Filter Coefficient Design

- Many algorithms to find the coefficients for a digital (or analog) filter
  - Butterworth
  - Chebyshev
  - Bilinear transformation
  - Elliptic
- Some specify no ripple in the pass band or the stop band

Parks-McClellan Method

- Parks-McClellan method is a popular method
  - Published in the early 70s
  - Iterative
  - Computationally efficient
  - Works by specifying length of filter and frequency/magnitude pairs
  - See Oppenheim & Schafer for a thorough discussion

Filter Specification

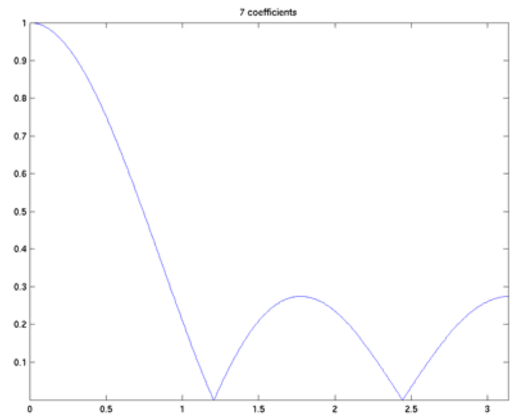
- Filter specifications are frequently given in dB as min/max attenuation/ripple over frequency regions
- Ex:
  - Low-pass filter
  - Maximum +/- 4dB ripple in passband
  - Sampling frequency is 100 MHz
  - Passband from DC to 12.5 MHz
  - Minimum attenuation 22dB from 19 MHz to 25 MHz

Example Filter

- Example filter
  - Low-pass
  - frequencies specified as fractions of π:
    [0 0.25 0.30 1];
  - corresponding amplitudes: [1 1 0 0];
  - Don't care about transition band between 0.25 pi and 0.30 pi
  - Use `remez()` function in matlab

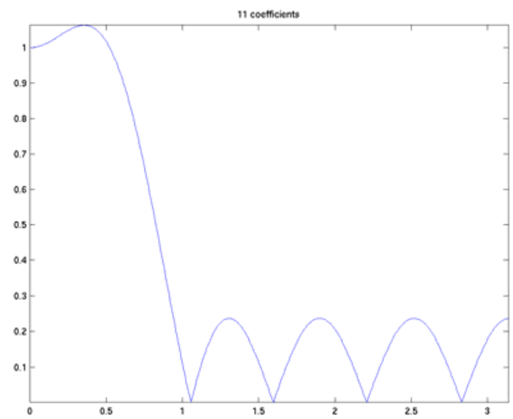
Example Filter

- 7 coeffs.



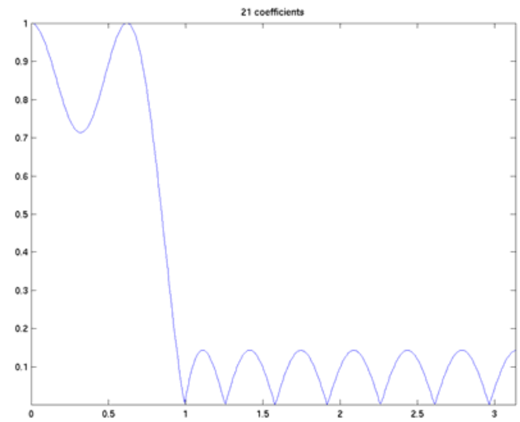
Example Filter

- 11 coeffs.



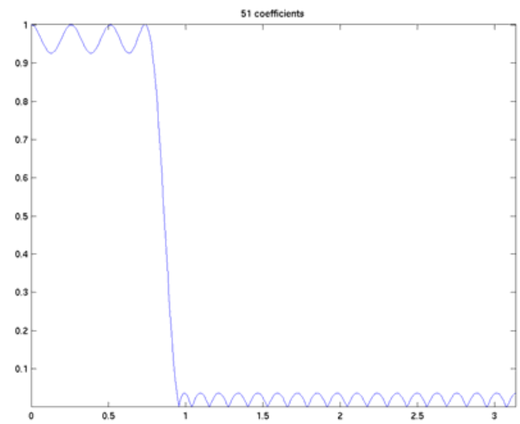
Example Filter

- 21 coeffs.



Example Filter

- 51 coeffs.



Example 21-tap Filter

- `coeffs = remez(20, [0 0.25 0.30 1], [1  1 0  0]);`
- Notice remez function's first argument is the number of desired taps minus 1
- `remez()` for filter design.
  `>> help remez`
  to get more information on a matlab function
- To plot the coefficients, use
  `stem(-10:10, coeffs);`

Example Filter Coefficients

- Coefficients of 21-tap filter
- Note sinc() shape in time domain
- Remember this is a low-pass which is a rect() in the frequency domain