

Post-doctoral position offer

Research group at Onera:

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Title : Formal modelling and analysis of the problem domain in requirements engineering

Requirements engineering (RE) is critical in software and system design. Indeed, a major part of the cost of software and system development is known to be traceable to the understanding of the problem domain and requirements. In the last decade, much research on this topic has reached maturity and has been integrated into modeling methods [vL09, BPG⁺04].

Over the last few years, Onera has been developing a “core” language for requirements modelling, called Khi [CBC11], which allows to describe the behavioural goals of the system on the one hand, and the different agents of the system, with their behaviour, on the other hand. The main problem addressed by Khi is to assess possible assignments of agents to goals, *i.e.*, to answer the following question: *is a given set of agents able to ensure a given goal?*

In order to allow formal verification, Khi comes with a formal semantics relying on a temporal multi-agent logic [AHK02, MMPV11] called Update Strategy Logic (USL) [CBC13]. USL generalizes temporal logics with the ability to reason about the strategies applied by agents in order to fulfill their objectives.

Although very promising, Khi lacks a tractable way to model and reason about the problem domain, *i.e.*, the conceptual entities that form the system and its environment, as well as their types, relationships, etc. Although some approaches allow to model a structural view of the domain, a unified formal framework considering the problem domain, goals and agents *altogether* is still lacking.

The aim of this postdoctoral position is to devise:

- an extension of Khi allowing to reason about both the expected behaviour of the system and the main concepts that form the domain. The underlying formal semantics will build on USL on the one hand, and on a formal framework well-suited for domain modelling (*e.g.*, first-order logic, relation algebra, description logics [BHS07] or algebraic specification) on the other hand. The choice for the latter will result from a trade-off between expressivity, user-friendliness and the potential for automated verification. Following an ongoing work concerning USL, meta-theoretical properties of the proposed logic will be possibly validated using a proof assistant such as Coq or Isabelle.
- a method, possibly supported by a software prototype, allowing to design and validate models of the above-mentioned Khi extension.

Application : This is a joint proposition between two Toulouse computer science labs: Onera/DTIM and IRIT. Candidates are expected to be fluent in English or in French and should send a resume via email to julien.brunel@onera.fr and bodeveix@irit.fr.

This 12-month position is available starting September 2013 (with some flexibility on the starting date). It is funded by RTRA STAE, a French space and aeronautics sciences & technologies foundation. Gross salary: ~2500 EUR.

Key words: Temporal logic, multi-agent logic, formal domain modelling, requirements engineering

References

- [AHK02] Rajeev Alur, Thomas A. Henzinger, and Orna Kupferman. Alternating-time temporal logic. *Journal of the ACM*, 49:672–713, 2002.
- [BHS07] Franz Baader, Ian Horrocks, and Ulrike Sattler. *Handbook of Knowledge Representation*, chapter 3, Description Logic. Elsevier, 2007.
- [BPG⁺04] Paolo Bresciani, Anna Perini, Paolo Giorgini, Fausto Giunchiglia, and John Mylopoulos. Tropos: An agent-oriented software development methodology. *Autonomous Agents and Multi-Agent Systems*, 8:203–236, 2004.
- [CBC11] Christophe Chareton, Julien Brunel, and David Chemouil. A formal treatment of agents, goals and operations using alternating-time temporal logic. In *Brazilian Symposium on Formal Methods (SBMF 2011)*, Lecture Notes in Computer Science. Springer-Verlag, 2011.

- [CBC13] Christophe Chareton, Julien Brunel, and David Chemouil. Towards an updatable strategy logic. In *1st workshop on Strategic Reasoning (SR 2013)*, volume 112 of *Electronic Proceedings in Theoretical Computer Science (EPTCS)*, pages 91–98, 2013.
- [MMPV11] Fabio Mogavero, Aniello Murano, Giuseppe Perelli, and Moshe Y. Vardi. Reasoning about strategies: On the model-checking problem. *CoRR*, abs/1112.6275, 2011.
- [vL09] Axel van Lamsweerde. *Requirements engineering, From System Goals to UML Models to Software Specifications*. Wiley, 2009.