Arseniy Alekseyev

presenting

Optimisation of Balsa control path using STG resynthesis

by

Arseniy Alekseyev, Ivan Poliakov, Alex Yakovlev, Victor Khomenko
What is Balsa

- High-level balsa language
- Predefined Breeze components
- Handshake communication

Advantages:
- Ease of design
- Incremental changes

Disadvantages:
- Area far from optimal
- Speed far from optimal
Balsa Workflow

High-level balsa code

Balsa compiler

Breeze components netlist

Per-component gate-level mapping

Gate-level netlist
Redundant handshakes

- External handshakes must be strict
- Internal handshakes do not matter
Main Idea

Specify the required behaviour of the entire circuit interface and let tools decide how to implement it
Circuit optimisation workflow

- Breeze components netlist
  - Netlist Segmentation (Workcraft)
    - Multiple smaller netlists
  - STG generation and composition (Workcraft+PCOMP)
    - STG decomposition (DesiJ)
      - Multiple smaller STGs
  - Synthesis (Petrify/MPSAT)
    - Optimised gate-level netlist
Netlist Segmentation

- Easier to implement
- Guaranteed success
- Not very fine-grained
- Questionable efficiency

STG Decomposition

- Potentially better efficiency
- Good control over the size of the resulting STGs
- Complex, requires tools (DesiJ)
Data path

- Too complex to synthesise
- Can be less efficient than custom-designed

Can be considered external to the system:
Individual components STGs

- No library of components — need our own

Component types:
- Pure control (Sequence, Concur)
- Data path control (BinaryFunc, Variable)
- Data path interface (Case, While)
Result optimisation

- Split the circuit with different tools
- Have different splits of the circuit
- Synthesise the circuit parts with different tools

Then choose any configuration of synthesised blocks such as to minimise the total circuit area.
Experimental results

- GCD contained 17 individual components with total cost of 285 literals if synthesised separately.
- GCD was synthesised in four blocks with total of 210 literals, which is 26% less.
- Not all combinations of components are possible to synthesise using current specifications.
Future work

- Make all combinations of components synthesisable
- Try STG decomposition
- Add data-path generation
- Compare performance to Balsa implementation
- Extend the components STG library
Thanks.

Questions?