

PhD thesis proposal :
Compositional Analysis of Systems-on-Chip
INRIA Rhône-Alpes

Context

The subject of this thesis is part of the OPENTLM project of the French “pôle de compétitivité” MINALOGIC, federating both public research labs and companies in focused research programs.

Systems-on-chip (SoC) are characterized by the (re-)use of different components (processors, memory, communication networks) connected on the same chip. The design of SoC requires methods and tools satisfying an increasing number of productivity and quality constraints : it is nowadays necessary to ship innovative solutions while guaranteeing short development cycles, for circuits integrating ever more functionalities. The abstraction level called “Transaction Level Modeling” (TLM) has been introduced to model the architecture of SoC, in order to enable development of the embedded software in advance of the hardware, and to carry out analyses early in the design cycle.

Subject

In order to reduce complexity of formal analysis, many approaches have been proposed, such as compositional approaches, assume-guarantee reasoning, and abstraction and static analysis techniques. In order to cope with the complexity of industrial SoC, it is crucial to combine several of them.

The goal of this thesis is to propose and implement a *compositional* analysis method of TLM models written in SystemC (<http://www.systemc.org>), in order for the analysis to scale to large systems. The principle of compositional techniques is to decompose the complexity of analysis by inferring correctness properties of a system from properties of its components and its structure. In a SoC, however, the behavior is likely to depend on addresses and data. In order to take them into account while keeping a reasonably small state space, the method should include an *abstraction* step. In contrast to most abstract interpretation techniques which focus on safety properties, we are interested also in properties like reachability, deadlock-freedom, liveness, confluence, etc.

The theoretical part of the work encompasses exploring the approaches mentioned above, and designing analysis algorithms combining these approaches in order to overcome the limitations of existing techniques.

The implementation of the obtained results will use the SYSTEMC front-end PINAPA, the compositional analysis tool PROMETHEUS, and possibly further, complementary verification tools. The approach should be validated on concrete case studies provided by the OPENTLM consortium.

Working context : the thesis is funded by the cluster MINALOGIC (initial salary : 1529 €/month net). The PhD student will work at INRIA, at the research center Grenoble/Montbonnot. He or she will work in collaboration with two research fellows and another PhD student of the team, and will interact with the partners of the project OPENTLM.

Required skills, and contact : this proposal is limited to candidates having a Master’s or engineering diploma in computer science, having good knowledge in formal methods. To apply, please e-mail your CV and references to Gregor Goessler, INRIA Rhône-Alpes, email : Gregor.Goessler@inrialpes.fr, phone +33 4 76 61 54 20.