Experience with the FSMDesigner4 high level design entry tool for design and verification in research and teaching

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Outline

- Motivation
- FSMDesigner4 Overview
- Experiences in Teaching
- Experiences in Research Projects
- Conclusion & Outlook
Motivation

- Immense growth of the HW design complexity
- Supplement the design flow for frontend and backend
- Writing finite state machines in HDL is exhausting and error prone
- Special tools and design approaches are required to support the design flow from an abstract view

FSMDesigner4 is in use for more than two years now including the test phase and this presentation will provide information about experiences, advances and results.
FSMDesigner4 Features

- Enables a fast and efficient graphical design of FSMs
- FSMs can be converted into HDL code
- Graphical editing and fast correction of errors
- Efficient synthesizable HDL code especially for high-speed FSMs
- Support for verification
- Interactive simulation together with the waveform viewer of the Cadence tool chain
- Helps to verify and visualize the behavior of the designed FSMs
FSMDesigner Concepts

Provides all standard features expected of modern software

Additional features:

- Non-modal easy to use widgets
- Multiple Undo/Redo
- Validation of FSMs
- Table-based editing
- X-rest function support
- Fully scriptable
FSMDesigner Links

Research project webpage:
http://ra.ziti.uni-heidelberg.de/index.php?page=projects&id=fsmdes4

Hosted by SourceForge:
http://sourceforge.net/projects/fsmdesigner/

Wiki Pages:
http://fsmdesigner.wiki.sourceforge.net/
Downloads during the last 12 months 1,778 (2.0 GB)
Total downloads 3,137 (3.5 GB)
Motivation for Teaching

- Ensuring that students learn the right methodologies for writing HDL
  - Eases the first steps in learning FSM designs
  - Good introduction for verification and simulation
  - Supports the understanding of the separation of data and control path

- Using the Cadence design flow environment
  - Get to know Cadence tool features
  - General understanding of importance and usage of scripting together with cadence tools
Teaching Example

- Integrated support of Cadence SimVision
  - Automatic generation of testbench structures
  - Mnemonic maps
- Simultaneous usage with SimVision
  - Coverage graph
Experiences in Teaching

- Support for verification and simulation very helpful
- Integrated checks are valuable
  - Internal structural checks
  - The automatic generated assertions for coverage and correctness
- Graphical co-simulation of FSMDesigner4 together with the Cadence Simvision environment very useful for students starting to learn digital design
- Feedback from students valuable to improve usability
Usage in Research Projects

- FSMDesigner4 has been used in several research and Ph.D. projects
  - Implementations of network chips
  - Several control modules in FPGA based developments
  - Supporting control of I/O devices
Experiences in Research Projects

- Design of FSMs
  - Easy extension of existing FSMs
    - FSMs always grow during implementation phases
    - Design changes are less time intensive and less error-prone
  - Less errors because of generated code

- Project interaction
  - Increases reusability
  - Eases synchronization between engineers

- Documentation
  - Easy export of graphs to Specifications and manuals
  - Convenient for Diploma and Ph.D. thesis
Research Projects Examples

- Flash Memory Controller FSM
- Arbiters
- DDR control
- Controlling various IC
- Interconnection Protocol controls & implementation support
- Usage for building block modules
## Research Projects Statistics

From the group’s subversion repository:

<table>
<thead>
<tr>
<th>Project</th>
<th>Single FSMs</th>
<th>FSM Projects (FSMs)</th>
<th>Total FSMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash Storage Project</td>
<td>5</td>
<td>9 (27)</td>
<td>32</td>
</tr>
<tr>
<td>Interconnection Network Project</td>
<td>-</td>
<td>13 (40)</td>
<td>40</td>
</tr>
<tr>
<td>Other Projects</td>
<td>38</td>
<td>18 (36)</td>
<td>74</td>
</tr>
<tr>
<td>Shared modules</td>
<td>1</td>
<td>12 (14)</td>
<td>15</td>
</tr>
<tr>
<td>All Projects and shared FSMs</td>
<td>44</td>
<td>52 (117)</td>
<td>161</td>
</tr>
</tbody>
</table>
Conclusion & Outlook

- FSMDesigner4 has proven its efficiency to:
  - be an useful tool for teaching digital design principals
  - reduce of design and verification time of projects
  - be ideal to supplement documentation

- Through the feedback from users further improvements will be implemented into the next releases

- A new major release is planned in about 6 months with a completely new graphical canvas implementation
Thank you for your attention!

Questions?