



Offre n°2024-07656

## Post-Doctoral Research Visit F/M Probabilistic heterogenous multicore time critical scheduling

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

Type de contrat : CDD

Niveau de diplôme exigé : Thèse ou équivalent

Fonction : Post-Doctorant

### Contexte et atouts du poste

Context - The postdoctoral fellow will be recruited within the Kepler associated team (see <https://team.inria.fr/kopernic/kepler/>) between the Kopernic team (Inria Paris) and the STER (Federal University of Bahia). While the postdoctoral position is located in Paris, visits to STER are planned. This position is funded by Inria International Relations Department supporting Inria international collaborations. The postdoctoral contract will have a duration of 12 to 24 months. The default start date is November 1st, 2024 and not later than January, 1st 2025.

Assignment - Candidates for postdoctoral positions are recruited after the end of their Ph.D. or after a first post-doctoral period: for the candidates who obtained their PhD in the Northern hemisphere, the date of the Ph.D. defense shall be later than September 1, 2022; in the Southern hemisphere, later than April 1, 2022. In order to encourage mobility, the postdoctoral position must take place in a scientific environment that is truly different from the one of the Ph.D. (and, if applicable, from the position held since the Ph.D.); particular attention is thus paid to French or international candidates who obtained their doctorate abroad.

More about Paris center and Kopernic team - The Paris Research Center of Inria conducts its scientific activities by developing close partnerships with the best international teams, industry and services. It benefits from rich exchanges with the many scientific and economic players in the Paris region (Grandes Ecoles, prestigious universities, global competitiveness clusters). Members of the Kopernic team study real-time critical systems, using statistical and probabilistic approaches. The results obtained and the team's skills in the probabilistic study of these systems place it among the leaders in the field of real-time probabilistic systems. The topic proposed below is related to the collaboration of the Kopernic team with colleagues from the Federal University of Bahia (FUB) within the Inria associated team (see <https://team.inria.fr/kopernic/kepler/> for more details).

Interested persons are asked to contact Liliana Cucu-Grosjean at [liliana.cucu@inria.fr](mailto:liliana.cucu@inria.fr) in order to prepare the application before June 2, 2024 with a detailed CV with a description of the PhD and a complete list of publications with the two most significant ones highlighted. The final postdoctoral topic is prepared together with Kepler members in order to include the applicants interest.

### Mission confiée

The problem of statistically estimating bounds on execution times has received a great deal of interest since the publication of Kopernic and FUB members [1] in 2013 of results putting Extreme Value Theory back at the center of the study of these bounds. By following the list of articles citing [1], the list of which is available online and updated regularly [2], we can follow the latest advances on statistical and probabilistic approaches for embedded systems. Ongoing work in the scientific and industrial community focuses mainly on improving estimates, as we have done in [1, 3, 5], when an industrially applicable solution requires properties such as reproducibility and composability [4] from measurement protocols. Nevertheless, **few results exist** on the introduction of probabilistic worst-case execution times within the problem of **multicore time critical scheduling**. Indeed, most research on real-time scheduling with probabilistic guarantees has focused on uniprocessor systems. In the context of the Kepler project, we understand that the probabilistic specification of system components can be seen as a general framework for describing their level of time critical constraints. Our goal is, thus, to extend real-time multiprocessor scheduling by including probabilistic description. In particular, we plan to extend known optimal and low-overhead multiprocessor real-time scheduling algorithms that were originally designed assuming non-probabilistic behavior of tasks. Examples of such algorithms are RUN and QPS, both proposed by the STER team [6]. Our goal is verifying the extent to which they can be extended for providing probabilistic timeliness guarantees, while comparing to another class of optimal multicore scheduling which is the fluid scheduling [7]. To our knowledge, this hot problem is open.

Problem: Finding of an (almost) optimal scheduling algorithm for heterogenous multicore processors while time parameters are described by probability distributions.

[1] Liliana Cucu-Grosjean, Luca Santinelli, Michael Houston, Code Lo, Tullio Vardanega, Leonidas Kosmidis,

Jaume Abella, Enrico Mezzetti, Eduardo Quiñones, Francisco J. Cazorla: Measurement-Based Probabilistic Timing Analysis for Multi-path Programs. ECRTS 2012: 91-101

[ 2 ] <https://scholar.google.co.uk/scholar?oi=bibs&hl=fr&cites=5251528091307735099,3459830546551474137>

[3] Liliana Cucu-Grosjean et Adriana Gogonel, Simulation Device, FR et US brevet, n°: FR2016/050504, 2016

[4] 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)

[5] Tadeu Nogueira C. Andrade, George Lima, Veronica Maria Cadena Lima, Slim Bem-Amor, Ismail Hawila, Liliana Cucu-Grosjean: On the impact of hardware-related events on the execution of real-time programs. Des. Autom. Embed. Syst. 27(4): 275-302, 2023

[6] Ernesto Massa, George Lima, Paul Regnier, Greg Levin, Scott A. Brandt: Quasi-partitioned scheduling: optimality and adaptation in multiprocessor real-time systems. Real Time Syst. 52(5): 566-597, 2016

[7] H. Cho, B. Ravindran and E. D. Jensen: An optimal real-time scheduling algorithm for multiprocessors, *Proc. 27th IEEE Int. Real-Time Syst. Symp.*, pp. 101-110, 2006

## Principales activités

Main activities:

- Updating state of the art results on optimal (or near) optimal multicore scheduling algorithms with real-time constraints
- Extending to probabilistic real-time tasks and providing associated schedulability analyses
- Numerical evaluation and energy-based comparison of different solutions on KDBench programs and platforms
- Interaction with Kerdata team in Rennes within a possible EU project
- Writing scientific papers and participating to the animation of meetings between young researchers of Kepler associated team

## Compétences

Technical skills and level required : PhD thesis in Embedded Systems (not necessarily real-time)

Languages : English is mandatory

## 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** : 2024-11-01
- **Durée de contrat** : 2 ans
- **Date limite pour postuler** : 2024-07-31

## Contacts

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

Team working

Mixing theoretical results and real applications to microcontrollers (and energy-oriented objectives)

Enjoying traveling between France and Bresil

**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.