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

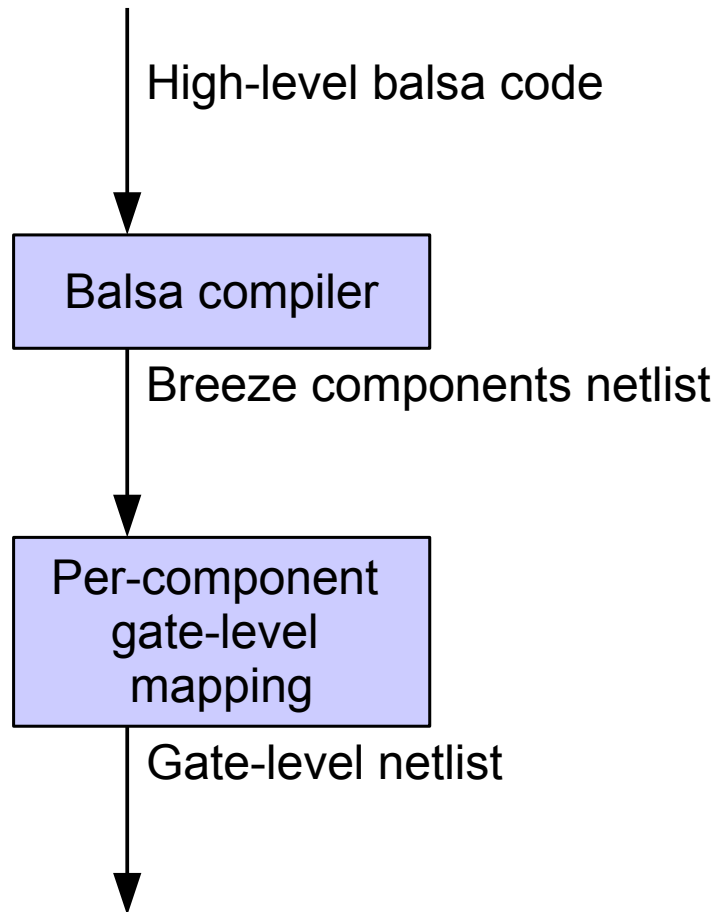- Predefined Breeze components

- Handshake communication

Advantages:
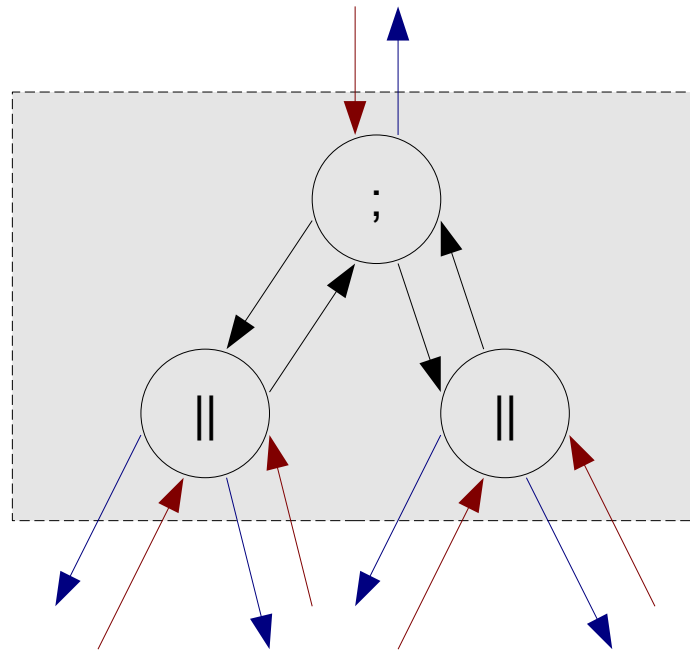
- Ease of design

- 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
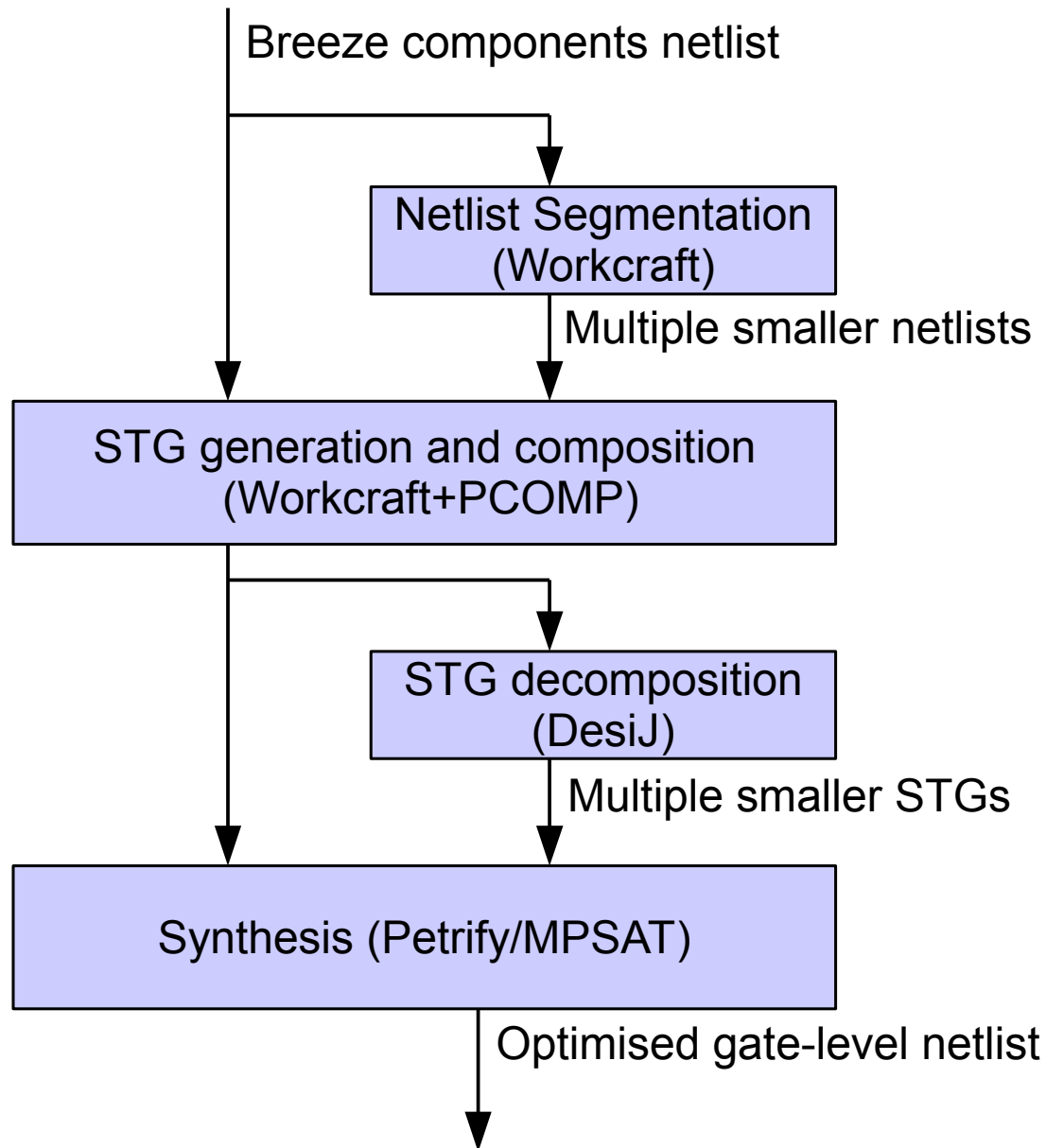mapping

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
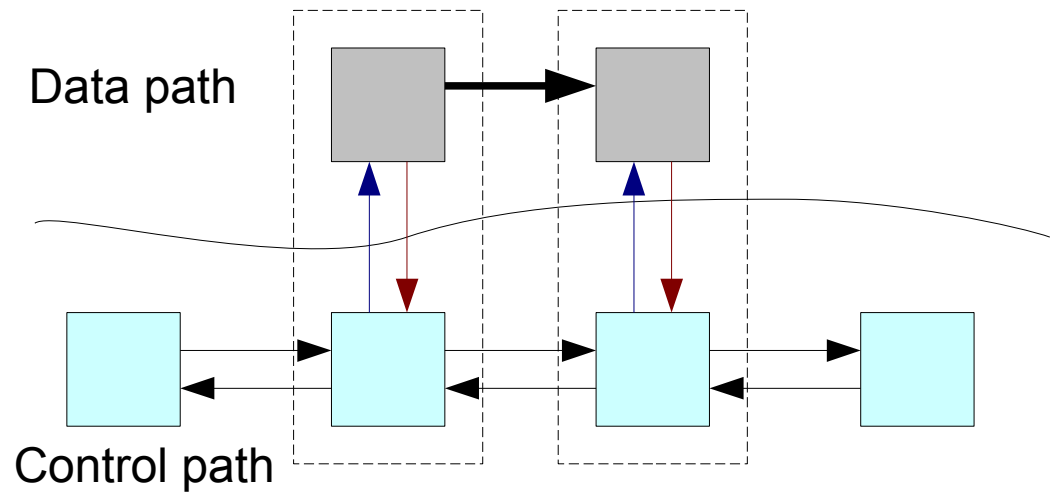
- Questionable efficiency

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:

Data path

Control path

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?