FIR

FIR-Filter for Betty SDR

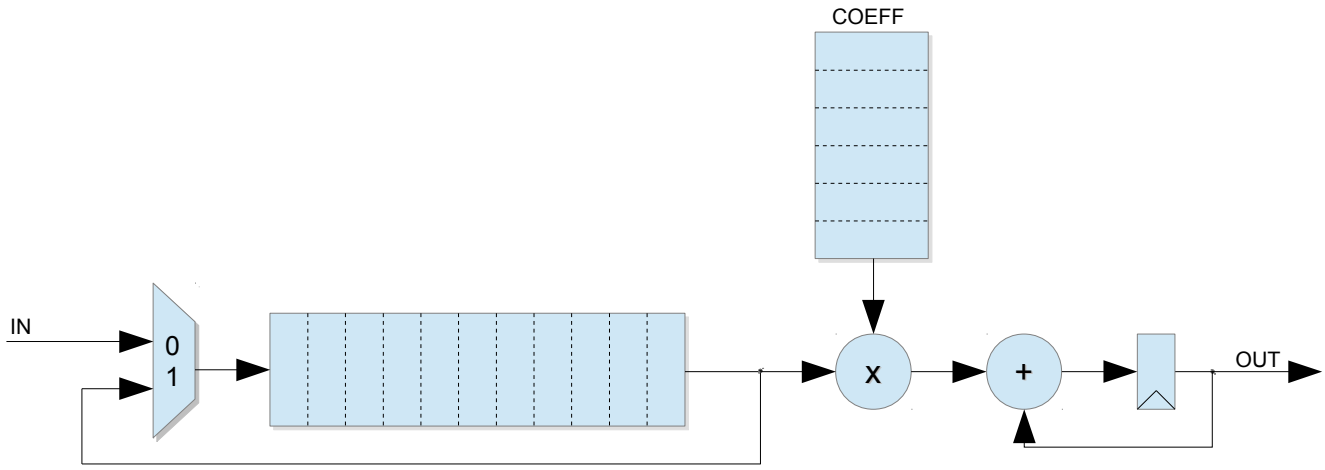
Filename: fir.vhd
Dependencies: none
Actual version: 1.0

Interface definition:

Generic Name	Type	Description
fir_order	natural	filter order
fir_coeff	fir_coeff_t	signed Q26 format

Port Name	Type	Description
clk	Input (std_logic)	system clock
stb	Input (std_logic)	input data strobe
d	Input (signed)	data input in Q26
q	Output (signed)	data output in Q26
rdy	Output (std_logic)	output data strobe

design structure:



FIR-Filter for Betty SDR

Design test:

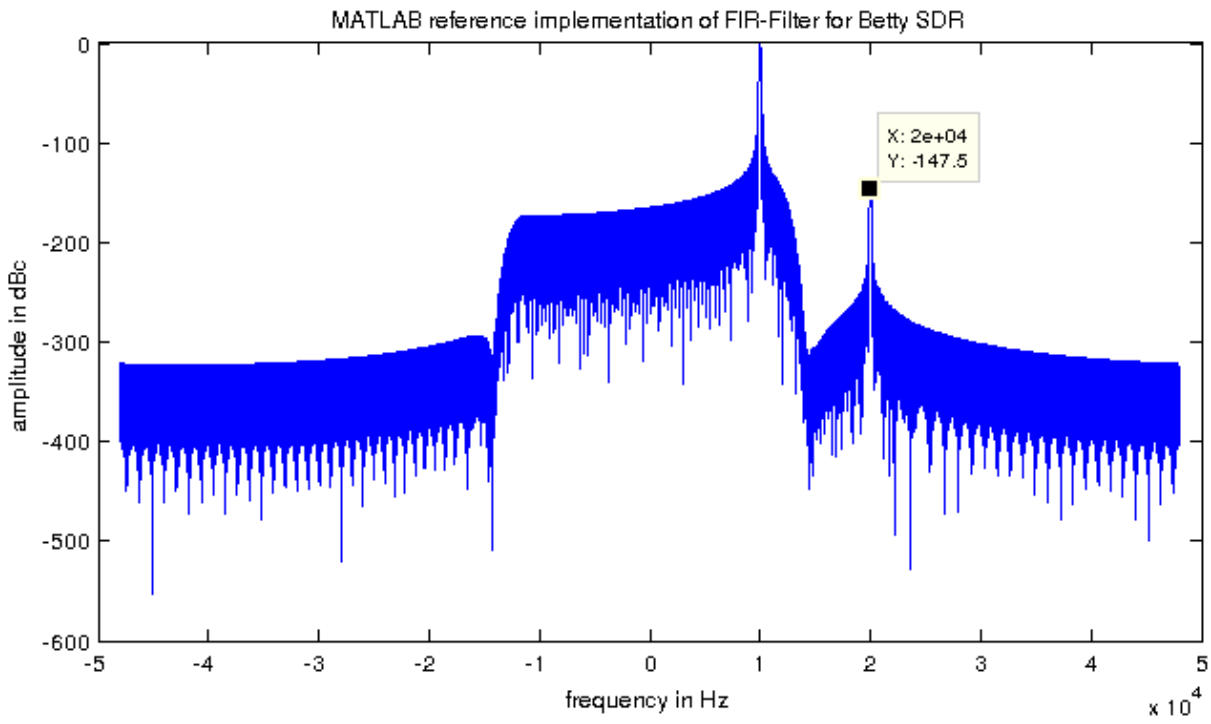
test enviroment: ghdl + matlab

test discription:
It will be tested for amplitude and phase errors.
The filter will be applied to two different channels. One stimulated with a sinus wave and the other stimulated with the orthogonal cosine wave. The two output signals forms a complex signal which will be analysed. In addition each channel consists of two different waves. One wave in the passband and one in the stopband of the filter.

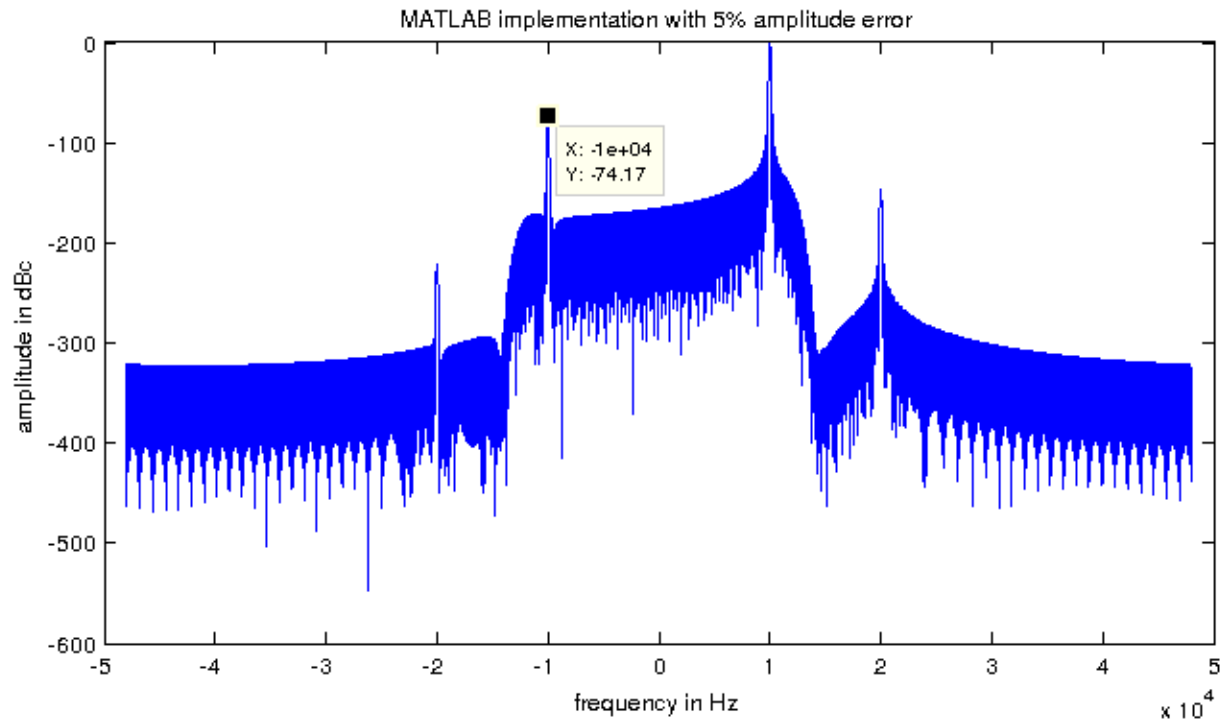
I channel: $X_I(t) = 0.5\cos(2\cdot\pi\cdot f_1\cdot t) + 0.5\cos(2\cdot\pi\cdot f_2\cdot t)$
Q channel: $X_I(t) = 0.5\sin(2\cdot\pi\cdot f_1\cdot t) + 0.5\sin(2\cdot\pi\cdot f_2\cdot t)$
with $f_1 = 10\text{kHz};\ f_2 = 20\text{kHz}$
filter characteristic: $f_c = 12.5\text{kHz};\ n = 128$

The complex output signal consists of one signal with a positive frequency on the position +10kHz. The signal with the positive frequency +20kHz should be suppressed. In the FFT plot there must no image frequencies.

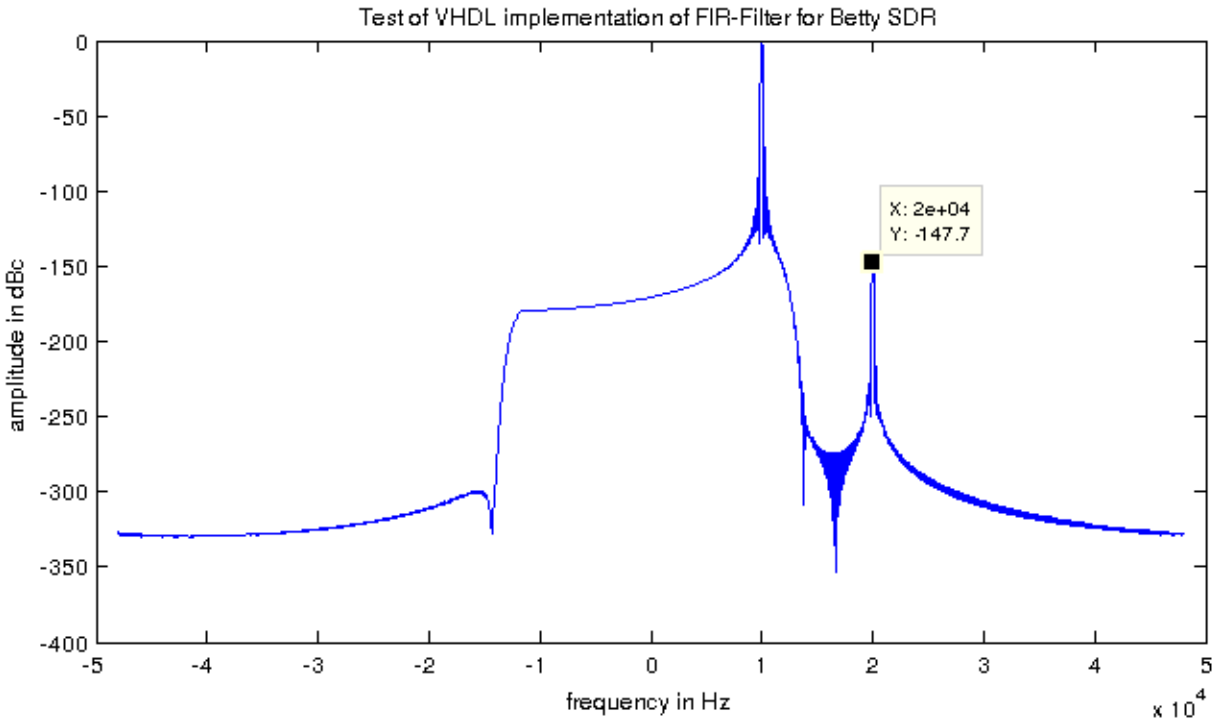
The result of the MATLAB reference implementation(firf.m in directory test):



An example of 5% amplitude error:



The result of the VHDL implementation:



Test result:

The spectrum of the output signal of the VHDL implementation shows no image frequency and has a perfect suppression of the signal in the stopband.
The Test is passed by the VHDL implementation.