



Offre n°2024-07737

PhD Position F/M Dimensioning probabilistic embedded systems for efficient execution of artificial intelligence algorithms

Le descriptif de l'offre ci-dessous est en Anglais

Type de contrat : CDD

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Doctorant

Niveau d'expérience souhaité : Jeune diplômé

Contexte et atouts du poste

The PhD thesis is funded by the Paris region program and it is hosted by the Kopernic team in Paris (see more details at <https://team.inria.fr/kopernic/>)

Supervised by Liliana Cucu-Grosjean (<https://who.rocq.inria.fr/Liliana.Cucu/Welcome.html>), the student interacts with Kopernic members as well as with StatInf members, a Kopernic spin-off (<https://statinf.fr>). The thesis is expected to start as soon as possible and no later than December 1st, 2024.

Travelling is expected in France and in Bresil as well as EU countries, the associated costs being covered following the current public laws. Inria offers an equal opportunity and friendly working environment, while covering partially the transport and meal costs. AGOS (its comité d'entreprise) provides financial support for holidays or jobbies.

Mission confiée

The arrival of artificial intelligence methods in the embedded systems area pushes for the inclusion of complex computations in presence of critical constraints like time or energy. For example, in an autonomous vehicle, understanding the impact of automatic recognition of a pedestrian on the reaction in time of that vehicle is an open problem.

In order to perform these complex calculations within a reasonable time delay, designers are integrating multiple cores processors within more hybrid architectures such as CPU-GPU or CPU-FPGA. Although hybrid architectures increase computing capacities, the time validation of the execution of programs running on these architectures is an open problem, especially if communication delays are considered. Within the Kopernic team we propose combining probabilistic and non-probabilistic models to deal with such validations.

The worst-case execution time (WCET) and the worst-case response time are important parameters in the time validation of real-time critical systems because they allow to verify if a program, combined with other programs, can be implemented on a processor while respecting strict time constraints. The WCET can be estimated either by static analysis methods, or by measurement-based methods, or by a combination of both approaches [1]. During this thesis, measurement-based statistical approaches are considered as well as methods combining analytical solutions to these approaches. Depending on this estimation, the response time calculation methods can be analytical or measurement-based. The objective of the thesis is to propose efficient scheduling algorithms of probabilistic embedded systems on hybrid architectures, to compare their energy performances wrt existing non-probabilistic algorithms, while respecting the time constraints. All results are illustrated on the Kopernic benchmarks - KDBench (see <https://team.inria.fr/kopernic/kdbench/>).

The following non-exhaustive list of papers may help understanding the background associated to this thesis:

- [1] Reinhard Wilhelm et al., The Worst- case Execution-time Problem: Overview of Methods and Survey of Tools, ACM Trans. Embed. Comput. Syst., 7(3), May 2008.
- [2] Robert Davis and Liliana Cucu-Grosjean, Survey of Probabilistic Schedulability Analysis Techniques for Real-Time Systems. Leibniz Trans. Embed. Syst. 6(1): 04:1-04:53 (2019)
- [3] Slim Ben-Amor, Liliana Cucu-Grosjean, Mehdi Mezouak, Yves Sorel: Probabilistic Schedulability Analysis for Precedence Constrained Tasks on Partitioned Multi-core. ETFA 2020: 345-352
- [4] Dorin Maxim, Robert I. Davis, Liliana Cucu-Grosjean, Arvind Easwaran : Probabilistic analysis for mixed criticality systems using fixed priority preemptive scheduling. RTNS 2017: 237-246
- [5] Liliana Cucu-Grosjean et al.: Measurement-Based Probabilistic Timing Analysis for Multi-path Programs. ECRTS 2012: 91-101

[6] Cristian Maxim, Adriana Gogonel, Irina Mariuca Asavoae, Mihail Asavoae, Liliana Cucu-Grosjean: Reproducibility and representativity: mandatory properties for the compositionality of measurement-based WCET estimation approaches. SIGBED Review 14(3): 24-31 (2017)

Principales activités

The thesis is expected to cover the following main activities :

1. State of the art on probabilistic and statistical approaches as well as non-probabilistic architectures for hybrid architectures.
2. Proposition of multicore scheduling algorithms for Directed Acyclic Graph tasks on hybrid architectures where some tasks implement learning methods.
3. Proposal of energy- relevant versions of proposed algorithms.
4. Validation of the results on a case study proposed by StatInf, as well as on an open source benchmarks.

All results are expected to be published within real-time conferences and journals.

Compétences

Technical skills and level required : background on real-time systems is an advantage, but not necessary, while back ground on embedded system is mandatory. Python is the main programming language, but being familiar with C/C++ code is expected.

Languages : English and French

Avantages

- 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 (after 12 months of employment)
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Informations générales

- **Thème/Domaine** : Systèmes embarqués et temps réel
Système & réseaux (BAP E)
- **Ville** : Paris
- **Centre Inria** : [Centre Inria de Paris](#)
- **Date de prise de fonction souhaitée** : 2024-10-01
- **Durée de contrat** : 3 ans
- **Date limite pour postuler** : 2024-07-27

Contacts

- **Équipe Inria** : [KOPERNIC](#)
- **Directeur de thèse** :
Cucu Liliana / liliana.cucu@inria.fr

A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 215 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3900 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 200 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

Clearly the student should enjoy working in a team, but also be sufficiently autonomous. Enthusiastic

about research and embedded systems, the student will interact with teams from avionics, space and automotive, thus the curiosity is a plus.

Attention: Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

Consignes pour postuler

Sécurité défense :

Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

Politique de recrutement :

Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.