IV LABORATORIJSKA VJEŽBA

1. 2D DFT

$$F[k,l] = \sum_{n=0}^{N-1} \sum_{m=0}^{M-1} f[n,m]\, e^{-j2\pi \frac{kn}{N}} e^{-j2\pi \frac{lm}{M}}$$

2D IDFT

$$f[n,m] = \frac{1}{N \cdot M} \sum_{k=0}^{N-1} \sum_{l=0}^{M-1} F[k,l]\, e^{j2\pi \frac{kn}{N}} e^{j2\pi \frac{lm}{M}}$$

UVJET: $f(n,m) = f_n(n) \cdot f_m(m)$

$f[k,l] = f_k(k) \cdot f_l(l)$

$$f[n,m] = \frac{1}{NM} \sum_{k=0}^{N-1} e^{j2\pi \frac{kn}{N}} \sum_{l=0}^{M-1} f(l) f(l) e^{j2\pi \frac{lm}{M}}$$

$$f[n,m] = \frac{1}{N \cdot M} \underbrace{\sum_{k=0}^{N-1} f_k(k)\, e^{j2\pi \frac{kn}{N}}}_{f(n)} \underbrace{\sum_{l=0}^{N-1} f_l(l)\, e^{j2\pi \frac{lm}{M}}}_{f_m(m)}$$

$$f[n,m] = \frac{1}{N \cdot M} f_n(n) \cdot f_m(m)$$

(2) $f(\pm x, \pm y) \Leftrightarrow F\left(\pm \frac{\varepsilon_1}{a}, \pm \frac{\varepsilon_2}{b}\right)$

$f(ax, by) \Leftrightarrow F\left(\frac{\varepsilon_1}{a}, \frac{\varepsilon_2}{b}\right) \cdot \frac{1}{|ab|}$

SKALIRANJE: PROSTOROM OBJEKTA NA SLICI RASTE I SADRŽAJ U FREKVENCIJSKOJ DOMENI,

ROTACIJA: ROTACIJOM PROSTORNE DOMENE ROTIRA SE I FREKVENCIJSKA

(3) SVOJSTVO SMICANJA ZA CSFT

$$f[x \pm a, y \pm b] \Leftrightarrow e^{\pm j2\pi(a t_1 + b t_2)} F(\varepsilon_1, \varepsilon_2)$$

④ $N \times N$

$$h[n,m] = \begin{cases} \frac{1}{N^2} & \left[-\frac{N-1}{2}\right] \le n \le \left\lceil \frac{N-1}{2} \right\rceil \; ; \left[-\frac{N-1}{2}\right] \le \left\lceil \frac{N-1}{2} \right\rceil \\ 0, & \text{INAČE} \end{cases}$$

NEPARNI $N = 5$ $\quad [-2, 2]$

PARNI $N = 4$ $\quad [-1, 2]$

PARNI N

$$H\left(e^{j\omega_1}, e^{j\omega_2}\right) = \sum_{m=-\frac{N}{2}+1}^{N/2} \frac{1}{N^2} \cdot e^{-j(\omega_1 m - \omega_2 m)}$$

FAZA ZA PARNI N JE $\quad -\frac{\omega}{2}$

FAZA ZA NEPARNI $N = 0$

POMAK $= \frac{-\delta\phi}{\delta\omega} = \frac{1}{2}$ ZA PARNI N

ZA NEPARNI $= 0$