Design of Reconfigurable and Approximate Functional Units for Wearable Applications

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 project is listed 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: University of Turku (UTU), Finland

ESR 12 Objectives:
- Profile state of the art wearable applications for error sensitivity, input data dependency and performance and energy gains with approximation.
- Design and implementation of approximate functional units based on profiling results that can accelerate bottleneck computation blocks for performance and energy gains.
- Design and implementation of system software to dynamically switch between accurate and approximate execution, considering application characteristics and system requirements of energy and performance.
- Demonstrate the efficacy of proposed setup over benchmark applications.

ESR Expected Results:
Characterization of wearable applications' performance-energy-accuracy trade-off space, approximate functional units, run-time methods for disciplined approximation, completion of the PhD/D.Sc.(Tech) at the hosting unit within 36 months.

Planned secondment(s): MIN, supervisor Dr. Lauri Koskinen, M18, 6 months industrial training for design, implementation and synthesis.

Supervisory team:
- Prof. Pasi Liljeberg (UTU), main supervisor
- Prof. Amir Rahmani (UTU/UCI), academic co- supervisor
- Dr. Anil Kanduri (UTU), academic co- supervisor
- Dr. Lauri Koskinen (MIN), industrial co- supervisor

Enrolment in Doctoral degree: University of Turku, Finland

Target degree: PhD/D.Sc.(Tech.) in Doctoral Programme of Mathematics and Computer Sciences (MATTI)

Degree details: https://www.utu.fi/en/research/utugs/doctoral-programme-in-mathematics-and-computer-sciences

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

Salary:
Approximate gross salary: about 3,600 EUR/month for researchers without family and about 4,000 EUR/month for researchers with family; this amount includes a separate living allowance, mobility allowance and family allowance according to MSCA rules.
Note: The monthly gross salary may vary somewhat in different years, as side costs change. For different positions within the same APROPOS network, the salary is country- and unit-dependent.

The University of Turku offers comprehensive services to its employees, including occupational health care, sports facilities, and opportunities for professional development.

Duration: 36 months

Researcher Profile: Doctoral candidate / First Stage Researcher (R1)

Research Field: Engineering; Computer science; Technology

Type of contract: Fixed-term

Job Status: Full-time

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. Turku region with its 320,000 people, former capital and a major urban area in Finland, is located in the southwestern Finland. A leading hub for technological development and economical growth, Turku has a rich cultural history and is the gateway to a most beautiful archipelago.

Read more about Finland and Turku:
- https://www.visitfinland.com/about-finland/
- https://finland.fi/
- https://kissmyturku.com/
- https://expat-finland.com/
- https://www.infofinland.fi/en/living-in-finland/work-and-enterprise/finnish-working-culture

Unit details: The University of Turku is a world-class multidisciplinary research university which offers interesting challenges and a unique vantage point to national and international research and education. The University of Turku is ranked in the top 1 % of universities in the world. It is an active academic community of more than 25,000 students and staff members from over 100 different countries.

Read more about University of Turku:

- https://www.utu.fi/en
- https://www.utu.fi/en/100/century-of-top-research-and-education
- See how it is to work at the University of Turku
  https://www.youtube.com/watch?v=CkZ7cMoJbSE&list=PLSmJtlSQuvVJLoW484Z7Cj
  YhiKqDPK4rm&index=3&t=0s

We welcome you cordially to our working community. In case you are arriving to Finland for the first time, we are offering you a good orientation support. Please read further information at the website https://www.utu.fi/en/university/come-work-with-us.

Seconding Unit description: Minima Processor Ltd develops energy saving subsystem for SoCs. It includes processor hardware macro, power management, and software. Minima's technology offers you ultra-low energy levels, a wide range of operating voltages, and flexible clocking.

Read more about Minima at: https://minimaprocessor.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: computer engineering, software engineering/computer science, electrical engineering, communications engineering, signal processing, biomedical engineering, etc.

English language requirements: Applicants must have good English language skills and a certificate that proves those skills. Please read more about the language requirements: https://www.utu.fi/en/research/utugs/how-to-apply/language

Additional information: Programming skills in general languages such as C/C++, Python is required. Knowledge of digital design and hardware description language such as VHDL/Verilog is advantageous. Prior knowledge on wearable computing, application of machine learning methods is highly advantageous. Strong motivation for research, good writing skills, ability to work independently as well as in collaboration are desirable. The

person selected for the position must separately apply for the Doctoral degree study right at the Faculty of Technology, University of Turku.

Attachments: Applicants should enclose with their application a short cover letter, CV, degree certificate(s), possible list of publications, a copy of English language tests (if already completed) and other documents that may influence the filling of position.

For further information, please contact: Professor Pasi Liljeberg, pasi.liljeberg@utu.fi