

Implementing Bio-Inspired Frequency Detection on an FPGA

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Research Question

How could the way fish use electric fields to sense objects be replicated for applications to fast, low-power remote sensing?

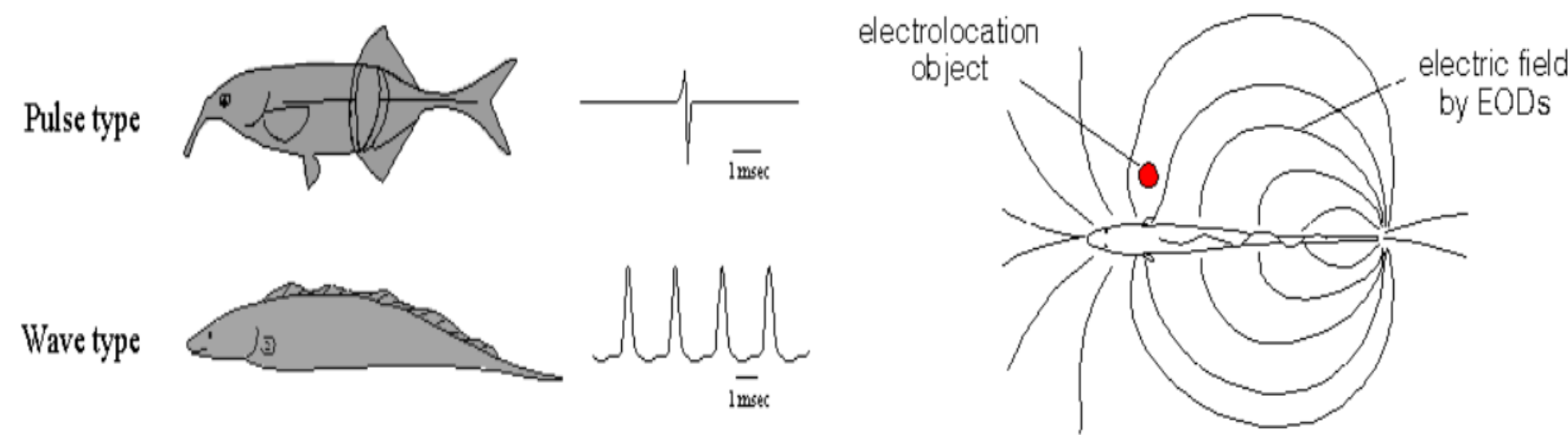


Figure 1: Signal generation Electric fish

Background

- Certain fish use electric fields to generate signals of certain frequencies to sense their surroundings
- Increasing need for fast, low-power methods to analyze frequencies of signals
- A Fast Fourier Transform (FFT), a signal processing algorithm built for speed, can be used to improve the execution time needed to analyze signals
- A Field Programmable Gate Array (FPGA), a user-programmable circuit board, can be utilized for low-power operation of FFT

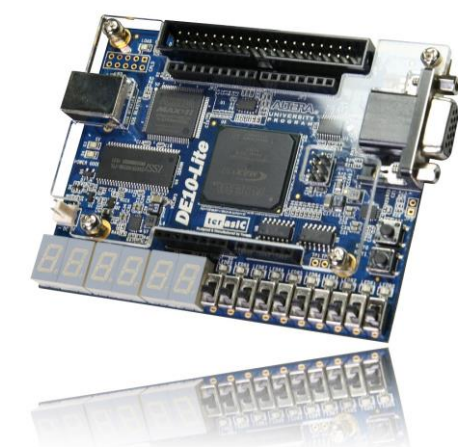


Figure 2: DE-10 Lite FPGA board

Research Method

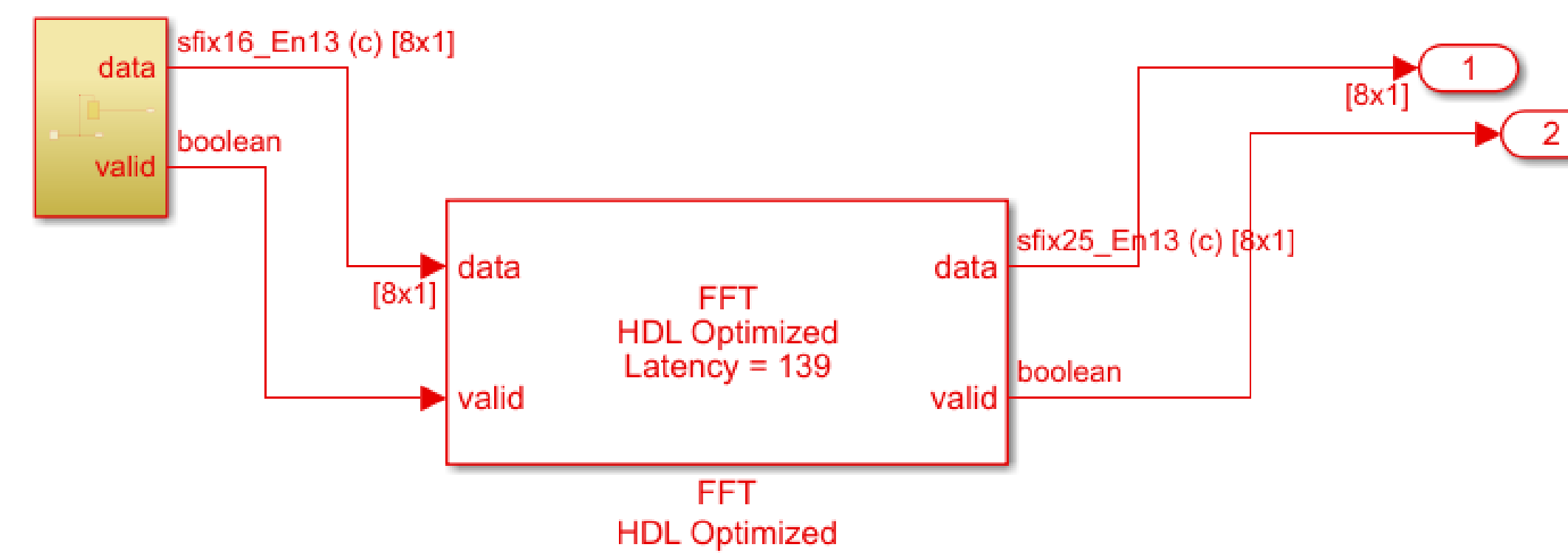


Figure 3: Simulink FFT HDL Block Model, HDL compatible for FPGA programming

Sample Mode	Output Complexity	Computational Method	Optimize Table for	Sample Time	Samples per Frame	Sampling Frequency, Fs
Discrete	Complex	Table Lookup	Speed	1/2000	8	2000

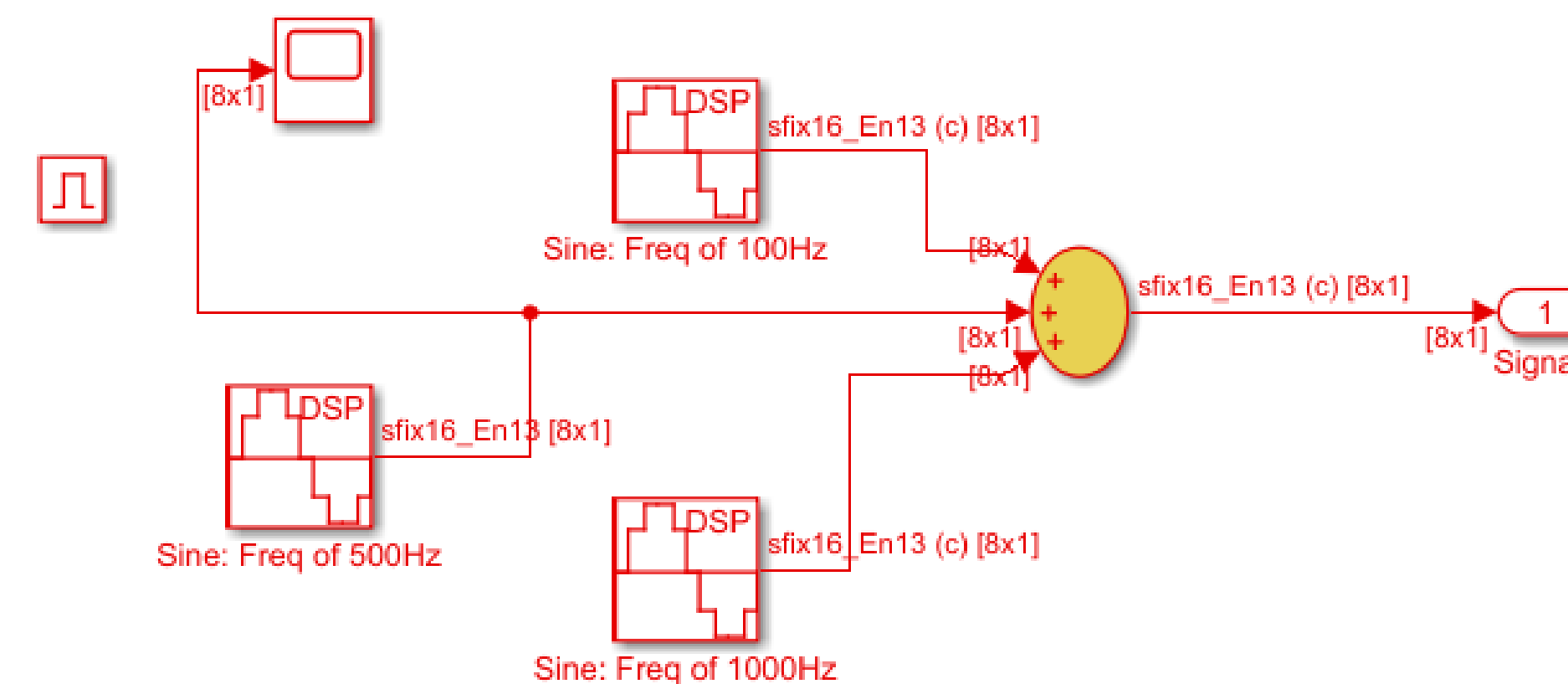


Figure 4: Digital Input Sine wave Signals of Varied Frequencies (100, 500, & 1000 Hz)

Findings

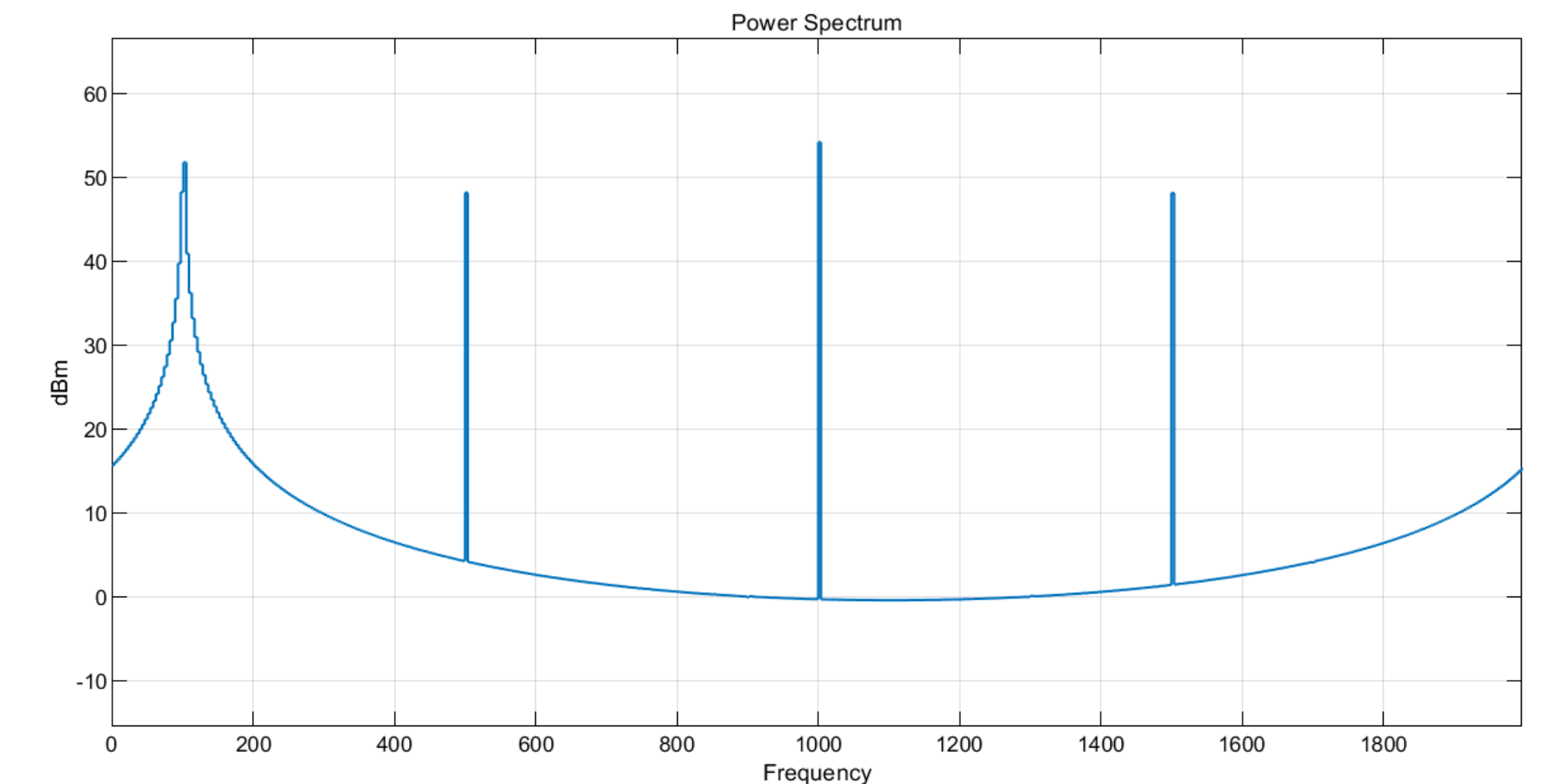


Figure 5: Power Spectrum shows peaks at desired frequencies of 100, 500, 1000 Hz

The FFT Algorithm compiled in FPGA software, Altera Quartus. Shows the possibility of designing fast signal processing algorithms for low power applications.

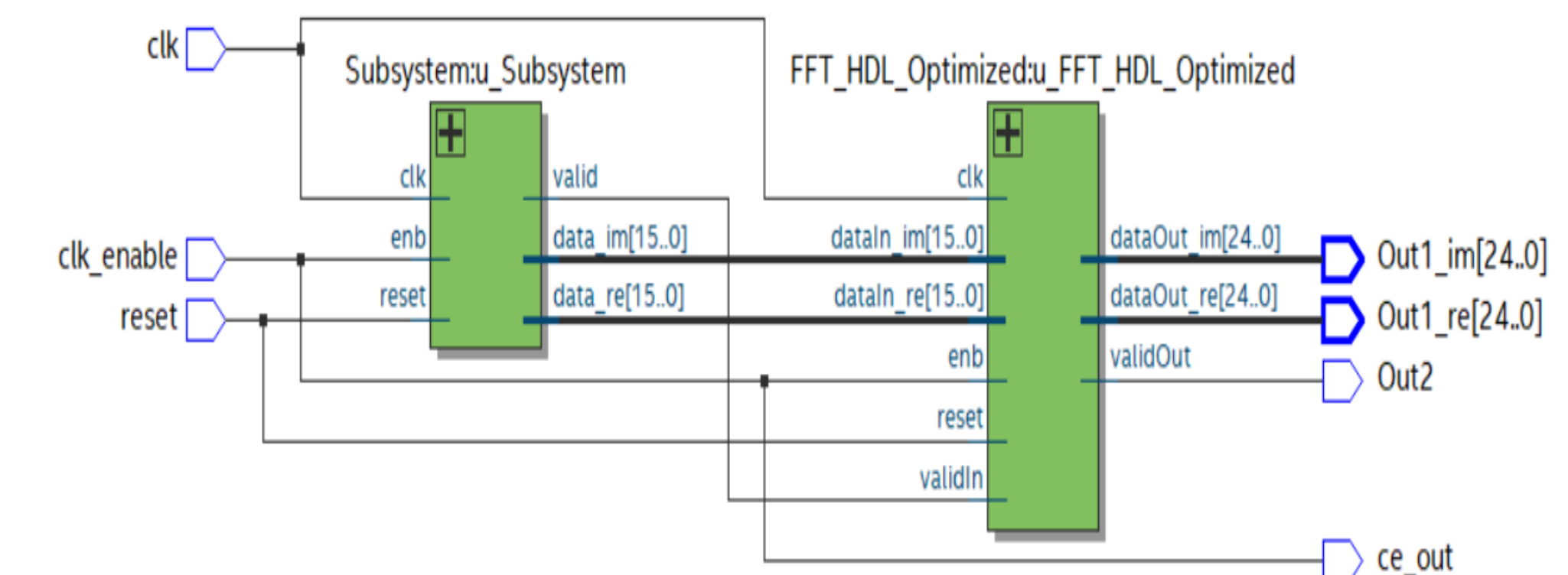


Figure 6: RTL Netlist shows the logic connectivity and flow

Acknowledgments

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