ICS M2 Degree - 2022-2023 - Advanced Digital Electronics

Practical Session N°5 & 6

Simulation using the modelsim tool
Use of processes

Realization of a data path and a state machine

We wish to realize an operator that allows to calculate the average power of a signal.
We will use the formula :

$$P = \frac{1}{N} \sum_{k=0}^{N-1} x_k{}^2$$

Where N is the number of samples used to make the calculation
The x_k signal arrives synchronously to the clock signal, and the P signal must remain present until the next calculation.
The calculation is started only if the control signal C is at 1. If it is at 0, the operator eventually finishes his last calculation and then goes into standby mode..

1°) Propose a data path diagram allowing the realization of this operator

2°) Identify all the signals used to control this data path

3°) Propose a state machine diagram to control the previous signals

4°) Describe and compile the entity of the operator in the td5 directory. The number N must appear as a power of 2 : $N=2^l$ with l the generic parameter equal to 10 by default.

5°) Write the testbench which will allow to check the correct operation of the operator. This testbench will generate a sinusoidal input signal with an amplitude equal to the maximum admissible amplitude. The amplitude of the input signal will be divided by 2 for every N samples. Compile and simulate the testbench.

6°) Describe the state machine part of the operator, then check its operation in simulation using the previous testbench.

7°) Describe the data path using integer operators and verify the operation of the whole circuit. In particular, check that the calculated power is divided by 4 at each new calculation. The size of the operators will be calculated from the generic parameter l.