Design Space Exploration of Streaming Multiprocessor Architectures

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Introduction

- Objective: Fast & accurate Design Space Exploration (DSE) method for streaming signal processing applications.
- Method should support DSE at high levels of abstraction - System level.
- Approaches examined: Symbolic Instruction Traces (TD), Control Data-Flow Graphs (CDFG), Data-Flow Graphs (DFG), and Symbolic Programs (SP). The main distinction among these approaches is with respect to internal representations they use.

The CDFG Approach (The Flow & the Complexity Issue)

- Pros: (1) Level of accuracy is high, and (2) degree of closeness to the common design approaches is in general high.
- Cons: (1) Driven by designers' experiences, and almost impossible to be automated, and (2) the complexity of CDFGs can be huge with respect to the level of abstraction being used.

The TD Approach (The Flow & the Inaccuracy Issue)

- Pros: (1) Fast way to obtain performance numbers, (2) architecture models are simple, and (3) easy to be automated.
- Cons: Reduced information in traces, and hence, (1) some characteristics cannot be modelled, so performance numbers may be inaccurate, and (2) degree of closeness to the common design approaches is in general low.

Symbolic Programs:

- They have control and structure as control data-flow graphs.
- They contain abstract operations (e.g., R, W, and E) as traces do.
- Common design transformations can be applied here as well.

The Hybrid DSE Mapping Approach: The SP Approach

- More accurate than the TD approach.
- Faster and easier to be automated than the CDFG approach.
- Valid only for a single data-set.

<table>
<thead>
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<th>Executable</th>
<th>YES</th>
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<tr>
<td>Control</td>
<td>YES</td>
<td>Symbolic Program</td>
</tr>
<tr>
<td>Data-Flow</td>
<td>YES</td>
<td>Graph</td>
</tr>
<tr>
<td>Symbolic Instruction Trace</td>
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<td></td>
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**Architecture**

**Symbolic Instruction Traces (TD)**

- Faster and easier to be automated than the CDFG approach.
- Valid only for a single data-set.

**Control Data-Flow Graphs (CDFG)**

- More accurate than the TD approach.
- Higher SIMULATION SPEED
- Low SIMULATION SPEED

**Data-Flow Graphs (DFG)**

- Pros: (1) Fast way to obtain performance numbers, (2) architecture models are simple, and (3) easy to be automated.
- Cons: Reduced information in traces, and hence, (1) some characteristics cannot be modelled, so performance numbers may be inaccurate, and (2) degree of closeness to the common design approaches is in general low.

**Symbolic Programs (SP)**

- They have control and structure as control data-flow graphs.
- They contain abstract operations (e.g., R, W, and E) as traces do.
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