

Transprecision Algorithms, Software Tools and FPGA Prototypes for Graph Analytics

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: Universitat Politecnica de Valencia (UPV), Spain

ESR 9 Objectives:

- Develop an experimental framework to investigate the effect of transprecision computing.
- Develop transprecision techniques and algorithms for data analytics.
- Validate the benefits of new algorithms via FPGA design prototypes
- Support benchmarking activities to evaluate the efficiency and efficacies of various approximate computing strategies at algorithmic and architectural levels.

ESR Expected Results:

Advance of the state-of-the-art in transprecision tools and hardware for numerical scientific applications arising in large-scale data applications, completion of the PhD at the hosting unit withing 36 months.

Planned secondment(s): IBM Zurich, supervisor Dr. A. Cristiano I. Malossi, M18, 6 months industrial training and matching the research results with IBM's platforms.

Supervisory team:

- Prof. Enrique S. Quintana-Orti (UPV), main supervisor
- Dr. Jose Flich-Cardo (UPV), academic co- supervisor
- Dr. A. Cristiano I. Malossi (IBM), industrial co- supervisor

Enrolment in Doctoral degree: Universitat Politecnica de Valencia, Spain

Target degree: PhD in Doctoral Programme of Computer Science

Degree details: <http://www.upv.es/entidades/EDOCTORADO/info/1004670normali.html>

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 4100 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: In terms of cost of living, **Spain** is one of the more reasonable places to move to in Europe. Income and housing prices are stable and Spain's public transportation system is highly developed throughout the country, connecting all major cities. The country's universal healthcare system is considered among the best in Europe. **València** is located on Spain's eastern coast, at the mouth of the Turia River, right in the centre of the Gulf of València.

Read more about Spain and Valencia:

- <https://www.spain.info/en/>
- <http://expat-spain.com>
- <https://www.spain.info/en/>

Unit details: Universitat Politècnica de València (UPV, <http://www.upv.es>) is a public university with four campus sites, over 35,000 students, and 2,600 faculty members and research staff. It consists of 44 Departments, most of them in engineering areas. It is the top University in Spain regarding patent production. Contributions to this project will come from the Parallel Architectures group (GAP, <http://ww.gap.upv.es>) of UPV. The group has a 26-year research expertise in different aspects of system architecture, especially on interconnection networks.

Read more about UPV:

<http://www.upv.es/organizacion/la-institucion/documentos/folleto-institucional-upv-eng.pdf>

Seconding Unit description: The mission of IBM Zurich Lab, in addition to pursuing cutting-edge research for tomorrow's information technology, is to cultivate close relationships with academic and industrial partners, be one of the premier places to work for world-class researchers, to promote women in IT and science, and to help drive Europe's innovation agenda.

Read more about IBM Zurich Lab. at: <https://www.zurich.ibm.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.