Professor A. N. Willson, Jr.

Assigned: October 6, 2004
Due: October 13, 2004

Reading Assignment:

- Proakis and Manolakis, *Digital Signal Processing*: Sections 7.1–7.4, 7.6.1 and 8.3.

Problems:

1. Use the bilinear transformation to determine analytically (not with MATLAB) the transfer function of the lowest-order Butterworth lowpass filter which will meet the following specifications:
   - passband edge frequency = 1 kHz
   - stopband edge frequency = 2 kHz
   - passband ripple = 0.5 dB
   - stopband attenuation = 30 dB

   The filter will operate at a sampling rate of 10,000 samples/second. Draw the Cascade-form realization for this filter using the direct-form II second-order sections and verify your design using the Digital Filter Analysis Toolbox (FAT).

2. In Section 7.6.1 of Proakis and Manolakis, the authors state that the direct-form II realization is much more sensitive to coefficient quantization than the cascade-form realization. To verify this claim, draw the direct-form II realization and plot the frequency response using FAT. Next, quantize the coefficients (excluding the input-scaling multiplier) of both the direct-form and cascade-form realizations to 5 bits and plot the frequency responses. Compare the results.