

## Reconfigurable Approximating Accelerators for Secure Edge Computing

### 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:** Tampere University (TAU), Finland

**ESR 10 Objectives:**

- Apply approximate computing to edge computing for dynamic IoT networks
- Combine dynamically adjustable approximation and vectorization for trade-offs in parallelism, energy, latency and accuracy
- Analyse security, data privacy and trust aspects of the proposed architecture
- Develop reconfigurable approximating accelerators for heterogeneous edge devices
- Support the benchmarking activities

**ESR Expected Results:**

Proof-of-concept implementation of adaptive reconfigurable edge computing node exploiting approximate computing methods, completion of the PhD/D.Sc.(Tech) at the hosting unit withing 36 months.

**Planned secondment(s):** ISW, supervisor Dr. Slawomir Pietrzyk, M18, 6 months industrial training and matching the research results with ISW's platform.

**Supervisory team:**

- Prof. Jari Nurmi (TAU), main supervisor
- TBA
- Dr. Aleksandr Ometov (TAU), academic co- supervisor
- Dr. Slawomir Pietrzyk (ISW), industrial co- supervisor

**Enrolment in Doctoral degree:** Tampere University, Finland

**Target degree:** PhD/D.Sc.(Tech.) in Doctoral Programme of Computing and Electrical Engineering (DPCEE)

**Degree details:** <https://www.tuni.fi/en/study-with-us/doctoral-programme-computing-and-electrical-engineering#switcher-trigger--overview>

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

**Approximate gross salary:** about 3600 EUR/month for researchers without family (and about 4000 EUR/month 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:** 6 months

**Working and living conditions in the country:** Finland is among the most stable, free, and safest countries in the world, based on prominent ratings by various agencies. It is also ranked as one of the top countries as far as social progress is concerned. Tampere is counted among the major academic hubs in the Nordic countries and offers a dynamic living environment. Tampere region is one of the most rapidly growing urban areas in Finland and home to a vibrant knowledge-intensive entrepreneurial community. The city is an industrial powerhouse that enjoys a rich cultural scene and a reputation as a center of Finland's information society.

Read more about Finland and Tampere:

- <https://www.visitfinland.com/about-finland/>
- <https://finland.fi/>
- <https://visittampere.fi/en/>
- <https://expat-finland.com/>

**Unit details:** Tampere University is the second largest university in Finland, established in the beginning of 2019 through the merger of Tampere University of Technology and the University of Tampere. This combination built a unique environment for multidisciplinary, inspirational and high-impact research and education and a hub of expertise in technology, health and society.

Tampere University is the majority shareholder of Tampere University of Applied Sciences and together the two institutions form a higher education community of 30,000 students, 330 professors and 4,400 other staff.

Read more about Tampere University:

- <https://tuni.fi/>
- <https://www.timeshighereducation.com/world-university-rankings/tampere-university/>

**Seconding Unit description:** ISW develops algorithms, protocols and tools for 4G and 5G networks. We offer selected functions of Software-Defined RAN (SD-RAN), enabling mobile networks to support more users with better performance at lower cost.

Read more about IS Wireless at: <https://www.is-wireless.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.