

2020 Advanced Information Engineering Assignment #2 November 9, 2020

Objective

To understand Fourier analysis of digital image.

1. Consider 2-dimensional sinusoidal wave signal $g_a(x, y) = 3 \cos(2\pi x - 4\pi y + \pi/4)$.
 - (a) Draw spectrum.
 - (b) Illustrate this wave assuming that its variables are x, y .
2. Calculate a continuous signal which has spectrums given by Fig. 1.
3. Perform discrete spatial Fourier transform of each of the signals shown in Fig. 2.
4. When a real-valued 2-dimensional discrete signal $g(n_1, n_2)$ satisfies that $g(n_1, n_2) = g(-n_1, -n_2)$, show that its discrete spatial Fourier transform (DSFT) $G(w_1, w_2)$ is real-valued.
5. Consider a 2-dimensional sinusoidal wave $g_a(x, y) = \cos(2\pi x + 4\pi y)$. In order to satisfy the sampling theorem, we would like to sample as follows:

$$g(n_1, n_2) = g_a(x, y)|_{x=n_1T_{S_1}, y=n_2T_{S_2}}. \quad (1)$$

Indicate the conditions for sampling intervals T_{S_1} and T_{S_2} to be satisfied.

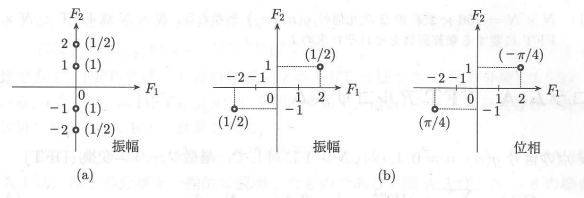


图 1

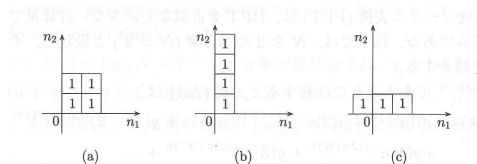


图 2

图 1: Figures for exercises

Due date

By November 23, 2020 (Monday) at the beginning of the class.