**Default\_[Final\_Report]**

**Compose Final Report**

Please summarize the PC's decision.

The Final Report and the Single Reports for the article will be accessible to the corresponding author.

**Decision Outcome**

Dear authors,

Based on the reviews, the editor set your submission to major revision.

When preparing the revised version, please make sure to address the reviewers'

comments and concerns raised (especially those of 101-R-441 as well as

101-R-407) accordingly.

Once having done so, please submit a ZIP FILE, containing your revised version

ALONG WITH A COVER LETTER, explaining the changes made, to the service till 15th

August 2016.

Kind regards,

Julia Rehder

STTT Editorial Office

**Report 101-R-441**

**Default**

**SECTION I: Summary and Recommendation**

**Summary of Evaluation**

Overall quality is:

Fair

**Score**

Please select the score of the paper.

Mild Reject

**Confidence**

Please select your confidence.

High

**SECTION III: Overview**

**Reader Interest**

1. Is the paper of current interest to a reasonable segment of the journal?

Perhaps

2. Relative to the current level of reader interest in the paper, how is this interest likely to change during the next five years?

Relatively little change

3. Within its particular field of specialization, is the topic of the paper considered important?

Yes, definitely

**Content**

1. Is the paper technically sound?

(not necessary for style review)

Yes

2. How would you describe the technical depth of the paper?

Appropriate for someone working in the field

3. Does the paper make a tangible contribution to the state-of-the-art in its field?

Yes, definitely

4. Is the bibliography adequate?

Yes

5. To what extent is the material in the paper likely to be used by other researchers and practitioners?

Average

**Presentation**

**Presentation**

1. Is the abstract an appropriate and adequate digest of the work presented?

Yes

2. Does the introduction clearly state the background and motivation in terms understandable to the non-specialist?

Yes

3. How would you rate the overall organization of the paper?

Satisfactory

4. Relative to the technical content, is the length of the paper appropriate?

No, should be lengthened

5. Is the English satisfactory

Yes

6. How readable is the paper for a computer scientist or engineer who is not a specialist in this particular field

Paper is self-contained, but considerable effort is needed

7. Disregarding the technical content, how would you regard the quality of presentation?

Fair

**Section IV: Detailed Comments for Author(s)**

Mandatory, please elaborate on your judgement.

The paper deals with (formal) verification and synthesis of embedded systems.

The approach suggested by the authors is to start with a high-level

specification of the target system using the BIP framework, from which both a

C implementation and a sequential circuit are generated.

The former is used for simulation and runtime verification, whereas the later

is the input of existing verification tool (ABC).

The main contributions of the paper are the definition and implementation of

automatic transformations from BIP to one loop programs (OLPs) and

corresponding C implementations, and from OLP to And-Inverted-Graphs (AIGs)

which are representations of sequential circuits considered by the ABC

verification framework.

The proposed tool-chain is also capable to map back counter-examples found by

ABC to original BIP models, and to visualize them through human readable wave

forms.

Such tool-chain is evaluated on two examples.

The paper contributes to existing work in the domain of verification of BIP

models.

It does not provide a direct comparison with the verification tool DFinder,

but as explained by the authors, since the current implementation of DFinder

does not consider transfer of data between components it is only applicable

to a restricted class of systems.

As shown by the experimental results, the verification with ABC on the AIGs

generated from BIP scaled better to large systems than existing NuSMV-based

model-checking approaches for BIP.

However, such results are mainly due existing reduction algorithms

implemented in ABC, the contribution of the paper regarding verification of

BIP models being only the translations from BIP to OLP, and from OLP to AIG

(which is the input format of ABC).

Moreover, these transformations are the core results of the paper, but their

presentation should be improved as they lack too many details (apart from

Section 2).

For instance, Section 3 is too short and I would expect it to include a

proper (formal) definition of the semantics of one loop programs.

My main concern regards proofs of both theorems: they are established

informally and without the necessary details, which make them not very

convincing and strongly limits their interest.

For these reasons I think the paper cannot be accepted in its present form,

and can only be considered for publication if (i) better definitions of the

semantics of OLP and AID are provided, and if (ii) proofs are updated w.r.t.

these semantics and properly formalized.

My other comments and suggestions are provided below.

- p.1: "Runtime verification [...] exhibit expensive [...]." -> "Runtime

verification [...] exhibitS expensive [...]"

- p.2: "However, DFinder [...] only the verification of deadlock-freedom.":

This is not correct, the method is applicable to the verification of any

safety property, although being based on abstractions it performs better for

a sub-class of safety properties, e.g. deadlock-freedom.

- p.3: "BIP is based on the generation [...] and the so-called BIP engine,

which simulates BIP semantics [...]" -> I would prefer "BIP is based on the

generation [...] and the so-called BIP engine, which interprets the BIP

semantics [...]"

- p.3: "1. Each atomic component sends [...] its current location.":

Technically in engine-based execution of BIP models are shared-memory

execution, i.e. states of components are not sent nor duplicated but simply

accessed (read) by the engine. In multi-thread execution, components only

send notification massages (without data) when they complete a transition

execution.

- p.3: "We recall the necessary concepts [...] desin:[...]" -> "We recall the

necessary concepts [...] design:[...]"

- p.4, §2: "x := f^x(X) \in f\_{\tau}" -> "(x,f^x(X)) \in f\_{\tau}"

- p.4: "The semantics [...] is an LTS over configurations [...]": At this

stage of the paper configurations are not defined. It would be good to either

give an informal definition of them here, or to move their formal definition

(the one after Def. 3) here.

- p.4, Def.3: This presentation of the semantics using v\_p is useful for

further composition of components including transfer of data, but it should

be commented otherwise it is very hard to understand. It would be good to

state that valuations v\_p are parameters that are further instantiated when

composing components w.r.t. data transfer functions considered for

connectors, and to cite existing papers which have the same presentation of

the BIP semantics. Moreover, in Definition 3 the notation v/v\_p is not

defined which brings additional fuzziness.

- p.4, § after Def.3: Explanations provided here do not provide any

clarification to Def.3. I would expect more here, as explained in the

previous point.

- p.4: "2.1.2 Creating composite components" -> "2.1.2 From Atomic to

Composite Components"

- p.4: "Assuming [...] how to connect the components in the set {B\_i}\_{i \in

I} with I \subseteq [1,n] [...]" -> "Assuming [...] how to connect a subset

{B\_i}\_{i \in I}, I \subseteq [1,n], of the components [...]"

- p.4, Def.4: To make sense, when you should compose components with disjoint

sets of ports and variables.

- p.4: "The meaning of the above rule [...]" -> "The meaning of the rule of

Figure 2 [...]"

- p.4, Def.6: "[...] is a state of B\_i." -> "[...] is a configuration of

B\_i.". In general avoid using different words for the same thing, especially

if you properly defined one of them in your context.

- p.5, Fig.2: According to Def.6, variables v\_i correspond valuations

associated to configurations q\_i = (l\_i, v\_i). Use another symbol to denote

the result of the transfer of data F\_a({ v\_{p\_i} }\_{i \in I})!

- p.5, Def.10: "\exist a\_i [...]" -> "\exist a\_i [...] and b\_i(index(a\_i)) is

true"

- p.5 "[...] execute simultaneously [...]": I would prefer "[...] can execute

simultaneously [...]" since parallel execution is a matter of implementation.

- p.6, Fig.4: This syntax is ambiguous, which is especially annoying for

ternary choices (a? b : c). Please add parenthesis in expressions of Fig.5

otherwise there is no way we can guess how to interpret them.

- p.6, Fig.5: "timer.timer.e = is[0]" -> "timer.timer.s = is[0]"

- p.6, Fig.5: "timer.done.e = is[1]" -> "timer.done.s = is[0]"

- p.6, Fig.5: "light.done.e = is[1]" -> "light.done.s = is[0]"

- p.6, Fig.5: In the next-list, replace also ".e" by ".s".

- p.6 "Function G : V \mapsto Types [...]" -> "Function G : V \to Types

[...]"

- p.7: "[...] vertices in R or I [...]" -> "[...] vertices which are either

inputs or registers [...]"

- p.7, Def.15: This definition is not complete and should mention Figure 6.

Moreover, the next paragraph is not useful.

- p.7: "node" -> "vertex": Again, avoid using different words for the same

thing.

- p.7: "fanouts": There is no proper definition of fanouts whereas there is

one for fanins. Please add one (definitions of fanins and fanouts could be

factorized using "resp.").

- p.8, Th.1: "[...] the set of traces of P is equal to the set of traces of

A.": Technically, traces of P and traces of A are different mathematical

objects, please establish correspondence between the two.

- p.8, Sec.5: "[...] with its own customized execution engine." -> "[...]

including an encoding of the semantics of interactions and priorities."

- p.9, 1.: "Currently, [...] to avoid executing conflicting interactions. Two

interactions [...].": This is misleading: the parallel execution of

interactions is not only restricted by conflicts when priorities are

considered. This is a topic in itself addressed by existing papers, please

cite some of them here.

- p.9, 2.: "Array element is[j] [...] when ip[j] is true either [...]" ->

"Array element is[j] [...] when ip[j] is true and either [...]"

- p.9, 2.: "[...] and j is the first enabled interaction greater with an

index greater than j": This does not make sense, please reformulate.

- p.9, 4.: "[...] when cycle is equal to zero [...]" -> "[...] when cycle is

equal to true [...]"

- p.9, 4.: "[...] when cycle is equal to one [...]" -> "[...] when cycle is

equal to false [...]"

- p.10, Sec 5.1: "[...] where cycle is equal to zero [...]" -> "[...] where

cycle is equal to false [...]"

- p.10: "[...] sets cycle to zero [...]" -> "[...] sets cycle to true [...]"

- p.11: "Otherwise, let a\_j be the interaction [...]" -> "Otherwise, let a\_j

be an interaction [...]"

- p.11, Sec.5.2: "The operational semantic [...]" -> "The operational

semantics [...]"

- p.11, Sec.5.2: Why can't you simply compose the effect of data transfer

transition execution to have one-cycle implementations in any case?

- p.11, Sec.6.1: "The module [...] the generate AIG [...]" -> "The module

[...] the generated AIG [...]"

**Report 101-R-407**

**Default**

**SECTION I: Summary and Recommendation**

**Summary of Evaluation**

Overall quality is:

Good

**Score**

Please select the score of the paper.

Either Way

**Confidence**

Please select your confidence.

High

**SECTION III: Overview**

**Reader Interest**

1. Is the paper of current interest to a reasonable segment of the journal?

Yes

2. Relative to the current level of reader interest in the paper, how is this interest likely to change during the next five years?

Relatively little change

3. Within its particular field of specialization, is the topic of the paper considered important?

Moderately so

**Content**

1. Is the paper technically sound?

(not necessary for style review)

Appears to be, but didn't check completely

2. How would you describe the technical depth of the paper?

Appropriate for someone working in the field

3. Does the paper make a tangible contribution to the state-of-the-art in its field?

To a limited extent

4. Is the bibliography adequate?

Yes, after certain additions and,or deletions (see Detailed Comments)

5. To what extent is the material in the paper likely to be used by other researchers and practitioners?

Average

**Presentation**

1. Is the abstract an appropriate and adequate digest of the work presented?

Yes

2. Does the introduction clearly state the background and motivation in terms understandable to the non-specialist?

Yes

3. How would you rate the overall organization of the paper?

Satisfactory

4. Relative to the technical content, is the length of the paper appropriate?

Yes

5. Is the English satisfactory

Yes

6. How readable is the paper for a computer scientist or engineer who is not a specialist in this particular field

Readable with ordinary effort

7. Disregarding the technical content, how would you regard the quality of presentation?

Good

**Section IV: Detailed Comments for Author(s)**

Mandatory, please elaborate on your judgement.

The paper present a method to verify BIP models. This is accomplished by

translating the BIP specification into a synchronous circuit, and using ABC to

perform the verification. The method is rather straightforward. Since BIP has

essentially a state machine semantics, all is needed is to create a list of

expressions that update the state variables at each clock cycle. Then, this

representation is translated into an AIG circuit and fed to ABC for

verification.

Overall the paper is interesting from a tutorial point of view, however the

method employed is not particularly innovative. Specifically, this kind of

translations have already been developed for several high level models, such

as the synchronous languages. For instance, Esterel can be compiled to Verilog

or BLIF (see the Columbia Esterel Compiler). How does your method differ?

I think the interesting part is the generation of the scheduler and the

detection of the properties, which I think should be expanded at the expense

of the details of the translations. For instance, it is rather obvious how one

would go about translating the OLP into the AIG. Instead, it is not obvious

how to generate the output that says whether the system is deadlock free: do

you use DFinder to generate the corresponding invariant? Also, it is not clear

how you define the invariants. You show them in the benchmarks. But are these

part of the BIP specification, or are they defined separately?

Regarding the scheduler, you describe the procedure in Section 5. Here, it

would be easier for the reader if you explained the method by which you

activate the interactions, rather than dividing the procedure into the various

steps. Essentially you need to select an interaction, and you build a circuit

to do so. Describe the circuit, and perhaps put a picture showing how the

different arrays are related. I was in particular struck by this statement:

"Currently, one interaction is selected to avoid executing conflicting

interactions."

Does the BIP framework do the same, or is it able to execute several

interactions at a time, if they are not conflicting? If so, does this mean

that your semantics is slightly different? To my understanding, wire

"selector" makes a non-deterministic choice, which is evaluated under all

possible values during verification. Is this right? I.e., does the

verification account for all possible selections? But still, not for

concurrent selections?

It would be extremely interesting to compare the OLP to the code that is

generated for NuSMV. In my understanding, NuSMV uses a very similar notation:

the transition relation is defined using next-state expressions. In fact, I

would argue that you could simply start from the generated NuSMV to derive the

circuit, instead of introducing the OLP. Why didn't you follow this path? Are

there differences in the way for instance the schedulers are generated?

Understanding these differences could also shed light into the evaluation:

right now, it is difficult to tell whether the improvement in performance is

because ABC is a lot better than NuSMV, or whether the code that you generate

for ABC is better than the one you generate for NuSMV. What if, for instance,

you were to generate NuSMV code out of the OLP? How would NuSMV perform

compared to the original code? Also, you mention you perform certain

reductions outside ABC. Do you include these reductions also for NuSMV?

A few minor things:

- The text of the second paragraph of step 2 (section 5, page 9) must be

revised ("is true either"? "interaction greater with an index greater"?).

- On page 3, I don't understand the meaning of: "The interaction bit vector is

evaluated in real-time". Does the traditional BIP main loop not evaluate the

interactions in real time?

- There is confusion when you says that you denote by p.X the set of variables

assigned to the port p. X was previously (two lines above) used to denote

the set of all variables (I assume), and now you use it to denote x\_p, which

was defined as a subset of X. Please change notation.

**Report 101-R-292**

**Default**

**SECTION I: Summary and Recommendation**

**Summary of Evaluation**

Overall quality is:

Good

**Score**

Please select the score of the paper.

Mild Accept

**Confidence**

Please select your confidence.

High

**SECTION III: Overview**

**Reader Interest**

1. Is the paper of current interest to a reasonable segment of the journal?

Yes

2. Relative to the current level of reader interest in the paper, how is this interest likely to change during the next five years?

Growing interest

3. Within its particular field of specialization, is the topic of the paper considered important?

Yes, definitely

**Content**

1. Is the paper technically sound?

(not necessary for style review)

Yes

2. How would you describe the technical depth of the paper?

Appropriate for someone working in the field

3. Does the paper make a tangible contribution to the state-of-the-art in its field?

To a limited extent

4. Is the bibliography adequate?

Yes

5. To what extent is the material in the paper likely to be used by other researchers and practitioners?

Average

**Presentation**

1. Is the abstract an appropriate and adequate digest of the work presented?

Yes

2. Does the introduction clearly state the background and motivation in terms understandable to the non-specialist?

Yes

3. How would you rate the overall organization of the paper?

Satisfactory

4. Relative to the technical content, is the length of the paper appropriate?

Yes

5. Is the English satisfactory

Yes

6. How readable is the paper for a computer scientist or engineer who is not a specialist in this particular field

Readable with ordinary effort

7. Disregarding the technical content, how would you regard the quality of presentation?

Good

**Section IV: Detailed Comments for Author(s)**

Mandatory, please elaborate on your judgement.

This paper presents a decent report on rather complex approach to support the

development of the so called BIP (Behaviour-Interaction-Priority) systems. The

support includes both the generation of efficient circuit implementation for

FPGA or ASIC platform, and verification of deadlock freedom using a model checker.

I think the constribution is reasonable within the scope of the journal, text of

the paper is well written and mature enough. Since I had no problems to follow

the technicalities, I am happy to recomend acceptance.

--

Mohamad Jaber

Assistant Professor

Computer Science

American University of Beirut

[mj54@aub.edu.lb](mailto:mj54@aub.edu.lb)

<http://staff.aub.edu.lb/~mj54>

tel: +961(1) 350 000 ext 4256