MINIMALIST: A CAD Environment for the Synthesis and Optimization of Burst-Mode Asynchronous Controllers

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ABSTRACT:

“Burst-mode” is a widely-used style for designing asynchronous controllers. The specifications were formalized in the early 1990’s, growing out of informal ideas in the 1980’s.

The controllers are Mealy-style, and are implemented as Huffman machines (i.e. combinational logic with feedback paths). As such, they have many commonalities with synchronous state machines and thus are fairly comfortable for use by synchronous designers.

This talk gives a short introduction to burst-mode controllers, then gives an overview of a state-of-the-art CAD package for burst-mode synthesis, called “MINIMALIST”.

A key focus of MINIMALIST is to facilitate “design-space exploration”:

- the package includes a configurable set of optimization algorithms, which can produce many different implementations for a given specification. Thus, the designer can explore trade-offs and select the implementation style which best suits the application.

- The package also includes graphical interfaces, a verification step, an interactive command shell, design scripts, and a Verilog back-end. The tool has been downloaded to over 100 sites in 18 countries.

Both exact and heuristic algorithms are included, such as state minimization, ‘optimal state assignment’, and fast algorithms for two-level logic minimization. The user can target ‘area’ vs. ‘speed’ tradeoffs, as well as literal optimization, single-vs. multi-output logic styles, using output wires as state variables, etc. Both two-level and “generalized C-element” implementations are targeted. Recently, such sophisticated options as ‘phase optimization’ have been included.

Benchmark results demonstrate its ability to produce implementations with better area and speed than existing burst-mode packages.

The presentation will also include industrial-style examples, as illustration.