2023-06475 - Post-Doctoral Research Visit F/M
Analysis and design of reliable domain-specific processors

Type de contrat : CDD
Contrat renouvelable : Oui
Niveau de diplôme exigé : Thèse ou équivalent
 Fonction : Post-Doctorant

A propos du centre ou de la direction fonctionnelle

The Inria Rennes - Bretagne Atlantique Centre is one of Inria's eight centres and has more than thirty research teams. The Inria Center is a major and recognized player in the field of digital sciences. It is at the heart of a rich RED and innovation ecosystem: highly innovative SMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institutes, etc.

Contexte et atouts du poste

Host team: The project will be held in the TARAN (formerly CAIRN) team of the IRISA/INRIA laboratory. The TARAN team, with more than 35 members from Inria, UR1, and ENS Rennes, has participated in several national and European RED projects (HIDRO, ARGO, FF7 Alma, FF7 Flexilis) and has strong industrial collaborations (e.g., Safran, Thales, Alcatel, Orange, SMIC electroconics, Technicolor, and various SMEs). TARAN has recognized experience in several domains related to the project, such as embedded system design, fault tolerance, safety-critical systems, computing architectures, design tools for specialized hardware architectures.

Acquiring new skills: As a new member of the TARAN team, you will be integrated in a research group with excellent prestige and deep knowledge of embedded systems. The TARAN research group can provide you with a more solid understanding of the mitigation solutions have focused on the Single-Event Upsets (SEUs), as they have considered as a major problem, because of digital logic characteristics, such as logic masking, electrical masking and locking. However, as the transistor sizes, capacitances and supply voltages decrease, the threshold required for a transient impulse to disturb the circuit has become increasingly low. Combined with the high operating frequencies, the possibility that a SET in the combinational logic will be stored on the storage element is increased. Therefore, SETs will rapidly exceed the SEU error rate in integrated systems, whereas the probabilities for multiple faults (Multiple-Bit Upset - MBU) are highly increased.

To deal with these problems, the architectures must have mechanisms to detect faults and to remedy their impacts on the application. However, to select an efficient error detection and correction mechanism, the potential faults and their impacts on the processor are required to be analyzed in order to drive the design of fault tolerant mechanisms removing the unnecessary performance, area and energy overhead.

Mission confiée

Context: The dense transistor integration on the silicon and the systems architecture complexity have increased the system sensitivity to faults. Since the 1980s it is known that the terrestrial cosmic rays cause several defects in electronic components, from logical faults up to the circuit destruction. The occurrences of this phenomenon, called SEE (Single Event Effect), have significantly increased in the 90s due to the downsizing of the transistor technology and the increase in the memory sizes. Up to now, most of the mitigation solutions have focused on the Single-Event Upsets (SEUs), as they have been identified as the dominant issue. The Single-Event Transients (SETs) were not considered as a major problem, because of digital logic characteristics, such as logic masking, electrical masking and locking. However, as the transistor sizes, capacitances and supply voltages decrease, the threshold required for a transient impulse to disturb the circuit has become increasingly low. Combined with the high operating frequencies, the possibility that a SET in the combinational logic will be stored on the storage element is increased. Therefore, SETs will rapidly exceed the SEU error rate in integrated systems, whereas the probabilities for multiple faults (Multiple-Bit Upset - MBU) are highly increased.

Goal: The topic of this position is to study the behavior of the domain-specific processors under the presence of faults, develop error models in higher abstract layers that the existing ones at the transistor level, and propose effective protection mechanisms across different design layers.

To achieve this goal, we will develop a cross-layer framework to perform vulnerability analysis through fault injection methodologies applied at different system layers. The methodology should decide where to insert faults in order to have a realistic simulation of the radiation impact on the processor components, whereas the development should take into account how to avoid exhaustive exploitation in order to reduce the time of the experiments. As a first step, the fault injection methodology will be based on scripts that modify the processor’s component by inserting faults at the gate level. The experiments can be performed by configuring adequately each time the fault injection occurs. The results gathered from the experiments will be used to obtain information to develop error higher abstraction models at the architecture level and to characterize the sensitivity of the different components of the processor to transient errors and drive the protection mechanisms.

Principales activités

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Informations générales

- Thème/Domaine : Architecture, langages et compilation
- Systèmes B réeaux (BAP E)
- Ville : Rennes
- Centre Inria : Centre Inria de l’Université de Rennes
- Date de prise de fonction souhaitée : 2023-09-01
- Durée de contrat : 1 an
- Date limite pour postuler : 2023-10-31

Contacts

- Équipe Inria : TARAN
- Recruteur : Kritikakou Angeliki / angeliki.kritikakou@irisa.fr

A propos d’Inria

Inria est l’institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 200 équipes-projets agiles, en général communis avec des partenaires académiques, impliquent plus de 3500 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 180 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.

Consignes pour postuler

Please submit online : your resume, cover letter and letters of recommendation eventually.
For more information, please contact angeliki.kritikakou@irisa.fr

Sécurité défense :
Ce poste est susceptible d’être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2017-
Compétences

Required expertise
- Good knowledge of computer architecture, hardware and embedded systems
- Good knowledge with FPGA design and/or High-Level Synthesis.
- Programming experience in HDL, tcl, bash scripting, C/C++ and python

A PhD in Computer Science, Computer Engineering, or Electrical Engineering is required.

Note that we also receive applications on the same topic for an engineering position (master is required).

Languages and skills:
- Very good communication skills in oral and written English.
- Open-mindedness, strong integration skills and team spirit.
- Mostly importantly, we seek highly motivated people.

Please send:
- Your CV along with your Bachelor/Master transcripts
- A motivational letter
- Reference letters
- Any additional documents/links that you think can show your experience (reports, notes, papers, github repositories...)

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (90 days per year) and flexible organization of working hours
- Partial payment of insurance costs

Rémunération

monthly gross salary amounting to 2746 euros