

$$I = I_0 e^{-\lambda d}$$

λ - współczynnik tłumienia

$$\lambda d = \int_{-\infty}^{+\infty} f(x, y) dz$$

$$\frac{I}{I_0} = e^{-\int_{-\infty}^{+\infty} f(x, y) dz}$$

$$\ln \left| \frac{I}{I_0} \right| = - \int_{-\infty}^{+\infty} f(x, y) dz$$

(2)

$$\int_{-\infty}^{+\infty} f(x,y) dz = -\ln \left| \frac{I}{I_0} \right| = P_{\varphi}(r)$$

$$P_{\varphi}(r) = \int_{-\infty}^{+\infty} f(x,y) dz$$

transformata Radona

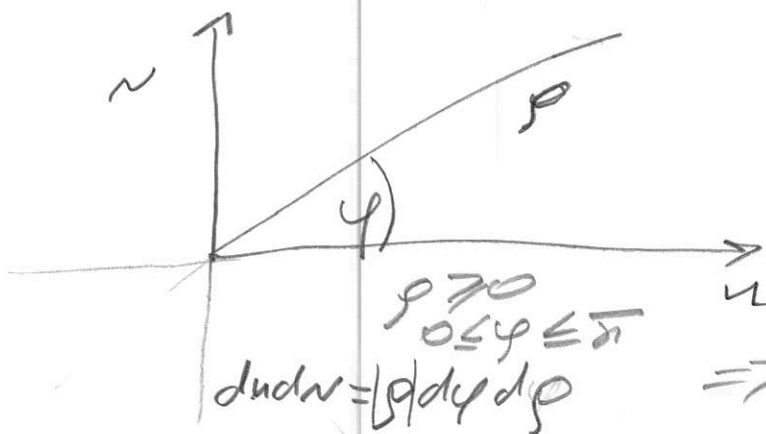
$$\begin{aligned} x &= r \cos \varphi - z \sin \varphi \\ y &= r \sin \varphi + z \cos \varphi \end{aligned} \quad \text{lub}$$

$$\begin{aligned} w &= x \cos \varphi + y \sin \varphi \\ z &= -x \sin \varphi + y \cos \varphi \end{aligned}$$

Transformata Fourier (DFT lub FFT)

$$P_{\varphi}(s) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{+\infty} P_{\varphi}(r) e^{-i r s} dr$$

$$F(u,v) = \frac{1}{2\pi} \iint_{-\infty}^{+\infty} f(x,y) e^{-i(ux+vy)} dx dy$$



$$\begin{aligned} u &= \rho \cos \varphi \\ v &= \rho \sin \varphi \Rightarrow \end{aligned}$$

$$\Rightarrow \rho = u \cos \varphi + v \sin \varphi$$

(3)

$$P_f(s) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} f(x,y) dz e^{-iys} dw =$$

$$= \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{+\infty} \left(\int_{-\infty}^{+\infty} f(x,y) dz \right) e^{-i s (x \cos \varphi + y \sin \varphi)} dw =$$

$$= \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{+\infty} \left(\int_{-\infty}^{+\infty} f(x,y) dz \right) e^{-i(xu + yv)} dw =$$

$$= \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} f(x,y) e^{-i(xu + yv)} dw dz, \text{ permutando } dw dz = dx dy$$

$$P_f(s) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} dx dy f(x,y) e^{-i(xu + yv)} = \sqrt{2\pi} F(u,v)$$

④

Transformata odwrótna

$$f(x,y) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} du dv \underbrace{F(u,v)}_{\frac{1}{\sqrt{2\pi}} P_{\varphi}(\rho)} e^{i(ux+vy)} =$$

$$= \frac{1}{(2\pi)^{3/2}} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} du dv \underbrace{P_{\varphi}(\rho)}_{e^{i(ux+vy)}} =$$

$$= \frac{1}{(2\pi)^{3/2}} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} du dv P_{\varphi}(u \cos \varphi + v \sin \varphi) e^{i(ux+vy)}$$

Wob Ponikwan' du du = $\int \rho dx dy dz$

(5)

$$\int (x,y) = \frac{1}{(2\pi)^{3/2}} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \rho(x,y,z) e^{i(ux+vy)} =$$

$$= \frac{1}{(2\pi)^{3/2}} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \rho(x,y,z) e^{i(x\cos\varphi + y\sin\varphi)}$$