASAS nodes and ASAS based systems. A proof-of-concept prototype of an approximate smart sensor. Insight about trade-offs in this design and operation space.

Planned secondment(s): TTTech, supervisor Dr. Wilfred Steiner, M21 4 months for integration with TTTech's platform. M35, 5 months for evaluation of the results and industrial training.

Supervisory team:
- Prof. Axel Jantsch (TUW), main supervisor
- Dr. Nima TaheriNejad (TUW), academic co- supervisor
- Prof. Pasi Liljeberg (UTU), academic co- supervisor
- Dr. Wilfred Steiner (TTT), industrial co- supervisor
- Dr. Mohammed Abuteir (TTT), industrial co- supervisor

Enrolment in Doctoral degree: TU Wien, Vienna, Austria

Target degree: PhD in Doctoral Program of Electrical Engineering and Information Technology

Degree details:
- https://etit.tuwien.ac.at/teaching/information_for_foreign_students/EN/
- https://etit.tuwien.ac.at/teaching/doktorat/EN/

Expected start date: April 2021 (M6 from the beginning of the project)

Approximate gross salary: about 41'000EUR/year for researchers without family (and about 47'000 EUR/year for researchers with family); Note: for different positions within the same APROPOS network, the salary is country- and unit-dependent.

Duration: 36 months

Researcher Profile: First Stage Researcher (R1)

Research Field: Engineering; Computer science; Technology

Type of contract: Temporary

Job Status: Full-time

Hours per week: 40

Trial period: 12 months

Working and living conditions in the country: Austria is a beautiful alpine country in central Europe. It has a great infrastructure allowing for easy travel around Europe, especially to neighboring countries: Italy, Germany, Switzerland, Lichtenstein, Czech Republic, Hungary, Slovakia and Slovenia. **Vienna** is the capital of Austria and Music. It boasts of a long history, beautiful monuments, and ranking first in the most livable cities of the world. Vienna is lively city with entertaining, high-quality social and cultural events all year long.

Unit details: TU Wien (formerly known as Technical University of Vienna as well) is the largest technical university in Austria and brags more than 200 years of history. Currently 27'415 students pursue a degree at TU Wien and 5'072 staff members of TU Wien support them in their endeavor.

Read more about TU Wien:
- https://tuwien.at/en/

Seconding Unit description: TTTech is the leading supplier of dependable networking solutions and safety platforms based on time-triggered technology and modular safety components. Its solutions and products improve the safety and reliability of networked computer systems and are used in various industries such as industrial automation, automotive, aerospace, off-highway, energy production, and railway. TTTech was founded as a spin-off from the Technical University of Vienna in Austria in 1998 after 20 years of R&D in the field of time-triggered technology. TTTech currently employs approximately 1500 people. TTTech offers a broad range of equipment for dependable real-time networks and systems, both in hardware and software.
Read more about TTTech at: https://www.tttech.com/

Eligibility criteria: please check carefully that you are eligible; all conditions below are compulsory

Transnational mobility: The researcher must not have resided or carried out their main activity (work, studies, etc.) in the country of the host organization for more than 12 months in the 3 years immediately prior to the start date. Note: the mobility rule applies to the (main) beneficiary where the researcher is recruited, and not to partners to which the researcher is sent or seconded. It is also only determined at one point in time: at the time when the ESR starts working for APROPOS.

Early-Stage Researchers (ESRs)/fresh MSc graduates: All researchers recruited in APROPOS must have less than 4 years since the completion of their first MSc degree and have not been awarded any doctoral degree at the date of the employment.

Background requirements: The applicant must be in possession of Master of Science (MSc) diploma in a relevant field, such as: electrical engineering, communications engineering, computer engineering, software engineering/computer science, signal processing, radio communications, mathematics, physics, aerospace engineering, mechanical engineering, biomedical engineering, etc.

English language requirements: The candidate must be in possession of an English certificate with good level according to the regulations of the university to which the student will be enrolled for the PhD degree – check the degree requirements of the corresponding doctoral program for details.