

Digital Integrated Circuits and Systems

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Lab 7: HLS IP and Vivado

Tool: Vitis 2025.1, Vivado 2025.1

Task: Synthesize FIR filter, package IP and insert in Vivado project, compare Vivado & HLS simulations

Vitis HLS FIR synthesis

- Synthesize digital filter with loop unroll, pipeline and interface directives

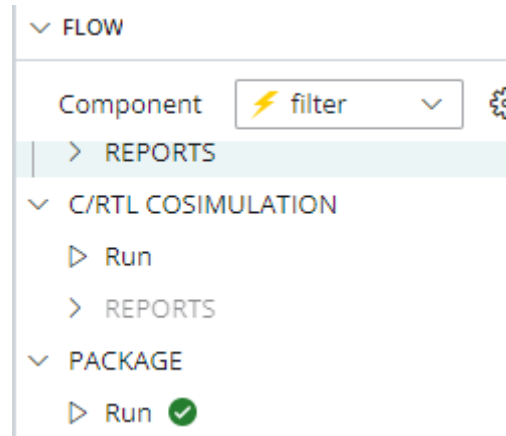
```
DT filt(const DT x)
{
    #pragma HLS INTERFACE mode=ap_ctrl_none port=return
    #pragma HLS PIPELINE
```

HLS Directives



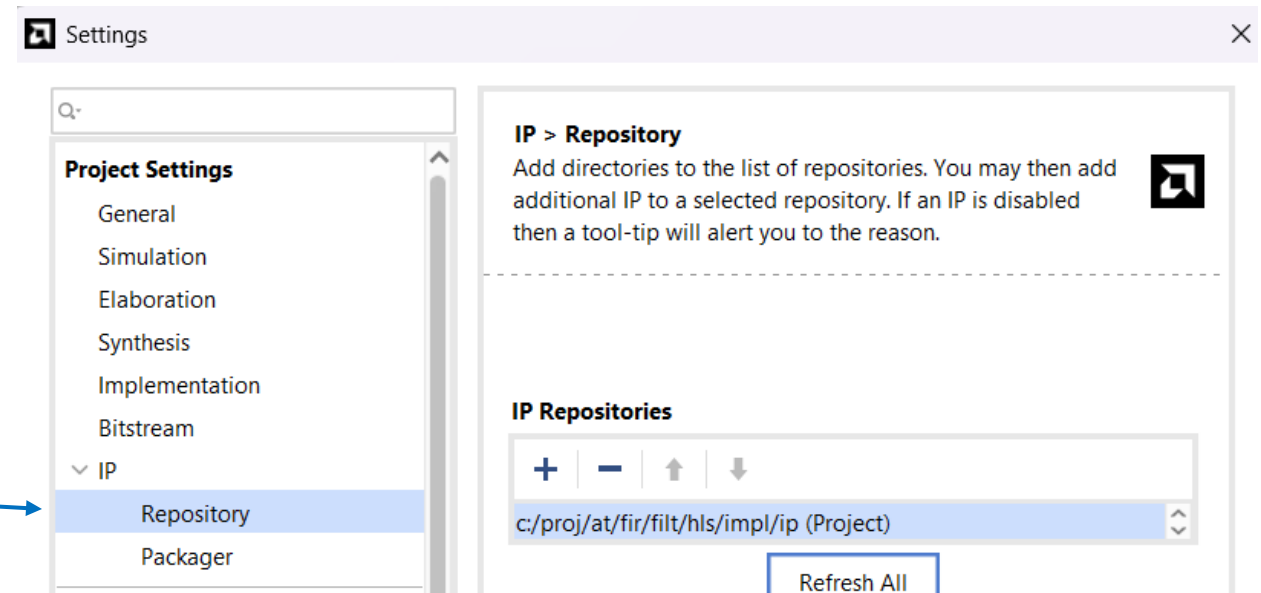
- Package your IP

- packaged files in ...\\hls\\impl\\ip
- description in component.xml
- all IP files in folder and in *.zip file

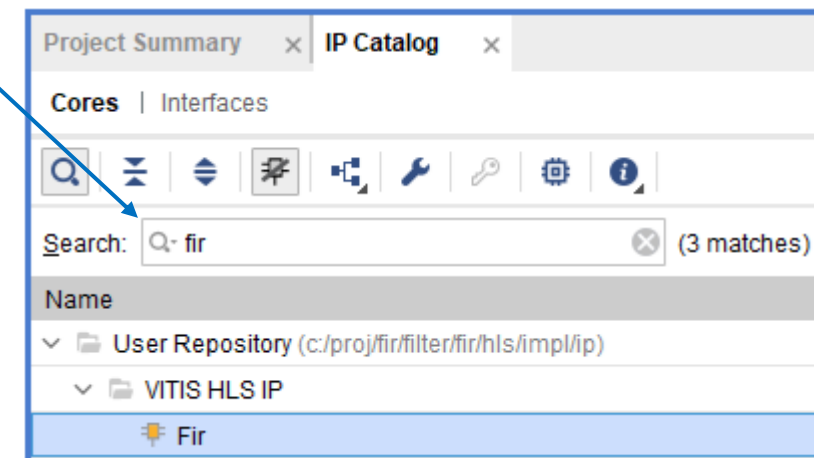
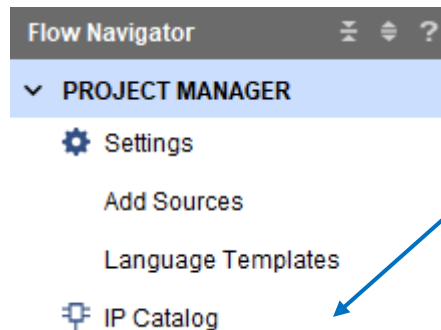


Vivado project

- create new Vivado project,
 - Default part: Boards, select Red Pitaya STEMLab-14
- Settings
 - Define IP location

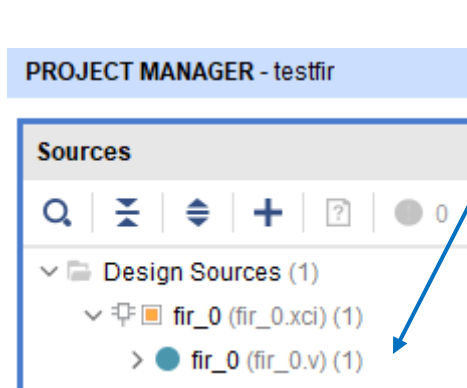


- Search and add from IP Catalog your filter to the project



Circuit simulation in Vivado

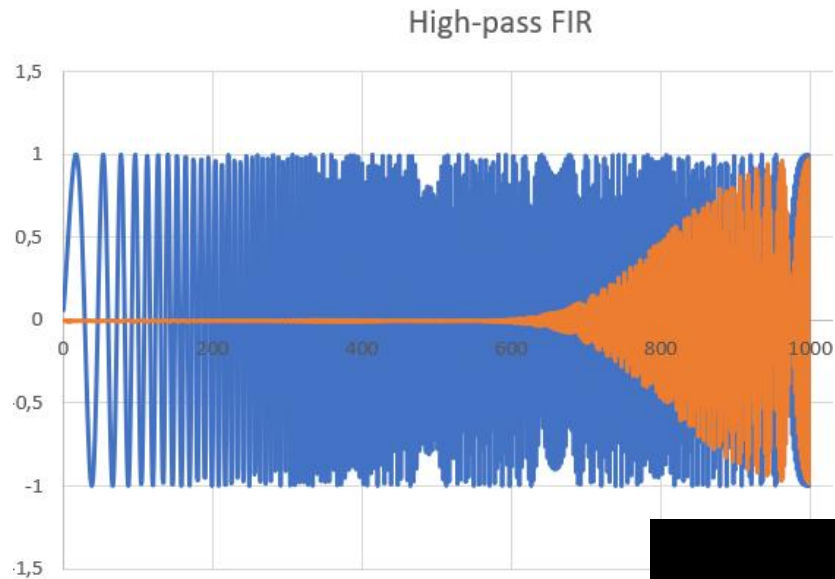
- Add the provided testbench file as simulation source
 - Add Sources, Add or create simulation sources
 - Check (and modify) filter instance name



```
module test_filt;  
    logic clk = 0; // 100 MHz clk  
    always #5 clk = ~clk;  
  
    logic signed [13:0] in; // DUT signals  
    logic signed [13:0] out;  
  
    fir_0 dut ( // Design Under Test  
        .ap_clk(clk),  
        .ap_rst(0),  
        .x (in), // input data  
        .ap_return(out) // output data  
    );
```

Compare FIR responses

- compare FIR design characteristics with HLS simulation results and Vivado circuit simulation



<https://fiiir.com/>

FIIIR! - Design FIR & IIR Filters - From TomRoelandts.com

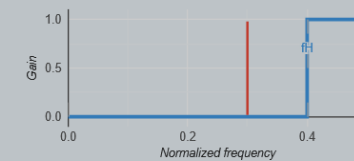
Filter Settings

Filter type

High pass (windowed-sinc FIR)

High-pass Windowed-sinc FIR filter (more info in [How to Create a Simple High-Pass Filter](#)). The ideal response is updated on the fly, but you still have to push the Compute Filter button below to recompute the filter.

Ideal response



Sampling rate [Hz]

1

Cutoff frequency f_H [Hz]

0.4

Transition bandwidth b_H [Hz]

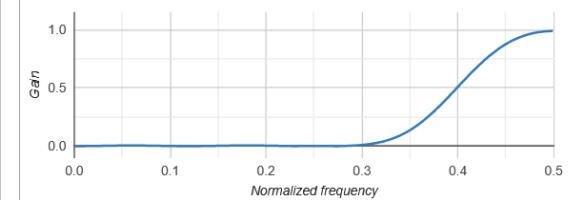
0.2

Window type

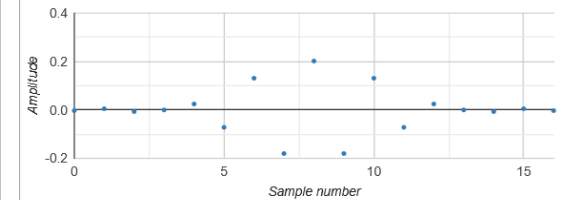
Hamming

Filter Characteristics

Frequency response



Impulse response



Filter code

```
0.025191657970260274,  
0.000000000000000011,  
-0.0066783048164296,  
0.004960993224681223,  
-0.003019330283618023,
```

