

Industrial and Scientific Applications for Benchmarking Approximate Computing Strategies

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 for 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: KTH – Royal Institute of Technology, Stockholm, Sweden

ESR 5 Objectives:

1. Develop benchmarks for approximate computing. from computational neuroscience, genomics, augmented reality, control theory and molecular dynamics
2. Develop metrics to quantify the efficiency and efficacy of approximate computing strategies depending on the nature of the application domain
3. Develop efficient mapping strategy to the enhanced SiLago framework.

ESR Expected Results:

Benchmarks for approximate computing

Metrics to quantify the efficacy and efficiency of approximate computing strategies

Enhanced the SiLago framework for approximate computing.

Benchmarks mapped to the enhanced SiLago framework.

Planned secondment(s): Dr. Manfred Grabherr, Methority AB. M6. Dr. Fredrik Dahlgren, Ericsson AB. M18.

Supervisory team:

- Prof. Ahmed Hemani (KTH), main supervisor
- Docent Masoumeh Ebrahimi, co-supervisor
- Dr. Manfred Grabherr, Methority AB, industrial co-supervisor
- Dr. Fredrik Dahlgren, Ericsson AB, industrial co- supervisor

Enrolment in Doctoral degree: KTH (Royal Institute of Technology), Stockholm, Sweden

Target degree: PhD Doctoral Degree in Doctoral Program for Information and Communications Technology (INFKTEKN)

Degree details: <https://www.kth.se/en/studies/phd/student/examination-and-degree-1.527043>

Expected start date: September 2021

Approximate gross salary: about 29000 SEK/month for researchers without family; Note: for different positions within the same APROPOS network, the salary is country- and unit-dependent.

Check <https://intra.kth.se/en/anstallning/anstallningsvillkor/lon/doktorandstegen-1.572915> for more details on the salary.

Duration: 36 months. The PhD program at KTH is equivalent of 4 years of full-time studies. The APROPOS project will fund the first three years. The extra year will be financed by other follow up projects aligned with the same research goals.

Researcher Profile: First Stage Researcher (R1)

Research Field: Algorithms, Compilers, Computer Architecture

Type of contract: Temporary position longer than 6 months

Job Status: Full-time

Hours per week: 40

Working and living conditions in the country: **Sweden** 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. **Stockholm** is the largest and the most cosmopolitan city in Scandinavia with a high quality of life. Stockholm is home to many prestigious higher education institutes and has abundance of international schools in English, German and French. Stockholm also offers rich possibilities for a variety of outdoor sports from boating, skiing, trekking and many regular sports arenas.

Unit details: KTH Royal Institute of Technology in Stockholm has grown to become one of Europe's leading technical and engineering universities, as well as a key centre of intellectual talent and innovation. We are Sweden's largest technical research and learning institution and home to students, researchers and faculty from around the world. Our research and education covers a wide area including natural sciences and all branches of engineering, as well as architecture, industrial management, urban planning, history and philosophy.

- The possibility to study in a dynamic and international research environment in collaboration with industries and prominent universities from all over the world. <https://www.kth.se/en/studies/phd/why-1.521017>
- A compulsory individual study plan to support your development in your area of interest.
- A workplace with many employee benefits and monthly salary according to <https://intra.kth.se/en/anstallning/anstallningsvillkor/ion/doktorandstegen-1.572915>
- A postgraduate education at an institution that is active and supportive in matters pertaining to working conditions, gender equality and diversity as well as study environment.
- Help to <https://www.kth.se/en/om/work-at-kth/relocation>

Read more about KTH and School of EECS and the division of EES where the project is located:

- <https://kth.se/>
- <https://www.kth.se/en/eecs/skolan-for-elektroteknik-och-datavetenskap-1.760855>
- <https://www.kth.se/ees>

Seconding Units description: Methority AB is a start-up that develops AI solutions for industry and will supervise the ESR in developing the genomics benchmark. Ericsson AB is a world leader wireless telecom infrastructure. Ericsson Research in Lund will guide supervise the ESR in developing an augmented reality benchmark.

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 science, electrical engineering etc. The applicant is expected to have a strong background in maths and algorithms, optimization methods, numerical methods. The applicant is also expected to have a good understanding of compilers, computer architecture and digital design.

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.

Additional information: The contact person at KTH for human resources is Ms. Tysse Norlindh Falk. She can be contacted at rekrytering@eecs.kth.se. Prof. Ahmed Hemani, who will be the main supervisor, can be contacted at hemani@kth.se