FIR Filter Design using MATLAB*

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Abstract

This module explains the MATLAB commands for FIR filter design.

1 FIR Filter Design Using MATLAB

1.1 Design by windowing

The MATLAB function `fir1()` designs conventional lowpass, highpass, bandpass, and bandstop linear-phase FIR filters based on the windowing method. The command

```
b = fir1(N,Wn)
```

returns in vector `b` the impulse response of a lowpass filter of order `N`. The cut-off frequency `Wn` must be between 0 and 1 with 1 corresponding to the half sampling rate.

The command

```
b = fir1(N,Wn,'high')
```

returns the impulse response of a highpass filter of order `N` with normalized cutoff frequency `Wn`.

Similarly, `b = fir1(N,Wn,'stop')` with `Wn` a two-element vector designating the stopband designs a bandstop filter.

Without explicit specification, the **Hamming window** is employed in the design. Other windowing functions can be used by specifying the windowing function as an extra argument of the function. For example, Blackman window can be used instead by the command `b = fir1(N, Wn, blackman(N))`.

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1.2 Parks-McClellan FIR filter design

The MATLAB command

```
b = remez(N,F,A)
```

returns the impulse response of the length `N+1` linear phase FIR filter of order `N` designed by Parks-McClellan algorithm. F is a vector of frequency band edges in ascending order between 0 and 1 with 1 corresponding to the half sampling rate. A is a real vector of the same size as F which specifies the desired amplitude of the frequency response of the points `(F(k),A(k))` and `(F(k+1),A(k+1))` for odd `k`. For odd `k`, the bands between `F(k+1)` and `F(k+2)` is considered as transition bands.