



Offer #2024-07868

PhD Position F/M Fine grain energy consumption measurement of HPC task-based programs

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

Level of experience : Recently graduated

About the research centre or Inria department

The Inria Saclay-Île-de-France Research Centre was established in 2008. It has developed as part of the Saclay site in partnership with **Paris-Saclay University** and with the **Institut Polytechnique de Paris**.

The centre has [40 project teams](#), 32 of which operate jointly with Paris-Saclay University and the Institut Polytechnique de Paris; Its activities occupy over 600 people, scientists and research and innovation support staff, including 44 different nationalities.

Context

This thesis is placed in the context of NumPEx (<https://numpex.fr/>), a key national project whose goal is to **co-design the software stack for the exascale era** and prepare applications accordingly.

This thesis will beco-supervised by **Inria Benagil (located in Evry)** and **Inria STORM (located in Bordeaux)**. Beyond the supervision, collaborations within NumPEx with the different partners of the consortium are to be expected.

Assignment

The power consumption of supercomputers is and will be a major concern. As a matter of fact, Frontier, the fastest supercomputer in the world consumes around 20 MW. As a consequence, reducing the power consumption of HPC applications is mandatory.

The first step towards reducing the power consumption of programs is being able to monitor their energy consumption. Servers usually contain wattmeters able to measure the power consumption of the CPU, the memory, the GPU, etc. However, these wattmeters only provide coarse grain energy measurement, with a typical measurement period of dozens of milliseconds. During this period of time, the application may execute hundreds of tasks. As a result, analyzing the power consumption of an application at the microsecond scale is tedious.

As part of the PEPR NumPex, we investigate ways to reduce the energy consumption of parallel applications running on supercomputers.

Main activities

The goal of this PhD is to investigate fine-grain energy measurement in StarPU. StarPU is a task-based runtime system that executes microsecond-scale tasks on CPUs and GPUs. Since StarPU executes many instances of a few types of tasks, it should be possible to build an energy consumption model of each type of task. The energy consumption model can then be provided to StarPU so that the task scheduling takes into account both the performance of tasks, and their energy consumption.

The proposed approach would be to measure the energy consumption of a server (its CPU, GPU, etc.) at coarse-grain (typically, one sample every 20 ms), and to log which tasks were executed during this period of time. By repeating this many times, it should be possible to solve a linear system that models the energy consumption of microsecond-scale tasks.

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs

- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Remuneration

1st and 2nd year : 2100€ gross/month

General Information

- **Theme/Domain** : Distributed Systems and middleware System & Networks (BAP E)
- **Town/city** : Evry
- **Inria Center** : [Centre Inria de Saclay](#)
- **Starting date** : 2024-11-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2024-07-28

Contacts

- **Inria Team** : [BENAGIL](#)
- **PhD Supervisor** :
Trahay Francois / francois.trahay@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :

As part of its diversity policy, all Inria positions are accessible to people with disabilities.