UMR 5505 – CNRS – INP ENSEEIHT – UPS

IRIT SITE ENSEEIHT
2 rue Charles Camichel
BP 7122
31071 TOULOUSE CEDEX 7
Tél 05 34 32 21 55 Fax 05 34 32 21 57

Proposal for Master 2 or PFE Internship

Topic	: Ensuring Correctness in Open Systems through Compatibility
Starting date	: February/march 2024
Duration	: 4 to 6 months
Advisors	: Meriem Ouederni and Rabéa Ameur-Boulifa
Location	: INP-Enseeiht (Toulouse) or IPP–Télécom Paris (Sophia Antipolis)
Supervisors	: Rabea AMEUR and Meriem OUEDERNI
Funding	: GERS Project (ETI2025)
Contact	: meriem.ouederni@toulouse-inp.fr, rabea.ameur-boulifa@telecom-paris.fr
Keywords	: Concurrency theory, Composability, Interoperability, Verification, Distributed Systems

Context :

As software applications become increasingly complex, the management of concurrency and communication has become a pivotal aspect of the design process. Highly concurrent and communicating models, in particular, require communication architectures that are both truly interoperable and scalable. This highlights a critical need for reliability and systematics structuring in the design of such systems. The adoption of decomposition methods and compositional proof techniques provides an effective solution for large-scale and verification of behavioural properties, while also supporting the design of robust and reliable systems.

One of the major challenges of compositional approaches lies in ensuring correct interactions between (re)used components within a global system. Verification algorithms for concurrent systems often face the issue of "state-space explosion".

To address this challenge, some approaches, such as [1, 2], propose composition rules and decidable algorithms that allow for verifying the correctness of a global system by ensuring the compatibility of its components. This compatibility is assessed based on their ability to interact without generating undesirable effects. However, these solutions primarily focus on closed-system models.

Other approaches, such as [4, 3], emphasize the importance of developing new paradigms by shifting from closed-system models to open-system models. These open models allow, on the one hand, the representation of parameterized systems and, on the other hand, the modelling of systems along with part of their environment. These models, based on a component-based approach that includes unavailable elements and interacts with an unrestricted environment, pave the way for verification methods that can adapt flexibly to varying and dynamic contexts.

Objectives

The objective of this internship is to adapt the concept of compatibility and the associated algorithms, as defined for closed systems, in order to extend them to open systems and enable the verification of their correctness. More specifically, the internship would follow the following steps:

UMR 5505 – CNRS – INP ENSEEIHT – UPS

IRIT SITE ENSEEIHT
2 rue Charles Camichel
BP 7122
31071 TOULOUSE CEDEX 7
Tél 05 34 32 21 55 Fax 05 34 32 21 57

- Familiarization with technical material: the semantics of open automata and the study of composability rules ensuring the compatibility of components defined for closed systems.
- Design of suitable compatibility rules for composing open automata and analysis of the guarantees provided by these rules.
- Development of examples illustrating the benefits of this work.

1- Required Skills

- Solid background on formal methods
- Good English level

4- Required Profil

Master 2 Computer Science or equivalent (engineering school).

5- Application Process

Interested candidates should submit the following documents to meriem.ouederni@irit.fr and rabea.ameur-boulifa@telecom-paris.fr :

• Detailed CV

• Cover letter explaining your motivation and relevant experience

• Academic transcripts

• References (recommended)

Bibliographic References

[1] S. Basu, T. Bultan, M. Ouederni. Deciding choreography realizability. Symposium on Principles of Programming Languages, POPL 2012 : 191-202

[2] M. Ouederni. Compatibility checking for asynchronously communicating software. Sci. Comput. Program. 205: 102569 (2021)

[3] R. Ameur-Boulifa, Q. Corradi, L. Henrio, E. Madelaine: Refinements for Open Automata. 21st International Conference on Software Engineering and Formal Methods, SEFM 2023, Eindhoven, Netherlands. pp.11-29, (Extended version) 〈hal-04193421〉.

[4] R. Ameur-Boulifa, L. Henrio, E. Madelaine: Compositional equivalences based on Open pNets. Journal of Logical and Algebraic Methods in Programming, 2022, 131, pp.100842. 〈hal-03894031〉.