Creative Computing II

Signals and Convolution

24th November 2009

This lab sheet covers basic signal representation through vector construction, signal visualization and the convolution of signals with simple LTI system impulse responses.

1. In Octave, construct vectors representing each of the following signals for discrete time $0 \leq k < 10$:

   (a) $x[k] = k$;

   (b) $x[k] = \sin(0.4\pi k)$;

   (c) $x[k] = \sin(0.3\pi k)$

   (d) $x[k] = 1$;

   (e) $x[k] = \begin{cases} 1 & k \text{ even} ; \\ -1 & k \text{ odd} . \end{cases}$

   (f) $x[k] =$ a random number between -1 and 1.

2. Plot each of the signals from part 1 individually. Next, plot a pair of signals; try to find a method of plotting that makes *both* signals clear.

3. For each of the signals from part 1, construct the unit-delayed signal using

   (a) directly zero-padding;

   (b) zero-padding and the `shift` operator;

   (c) the `conv` operator with the unit delay kernel `[0 1]`.

   Verify that your three methods give the same answer. Visualize each original signal along with the unit-delayed signal from this part.

4. For each of the signals in part 1, investigate the action of the systems with impulse responses `[0.5 0.5]` and `[0.5 -0.5]`. Try to describe in words the effect of these two systems.

Other resources:

- Oppenheim, A. V., A. S. Willsky and S. Hamid, *Signals and Systems*, Chapters 1–2.
- Eaton, J. W., *The Octave Manual*. Available at `http://www.gnu.org/software/octave/doc/interpreter/`
- `http://en.wikipedia.org/wiki/Convolution`.