

Homework #3: Discrete-Time Filters

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Questions

Please print this out and answer the following questions in the space provided below. Please add additional sheets if necessary or use the backs of sheets. For full points, please provide explanations and reasoning in your solutions.

1. Consider the following ARMA filter:

$$y(n) = 0.5y(n-1) + 5x(n) + 3x(n-1) - 4x(n-2) + x(n-3).$$

- a. Provide a Direct Form I realization of the ARMA filter.

- b. How many multiplications, additions and memory elements are required in the realization of part a?

c. Provide a Direct Form II realization of the ARMA filter.

d. How many multiplications, additions and memory elements are required in the realization of part c?

e. Find the system function of this ARMA filter.

Answer YES or NO to the following questions:

- f. Assume all initial conditions are zero. Is the system linear and time invariant?

- g. Is the system causal?

- h. Is the system BIBO stable?

Circle the appropriate answer:

- i. The region of convergence of the system function of part e, the shape of:
 - i. a disk.
 - ii. annular region of the form $a < |z| < b$, where $0 < a, b < \infty$.
 - iii. the outside part of a disk.

- j. The ARMA filter corresponds to a:
 - i. Finite impulse response filter.
 - ii. Infinite impulse response filter.

