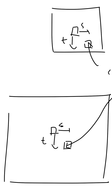
Convolution



→ Influence of a pixel on its neighbors.

$f(x)$

$$F(f)(\xi) = \int_{-\infty}^{+\infty} f(x) e^{-i2\pi\xi x} dx$$

$f : \mathbb{R} \to \mathbb{R}$ $\qquad$ $g : \mathbb{R} \to \mathbb{R}$

$$(f * g)(x) = \int_{-\infty}^{+\infty} f(x-t) g(t) dt$$

$$F(f*g)(\xi) = \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} f(x-t) g(t) dt \, e^{-i2\pi\xi x} dx$$

$$= \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} f(x-t) g(t) e^{-i2\pi\xi x} dt \, dx$$

$$= \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} f(x-t) g(t) e^{-i2\pi\xi x} dx \, dt$$

$$= \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} f(x-t) e^{-i2\pi\xi x} dx \, g(t) dt$$

$$= \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} f(v) e^{-i2\pi\xi(v+t)} dv \, g(t) dt$$

$v = x - t$

$dx = dv$

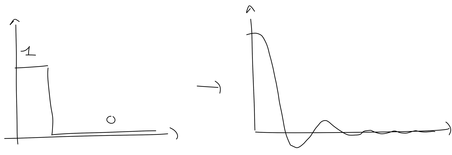
$$= \int_{-\infty}^{+\infty} \underbrace{\int_{-\infty}^{+\infty} f(v) e^{-i2\pi\xi v} dv}_{} \, g(t) e^{-i2\pi\xi t} dt$$

$$= \int_{-\infty}^{+\infty} F(f)(\xi) g(t) e^{-i2\pi\xi t} dt$$

$$F(f*g)(\xi) = \underbrace{F(f)(\xi)} \times \underbrace{F(g)(\xi)}$$

Image $\boxed{\text{②}}$

FFT of a sharp window

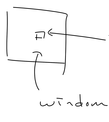


Multiplied by a gaussian in Frequency

↳ Convolution with a gaussian in Spacial.

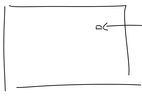
Noise

↳ Median filter

→ 

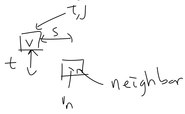
} take the median shade in the window

Well suited for specular noise.



Bilateral filter

↳ gaussian + keep edges.



neighbor $\times\ \sigma_s(s,t) \times \sigma_v(v - v_n)$