MAS WES 268

Projet 4 : FFT

Rajan Verma

Initial :

```
1023    -513.063354 -166885.500000
Comparing against output data
---------------------------------------------
   RMSE(R)           RMSE(I)
0.000819118518848 0.001881957286969
---------------------------------------------
*********************************************
PASS: The output matches the golden output!
*********************************************
```

Hardware implementation – First :

Github Path : project4/FFT/HLS/2_Skeleton_Restructured

Report : project4/FFT/HLS/2_Skeleton_Restructured/fft_hardware_1/solution1/syn/report

```
6 ---------------------------------------------
7    RMSE(R)           RMSE(I)
8 0.000450454419479 0.000541143584996
9 ---------------------------------------------
0 *********************************************
1 PASS: The output matches the golden output!
2 *********************************************
```

Target	Estimated	Uncertainty
10.00 ns	7.256 ns	2.70 ns

Performance & Resource Estimates

Modules Loops

& Loops	Issue Type	Violation Type	Distance	Slack	Latency(cycles)	Latency(ns)	Iteration Latency	Interval	Trip Count	Pipelined	BRAM	DSP	FF	LUT	URAM
				-	-	-	-	-	-	no	38	36	5610	9036	0
_Pipeline_VITIS_LOOP_51_1	II Violation			-	3075	3.075E4	-	3075	-	no	0	0	139	340	0
_Pipeline_VITIS_LOOP_79_1				-	529	5.290E3	-	529	-	no	0	0	779	220	0
_stages	II Violation			-	-	-	-	-	-	no	0	12	2054	2874	0
TIS_LOOP_143_2				-	11264	1.130E5	22	-	512	no	-	-	-	-	-

Throughput : 45.9 Mega Samples/second

Architecture explanation :

Starting with Bit reversal , here both real and imaginary parts, so we go through all th indices and swap the elements. And this is required so that the data is in order for butterflies computations.

for the first layer I use the unity twiddle factor (these come from give W* arrays). This stage performs pairwise computations also called butterlies for entire dataset. , we also calculate sum and differences of pairs.

For the middle stages , again butterflies are calculates. and this is for 2 to logN-1 (log base2).

The function calculates the number of points in each sub DFTs and iterates for maths.

For final stage processes entire dataset with twiddle factos and completed the transportion of time to frequency domain.

Github : project4/FFT/HLS/2_Skeleton_Restructured_optimized

When I try to use Pragmas, loop unrolling and other techniques , testbench fails :

```
5 ------------------------------------------------
6    RMSE(R)           RMSE(I)
7 0.008071812801063 1.153418779373169
8 ------------------------------------------------
9 ************************************************
10 FAIL: Output DOES NOT match the golden output
```

OFDM :

I updated some code in qpsk_decode, updated fft.h though its still failing for compilation. so need to further work on this.