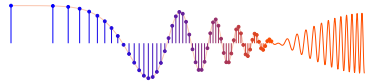

## PROBLEM:

Explain how the MATLAB functions `filter(b,a,x)` and `freqz(b,a,N)` work. In particular, what do the vectors `a` and `b` stand for?

NOTE: it may be necessary to download the "Signal Processing" Toolbox for MATLAB. This is a menu item under "Applications" in download.

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458. 

SOLUTION

filter(b, a, x) implements a difference equation.

b is a vector containing the feedforward coefficients

a is a vector containing feedback coeffs.

x is the input signal

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$$y[n] = +a_1 y[n-1] + a_2 y[n-2] + \cdots + a_N y[n-N]$$

$$+ b_0 x[n] + b_1 x[n-1] + b_2 x[n-2] + \cdots + b_M x[n-M]$$

Diff EQN.

Resulting vector definitions:

$$a = [\,1 \quad -a_1 \quad -a_2 \quad -a_3 \quad \cdots \quad -a_N\,]$$

$$b = [\,b_0 \quad b_1 \quad b_2 \quad b_3 \cdots \quad b_M\,].$$

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freqz(b, a, N)

computes frequency response at

$\hat{\omega} = \frac{2\pi}{N} k \qquad k = 0, 1, 2, \ldots N-1$

$$H(\hat{\omega}) = \frac{b_0 + b_1 e^{-j\hat{\omega}} + b_2 e^{-j2\hat{\omega}} + \cdots + b_M e^{-jM\hat{\omega}}}{1 + a_1 e^{-j\hat{\omega}} + a_2 e^{-j2\hat{\omega}} + \cdots + a_N e^{-jN\hat{\omega}}}$$

a & b have the same meaning to freqz as they did for filter.