Mid-Term Review

This lecture summarizes and clarifies the objectives given in the heading before each of lecture notes.

Exam Format

- *The mid-term exam will be on Tuesday, February 27 at 10:30 AM in MacMillan 166.*
- *The exam will be 50 minutes long and is worth 25% of your final mark.*
- *The exam will cover up to and including the lecture titled "Overview of Filter Design".*
- *The exam is open-book (all books or notes allowed). Calculators are allowed.*

Introduction to DSP

- Explain advantages and disadvantages of DSP.
- Find the spectrum of a signal after anti-aliasing filtering, sampling, D/A conversion and reconstruction filtering.
- Find quantization noise power and SQNR (for a sine wave).
- Compute (by hand) the linear convolution of two discrete-time sequences.

The DFT

- Compute (by hand) the DFT and inverse DFT of a given sequence.
- Use the properties of the DFT to compute other DFTs and their inverses (linearity, periodicity, time shift, modulation/convolution, real/imaginary, and odd/even sequences/transforms).

The FFT

- Define and apply FFT-related terms (in-place, radix, decimation in time, twiddle factor, bit-reversed order, butterfly).
- Draw a signal flow diagram for a power-of-two decimation in time (DIT) FFT algorithm
- Find the number of operations (multiply/add) required to compute an FFT.

The z-transform

- Determine if a system is linear, time-invariant, and/or causal from a description of its time-domain behaviour.
- Find the z-transform of a finite sequence.
- Use the time-shift and convolution properties of the z-transform to find the z-transform of a sequence.
- Obtain the z-domain transfer function for an FIR or IIR system from its difference equation.
- Find the poles and zeroes of a z-domain transfer function.
- Be able to convert between the following representations of a LTI system: (z-domain) transfer function, pole/zero, difference equation and signal flow graph.

The Inverse z-transform

- Obtain the inverse z-transform of a rational z-transform by polynomial division.
- Re-write a rational z-transform as a sum of a partial fractions.
- Evaluate the stability and frequency response of an FIR or IIR system from its transfer function.
- Sketch the frequency response based on a pole/zero description.
- Compute the frequency response from the (z-domain) transfer function.

Correlation and Convolution

- Compute the circular and linear auto-/cross-correlation of one/two sequences of the *same* length.
- Compute "fast" circular and linear correlation or convolution using the DFT (FFT) by zero padding to the required length.
- Compute the energy/power spectrum of a signal from its autocorrelation function.
- Use auto-correlation to estimate the period of a signal and cross-correlation to estimate the time difference between two signals.

Overview of Filter Design

- Apply the basic terminology used to specify filters in the frequency domain (passband, stopband, ripple, etc), and types of filters (low-pass, bandpass, etc).
- Decide whether an FIR or IIR design is the most appropriate to meet particular design requirements.
- List the possible sources of degradation due to a finite word length implementations (sample and coefficient quantization, rounding).