FIR Filter

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Finite Impulse Response (FIR) filters are a type of digital filter widely used in signal processing due to their simplicity, stability, and flexibility.

Key Characteristics of FIR Filters

1. **Finite Impulse Response:**
   - The term "finite impulse response" indicates that the filter's impulse response settles to zero in a finite amount of time. This is because FIR filters do not have feedback loops, so the output is entirely based on a finite number of input samples.
2. **Linear Phase Response:**
   - FIR filters can be designed to have a linear phase response, which means they preserve the phase relationships of the frequency components of the signal. This is important in applications like audio processing, where phase distortion is undesirable.
3. **Stability:**
   - FIR filters are inherently stable because they lack feedback. The output depends only on current and past input values.
4. **Flexibility:**
   - FIR filters can be designed to approximate almost any frequency response, making them suitable for a wide range of applications.

An FIR filter processes an input signal using the following equation:

$$\text{What is the output } y[n] \text{ of the system defined as } y[n] = \sum_{k=0}^{N-1} h[k] \cdot x[n-k]$$

Project explanation

As illustrated in Figure 1, the FIR filter has been implemented using a block diagram approach. In this design, the input and output bit widths are defined as parameters, enabling the designer to customize these values according to the required filter order. In this particular case, a 5th-order filter has been implemented. However, thanks to the parametric design, the filter order can be easily modified by adjusting the relevant parameters.

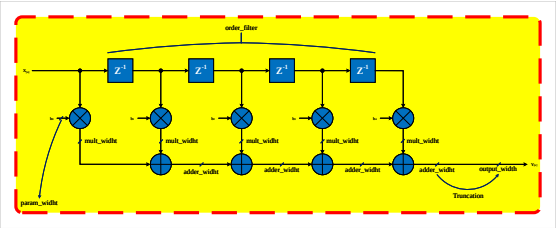

Figure 1: *FIR Filter*

As shown in Figure 2, by utilizing this generated IP and modifying its parameters, the desired filter order can be adjusted as needed.

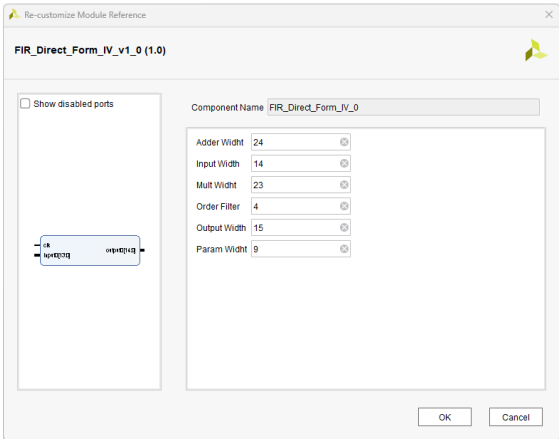

Figure 2: *IP Core*