Applying Transaction-level Debug and Analysis Techniques to DUT Simulated Activity Using Data-Mining Techniques

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Content will be reformatted into a poster for printing

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Abstraction of Simulation Activity

- Signal-level waveforms too fine-grained for most analysis
- <u>Transaction-level</u> provides the required clarity for bus-level activity for complex protocols
- Engineers today do the mapping manually



Right Tool for the Right Job



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Signals



Transactions encapsulate and communicate chunks of data instead of discrete signals

Anatomy of a Transaction



Representing Transactions in Debug Tool

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Overlapping transactions

Data Mining from Signal-Level Trace



 SVA has local variables which can map to attributes for transactions

Example SVA Code

```
sequence core_memory_write;
logic [10:0] Addr;
logic [31:0] Data;
```

```
(1) ## 0
(EN == 1'b1 && WE == 1'b1,
Addr = ADDR, Data = DI) ##1
(!(EN == 1'b1 && WE == 1'b1));
adapaguanga
```

endsequence

```
sequence core_memory_read;
logic [10:0] Addr;
logic [31:0] Data;
```

```
(1) ## 0
(WE == 1'b0 && RST == 1'b0 &&
RDInvalid == 1'b0, Addr = ADDR) ##1
(RDInvalid == 1'b0) ##1
(1, Data = DO);
Endsequence
```

CORE_MEM_WRITE : assert
 property(@(posedge CLK)
 core_memory_write);

CORE_MEM_READ : assert
 property(@(posedge CLK)
 core_memory_read);

nVidia Flow and Code

- Code SVA to describe transaction information.
- Dump trace file which has protocol signal activity
- Data-mine transactions.
- Load new generated trace file with transaction data

```
property APB_READ;
logic [ 31 :0] Addr; // local variable to record attribute addr
logic [ 31 :0] Data; // local variable to record attribute data
logic [127:0] Client; // local variable to record attribute client name
@(posedge pclk) disable iff (disable_ntx_dump)
((psel && !penable && !pwrite), Addr = paddr) |-> ##1
(((psel && penable && !pwrite && pready)[->1]), Data = prdata, Client = "dtv");
endproperty
```

APB_READ_nTX : assert property(APB_READ);

In Real-Life



* Example from nVidia environment

Filtering and Highlighting



User-defined highlighting (regular expression based)

Filtering works in a similar fashion

Relationships



Protocols often have complex relationships between a hierarchy of transactions

Future: A tool designed from the ground-up for Transaction-Debug

- Next-level Requirements are different that what a waveform can provide. User-driven application-level data mining is key
 - Sorting
 - Filtering
 - re-arranging
- Similar to commercial DBs and SQL
- Abstraction will become critical as the realities push signal-level analysis out of mainstream
- Research into intelligent recognition without any user input

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