Static Analysis of Synchronous Dataflow Programs via Horn Encoding

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Context

Synchronous languages [1] have been developed since the middle of the 80s for the design and implementation of embedded reactive systems. They have been successfully applied to embedded control of critical systems, for which the physical environment often imposes hard real-time constraints [2]. In this work, we will more particularly focus on dataflow synchronous languages, with which the developer describes the application as an assembly of independent components that communicate only through FIFO channels, as is done in Kahn process networks [3].

In this work we propose to explore the static analysis of such programs via solving Horn Clauses, a logic formalism with efficient algorithmic, which has recently proven its suitability for program analyses, for instance to prove complex properties such as array sortedness [4].

Subject

In a previous work [5], an encoding of Lustre into Horn Clauses has been proposed and the performance of this encoding has been illustrated for the proof of small-size benchmarks. The resulsts obtained are quite encouraging but work remains to be done in order to propose efficient proof techniques for Lustre programs based on Horn Clauses.

The candidate will work toward this goal by implemeting abstractions based on the regular shape of Lustre programs manipulating arrays, as proposed in [6]. He/she will also apply this work to more realistic programs such as a process scheduler written in Lustre.

The contributions of the candidate will be implemented inside a branch of the Lustre compiler (`http://www-verimag.imag.fr/SYNCHRONE/lustre-v6/`) and developped in OCaml.

Références

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