

2.

(a) 兩 real $f_1[n]$, $f_2[n]$ 做 DFT

$$1. f_3[n] = f_1[n] + j f_2[n]$$

$$2. F_3[m] = \text{DFT}\{f_3[n]\}$$

$$3. F_1[m] = \frac{F_3[m] + F_3^*[N-m]}{2}, F_2[m] = \frac{F_3[m] - F_3^*[N-m]}{2j}$$

只用了 - 個 DFT

(b) 令 $x_1[n]$, $x_2[n]$ real and even
 $x_3[n]$, $x_4[n]$ real and odd

$$y[n] = x_1[n] + x_3[n] + j(x_2[n] + x_4[n]) = y_1[n] + j y_2[n]$$

$$y[n] \xrightarrow{\text{DFT}} Y[m]$$

$$Y_1[m] = \frac{Y[m] + Y^*[N-m]}{2}, Y_2[m] = \frac{Y[m] - Y^*[N-m]}{2j}$$

由 real, even 得.

$$X_1[m] = X_1[N-m], X_2[m] = X_2[N-m]$$

由 real, odd 得

$$X_3[m] = -X_3[N-m], \quad X_4[m] = -X_4[N-m]$$

$$\begin{aligned} Y_1[m] + Y_1[N-m] &= X_1[m] + X_3[m] + X_1[N-m] + X_3[N-m] \\ &= 2X_1[m] \end{aligned}$$

$$\begin{aligned} Y_1[m] - Y_1[N-m] &= X_1[m] + X_3[m] - X_1[N-m] - X_3[N-m] \\ &= 2X_3[m] \end{aligned}$$

$$\begin{aligned} Y_2[m] + Y_2[N-m] &= X_2[m] + X_4[m] + X_2[N-m] + X_4[N-m] \\ &= 2X_2[m] \end{aligned}$$

$$\begin{aligned} Y_2[m] - Y_2[N-m] &= X_2[m] + X_4[m] - X_2[N-m] - X_4[N-m] \\ &= 2X_4[m] \end{aligned}$$

$$X_1[m] = \frac{Y_1[m] + Y_1[N-m]}{2}, \quad X_2[m] = \frac{Y_2[m] + Y_2[N-m]}{2}$$

$$X_3[m] = \frac{Y_1[m] - Y_1[N-m]}{2}, \quad X_4[m] = \frac{Y_2[m] - Y_2[N-m]}{2}$$

只用一個 DFT

3.

(a)

[0 0 0 0 0 0 0 0 0 0 0 0 1 - 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0]

(b) extract local feature (edges for different
locations scales)

4.

proper:

- (b) 和 walsh 的每個 row 一樣方方正正, 故適合
- (c) 遵守 modulation property

improper:

- (a) Walsh 的 convolution 為 logical convolution, 和 LTI 的 linear convolution 不一致
- (d) 難可 extract edge feature, 但 Harr transform 較適合 local

5.

(a) $16 = 2^4$, 4 stage

$$4 \times 16 = 64$$

(b) 可用 LUT, 0 ADDs

6.

1. 正交 \Rightarrow 可還原信號

2. QFDM can be performed by the

fast algorithm of the FFT

$$\therefore Z\left(m\frac{T}{N}\right) = \sum_{n=0}^{N-1} X_n e^{j\frac{2\pi mn}{N}}$$

same form as IDFT

7.

1. 由 γ 波之變化可推斷,

white noise 可能有助於記憶力提升

2. 由 α 波之變化可推斷

聆聽莫扎特音樂比起 white noise

來的 relax

8.

(a) $0 \rightarrow -1$ $[1 \ -1]$, $[-1 \ 1 \ -1]$, $[1 \ 1 \ -1]$

A diagram showing a horizontal line with three points labeled d_1 , d_2 , and d_3 below it. A vertical line segment labeled '1' is at the left end of the horizontal line.

$$d. \begin{bmatrix} 1 & -1 & 1 & 3 & 3 & 1 & -1 & 1 & -1 & 1 & 3 & 1 & 1 & 3 & 1 & -1 \end{bmatrix}$$

$$d_2 [1 \ -1 \ -3 \ -1 \ -1 \ -3 \ -1 \ 1 \ -1 \ 1 \ -1 \ -3 \ -3 \ -1 \ 1 \ -1]$$

$$d_3 \begin{bmatrix} -1 & 1 & 3 & 1 & 1 & 3 & 1 & -1 & 1 & -1 & 1 & 3 & 3 & 1 & -1 & 1 \end{bmatrix}$$

(b) N_0 , 容錯能力不佳, wash transform
之 CDMA 可容許信號有 delay, 或錯誤的
bits, 而 NTT 對此容錯較低

Extra: 尾数?

$$656 \times 1315 \pmod{13} = 6 \times 15 \pmod{13}$$

$$= 6 \times 2 \pmod{13}$$

$$= 12$$