Digital Signal Processing

http://kom.aau.dk/~zt/cources/DSP_E/

Exercises of Lecture 6 (MM6)

Exercise 6.1

The flow graph shown in Fig. P6.6 is noncomputable; i.e., it is not possible to compute the output using the difference equations represented by the flow graph because it contains a closed loop having no delay elements.

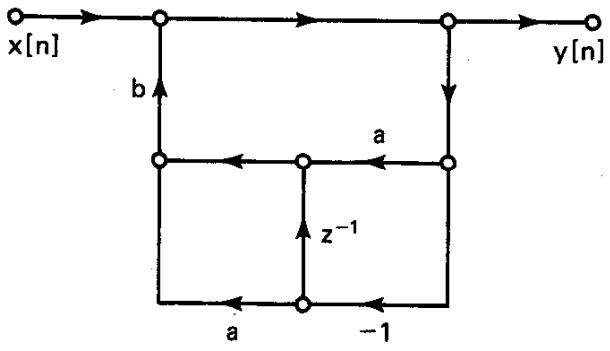

Figure P6.6

(a) Write the difference equations for the system of Fig. P6.6 and from them find the system function of the network.

(b) From the system function, obtain a flow graph that is computable.

Exercise 6.2

For the filter:

$$H(z) = \frac{b_0 + b_1 Z^{-1} + b_2 Z^{-2}}{1 + a_1 Z^{-1} + a_2 Z^{-2}}$$

(a) find the difference equation.

(b) draw the signal graph for a canonic form (Direct From II) implementation

Exercise 6.3

A linear time-invariant system is realized by the flow graph shown in Figure P6.5-1.

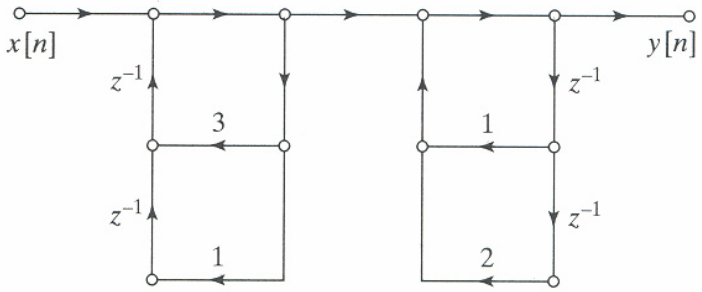

Figure P6.5-1

(a) Write the difference equation relating $x[n]$ and $y[n]$ for this flow graph.

(b) What is the system function of the system?

(c) In the realization of Figure P6.5-1, how many real multiplications and real additions are required to compute each sample of the output? (Assume that $x[n]$ is real, and assume that multiplication by 1 does not count in the total.)

(d) The realization of Figure P6.5-1 requires four storage registers (delay elements). Is it possible to reduce the number of storage registers by using a different structure? If so, draw the flow graph; if not, explain why the number of storage registers cannot be reduced.

Exercise 6.4

Draw the signal flow graph for the direct form I implementation of the LTI system with system function

$$H(z) = \frac{1 - \frac{1}{2}z^{-2}}{1 - \frac{1}{4}z^{-1} - \frac{1}{8}z^{-2}}$$

Thanks Borge Lindberg for providing part of the exercises and solutions.