

Fast and Accurate Prediction of the Impact of Approximate Operators on a Complex Computation

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 project titled '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 have the opportunity to 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: Politecnico di Torino, Italy

ESR 7 Objectives:

- Development of stochastic approaches to quickly estimate the impact of different Approximate Operators on a computation in terms of precision and other design dimensions such as power, area, code complexity, and execution time.
- Support the benchmarking activities

ESR Expected Results:

A complete framework to estimate the impact of the application of different combinations of approximate operators on the precision of the results of a computation and on the power consumption and performance of the computation. A library of characterized approximated operators to be exploited in our framework.

Planned secondment(s): Arduino (ARD), supervisor Dr. Dario Pennisi, M18, 6 months for accurate prediction of the Impact of approximate operators in embedded IoT devices for extreme low power applications.

Supervisory team:

- Prof. Stefano Di Carlo (POLITO), main supervisor
- Dr. Alessandro Savino (POLITO), academic co- supervisor
- Dr. Dario Pennisi (ARD) industrial co- supervisor

Enrolment in Doctoral degree: Politecnico di Torino Italy

Target degree: PhD programme in Computer and Control Engineering

Degree details:

- <http://www.phd-dauin.polito.it/>
- <http://dottorato.polito.it/en/home>

Expected start date: May 2021 (M7 from the beginning of the project)

Approximate gross salary: about 3250 EUR/month (before taxes) for researchers without family (and about 3650 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

Working and living conditions in the country:

Piemonte region is located North-West of Italy, close to the borders with France and Switzerland. Surrounded by the Alps, Torino is the capital city of Piemonte region, fourth largest Italian city in terms of population and the third biggest economic and industrial hub after Milan and Rome. Italy's first capital, Torino is a baroque jewel on the banks of the Po river, to discover with a gourmet break in a historic café and a walk under 18 kilometers of arcades with beautiful shops windows, a stop at Porta Palazzo, Europe's largest open-air market, or during one of the world-class sporting events. And after a well-deserved shopping spree and a visit to an elegant Royal Residence of Piemonte, pamper yourself with the original Torino's aperitif ritual: here, in the birthplace of vermouth, artisan gelato, giandujotti and grissini, Piemonte's culinary tradition gives its best in iconic foods to taste in a great number of Michelin-starred restaurants and typical trattorias.

- <https://www.visitpiemonte.com>
- <https://www.to.camcom.it/piemonte-facts-and-figures>
- <https://www.turismotorino.org/en>
- <https://www.turismotorino.org/en/your-trip/tourist-information-centres/noicisiamo-1>

Unit details: Politecnico di Torino (POLITO) is one of the most important universities in Europe for engineering and architecture studies, strongly committed to collaboration with industry. POLITO offers excellence in technology. The range of studies is broad and ever-widening it spans space, environment and land, telecommunications, information technologies, energy, mechanics, electronics, chemistry, automation, industrial design, architecture and building: very different subjects requiring different study methods as well as inventiveness. POLITO has close relationships with international institutions, companies, local government and other types of associations and takes social and economic consideration into account.

In 2005 POLITO was one of the first institutions to endorse the “European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers”; in November 2013 the European Commission awarded the 'HR Excellence in Research' logo to Politecnico di Torino, remarking the strong commitment in the implementation of the principles of the Charter and Code aimed at creating a high quality academic environment where researchers and students from all over the world can study, work and collaborate on innovative and challenging projects. In 1999, Politecnico di Torino was the first Italian University to establish the Doctoral School, a specific structure dedicated to the management of all activities related to PhD programmes.

Read more about Politecnico di Torino at

- <https://www.polito.it/>

- <https://international.polito.it/>
- https://www.coronavirus.polito.it/en/measures_for_students/incoming_and_outgoing_students

Seconding Unit description: Arduino (Chiasso, Switzerland) is the world's leading open-source hardware and software ecosystem. The Company offers a range of software tools, hardware platforms and documentation enabling almost anybody to be creative with technology.

Arduino is a popular tool for IoT product development as well as one of the most successful tools for STEM/STEAM education. Hundreds of thousands of designers, engineers, students, developers and makers around the world are using Arduino to innovate in music, games, toys, smart homes, farming, autonomous vehicles, and more.

Read more about Arduino at: <https://www.arduino.cc/en/>

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

Master's Degree recognized valid by POLITO Doctoral School: M.Sc. degree (i.e., 2° level title, as defined by the Bologna Process), issued by an officially recognized academic institution, which grants admission in Ph.D. programmes in the country of issuance.

In order to evaluate the University career, the candidate should provide: Master's Degree and transcript of records of the Master's Degree, Bachelor's Degree and transcript of records of the Bachelor's Degree.

The documents shall be issued by the relevant university in one of the following languages: Italian, English, French, Portuguese or Spanish To be verified by PoliTo Doctoral School before the interviews.

The original diploma and transcript should be available by 31st October 2021 at the latest.

GRE® General: Valid GRE certificate to present by the 31st October, 2021

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, mathematics, physics, etc.

English language certificate: One of the following certificates of English language knowledge, regardless of the date of obtainment:

- IELTS with a minimum score of 5.0;
- one of the language certificates recognized equivalent to IELTS 5.0 by the Foreign Languages Centre and detailed in the table published at the webpage: <https://didattica.polito.it/zxd/b5eda0a74558a342cf659187f06f746f/9dde3c1deee7c791026d6a0ac91322bb/815f4c1f644cb627e050c0828c371966?1549616887585>

Or a declaration of having a Ba. and/or M.Sc. degree issued by a University in which courses are taught in English, i.e. “The medium of instruction was English”.