2018-00522 - Energy optimization of synchronous and real-time programs - Post-Doctorant Inria Grenoble Research center

Type de contrat: CDD de la fonction publique
Niveau de diplôme exigé: Thèse ou équivalent
Fonction: Post-Doctorant
Niveau d’expérience souhaité: Jeune diplômé

A propos du centre ou de la direction fonctionnelle

Grenoble Rhône-Alpes Research Center groups together a few less than 800 people in 35 research teams and 9 research support departments.

Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas.

Present in the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

ConteXte et atouts du poste

Over the years, synchronous programming has become a paradigm of choice for real-time embedded systems [1]. For instance, the SCADE commercial tool from Esterel Technologies is the de facto standard in safety critical systems (civil airplanes, trains, subways, nuclear power plants, ...). The benefit of synchronous programming is to precisely control the execution time of the resulting program on the chosen target processor. However, one issue that is not solved is the minimization of the energy consumption, a topic which is becoming more and more important in a large class of embedded systems: satellite systems, portable medical devices, full authority digital engine control (FADEC) in aircraft, and so on. As a consequence, both the execution time and the energy consumption must be minimized for this class of embedded real-time systems.

Dynamic Voltage and Frequency Scaling (DVFS) has emerged as one of the best chip technology to minimize the energy consumption: by lowering the voltage, the dynamic power is reduced, which therefore reduces the overall energy consumption. But at the same time, the frequency must also be lowered, which causes the execution time to increase. We are thus faced with a tradeoff between the energy consumption and the execution time.

The topic of energy minimization for synchronous programs has only recently started to receive attention [2] in the context of the PRET-C synchronous language [3]. In [2], a PRET-C program is first compiled into a so-called Timed Concurrent Control Flow Graph (TCCFG). Each basic block of this TCCFG is then labeled with the number of clock cycles necessary to execute it on the target processor. Finally, executable code is generated from this labeled TCCFG with DVFS switching points inserted at each control point of the TCCFG.

By carefully choosing the (voltage,frequency) values, it is possible to produce schedules of the TCCFG that implement different tradeoffs between the energy consumption and the execution time. In general, two such schedules will be non comparable. E.g. the schedule S1 with execution time 100 and energy 200 cannot be compared with the schedule S2 with execution time 200 and energy 100. In the Pareto sense, we say that S1 does not dominate S2 and that S2 does not dominate S1. In terms of optimization, we are interested in computing the set of schedules that are dominated by no other schedules. These non-dominated schedules are called Pareto optima, and the set of all the Pareto optima is called the Pareto front in the 2D search space (energy, execution time).

Mission confiée

During the first part of this postdoc, we are interested in improving the technique proposed in [2] so as to generate better (and even optimal) Pareto fronts, and more importantly to extend it to synchronous programs compiled for multi-core chips and written in ForeC [4].

During the second part of this postdoc, we are interested in the Logical Execution Time paradigm (LET) [5]. The LET abstraction was originally introduced as a real-time programming paradigm and is tightly related to the synchronous model [1]. It has gained traction recently in the automotive industry with the shift to multicore architectures and is now used for development at the ECU level by some OEMs and Tier 1 suppliers [6,7]. Our main objective is to propose new concepts and language constructs for system-level LET that make network communication explicit. This is necessary because network communication does not easily fit into LET intervals. We will apply the proposed

Informations générales

- Thème/Domaine: Systèmes embarqués et temps réel
- Ville: Montbonnot
- Centre Inria: CRI Grenoble - Rhône-Alpes
- Date de prise de fonction souhaitée: 01-11-2018
- Durée de contrat: 1 an, 4 mois
- Date limite pour postuler: 04-04-2018

Contacts

- Equipe Inria: SPADES
- Recruteur: Girault Alain / alain.girault@inria.fr

Conditions pour postuler

Starting date: 1st November 2018.

The postdoc position is for up to 18 months, starting end of 2018 (November ideally). The duration can be between 12 and 18 months.

Applications should hold a PhD (defended between 1st September 2016 and 31st October 2018) in Systems and Control or Applied Mathematics.

Applications have to be made on-line on the Inria web site before end of March.

Send a CV and the contact information of 2 or 3 recommenders to : alain.girault_at_inria.fr and sophie.quinton_at_inria.fr

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.
methodology to a use case provided by our partner Daimler. An important by-product of this work will be a better understanding of the similarities and differences between the LET and the synchronous models.

References:


Principales activités

Main activities:

- Conduct research in collaboration with postdoc advisors.
- Study and review the state of the art.
- Write research articles.
- Attend conferences to present your research results.

Compétences

A PhD in formal methods, embedded systems, and/or real-time programming (e.g., analysis, semantics, compiling, code generation, energy optimization, ...). A knowledge of synchronous programming and/or LET would be appreciated.

The working language will be English. French is not a requirement.

Avantages sociaux

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities

Rémunération

Salary: 2 653 euros gross monthly (about 2.150 euros net).