9 Assertions and Sequences

The testing that has been demonstrated to this point has been direct testing. *Direct testing* is a method where the designer generates an input vector with the sole purpose of testing for a specific fault or set of faults. In the combinational design, this amounted to generating all 2^n values for n inputs and checking to see that the output values were correct. In the the design of FSMs, the testbench generated a sequence of inputs that would drive the FSM through all of its state transitions. Although each of the test vectors may have uncovered more than the intended fault, the point is that the test vectors were generated with the purpose of directly testing a specific fault set.

Assertions provide a means of *indirectly* testing a general property of the design. An example of a property might be that: the value in the FSM state register will only be valid state assignments defined in an enumeration. Then as the system operates with a set of test vectors for a different fault, if that property is violated, the assertion will flag the error. Another situation may be the operation of a system bus. Read and write protocols (sequences of input values) are defined for the bus and assertions are written to check for violations of these protocols. Then a processor on the bus is simulated executing a program from the memory. Since the processor fetch and program execution need to access the memory, the assertions check if there is any violation of the bus protocols.

Notice that the test vectors in the first example, and the program's instructions in the second, weren't generated to find specific faults. Indeed, they could have been randomly chosen. Rather, the system was being run through its general functionality while the assertions watched for violations.

9.1 Introduction

There are two basic types of assertions: immediate and concurrent.

- An ***immediate assertion*** is a procedural statement and thus can be used anywhere a procedural statement is allowed. Since an immediate assertion is typically part of the