

2020 Advanced Information Engineering  
Assignment #3 December 7, 2020

## Objective

To understand multi-dimensional filters.

## Exercises

1. Illustrate the following signals:
  - (a)  $x(n_1, n_2) = 2\delta(n_1 + 1, n_2) + 3\delta(n_1, n_2) - \delta(n_1, n_2 - 1)$
  - (b)  $x(n_1, n_2) = u(n_1 - 1, n_2 - 1)$
2. Let's think about the input signal  $x(n_1, n_2)$  and its impulse response  $h(n_1, n_2)$  in Fig. 3.24.
  - (a) Represent  $x(n_1, n_2)$  by a set of impulse  $\delta(n_1, n_2)$ .
  - (b) Assume that the system is linear shift-invariant. Perform the convolution  $y(n_1, n_2) = h(n_1, n_2) * x(n_1, n_2)$  and find the output  $y(n_1, n_2)$ . Please use  $h(n_1, n_2)$  in Fig.3.24(b).
  - (c) Again assume that the system is linear shift-invariant. Perform the convolution  $y(n_1, n_2) = h(n_1, n_2) * x(n_1, n_2)$  and find the output  $y(n_1, n_2)$ . Please use  $h(n_1, n_2)$  in Fig.3.24(c).
3. Let's think about the impulse response  $h(n_1, n_2)$  in Fig.3.24(c).
  - (a) Perform z transform and find the transfer function.
  - (b) Is the signal separable or non-separable?
  - (c) Find the frequency characteristic.

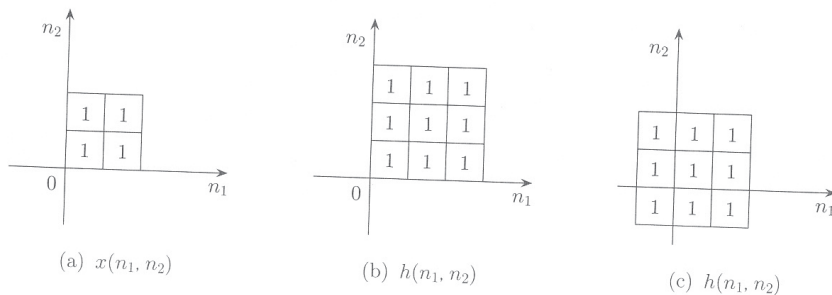


图 3.24 演習問題 3(2)

图 1:

## Due date

By December 21, 2020 (Monday) at the beginning of the class.