

Assignment - 2

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Abstract—This document contains the solution to Exercise 2.20 (c) of Oppenheim.

Problem 1. Using the definition of linearity, show that the moving average system is linear.

Solution: The ideal delay system:

$$y[n] = T\{x[n]\} = x[n - k] \quad (1)$$

Using the definition of linearity:

$$T\{ax_1[n] + bx_2[n]\} = ax_1[n - k] + bx_2[n - k] \quad (2)$$

$$= ay_1[n] + by_2[n] \quad (3)$$

So, the ideal delay system is LINEAR.

The moving average system is given by

$$y[n] = Tx[n] = \frac{1}{M_1 + M_2 + 1} \sum_{k=-M_1}^{M_2} x[n - k] \quad (4)$$

by linearity:

$$T\{ax_1[n] + bx_2[n]\} = \frac{1}{M_1 + M_2 + 1} \sum_{k=-M_1}^{M_2} (ax_1[n] + bx_2[n]) \quad (5)$$

$$= \frac{1}{M_1 + M_2 + 1} \sum_{k=-M_1}^{M_2} ax_1[n] + \frac{1}{M_1 + M_2 + 1} \sum_{k=-M_1}^{M_2} bx_2[n] \quad (6)$$

$$= ay_1[n] + by_2[n] \quad (7)$$

Conclude, the moving average system is linear.