

# FT-properties

## I. LINEARITY

### A. Reference

[Linearity, wikipedia](#)

### B. Definition

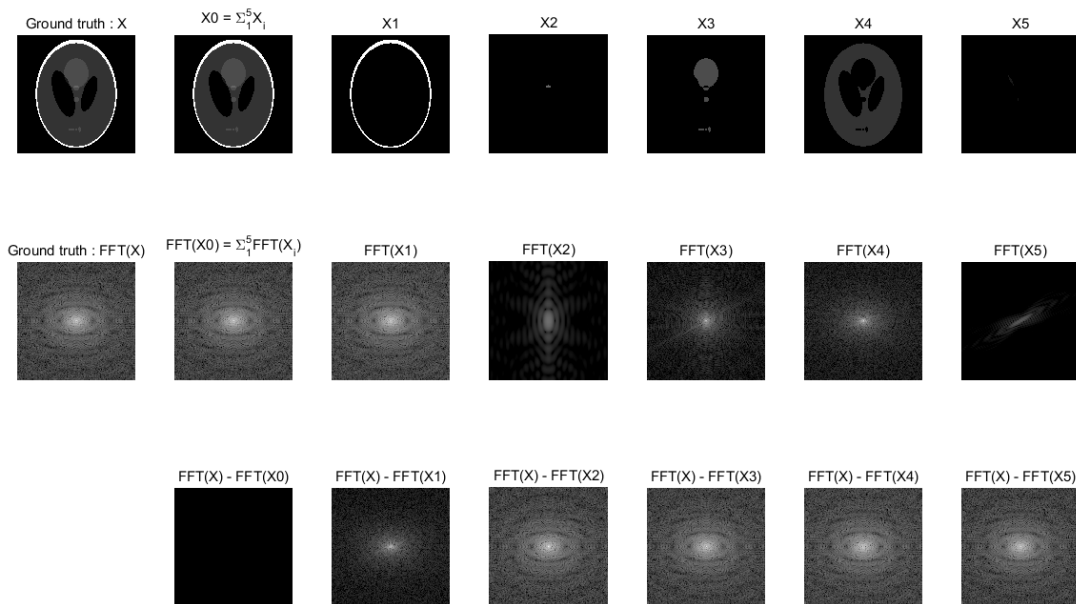
For any complex numbers  $a \in \mathbb{C}$  and  $b \in \mathbb{C}$ ,

$$h(x) = a * f(x) + b * g(x) \quad \leftarrow \mathcal{F} \text{ (Fourier transform)} \rightarrow \quad \hat{h}(\xi) = a \cdot \hat{f}(\xi) + b \cdot \hat{g}(\xi)$$

### C. Execution

Run **demo\_fourier\_properties\_1\_linearity.m**

### D. Results



## II. SHIFT IN SPATIAL DOMAIN

### A. Reference

[Shift in Spatial domain, wikipedia](#)

### B. Definition

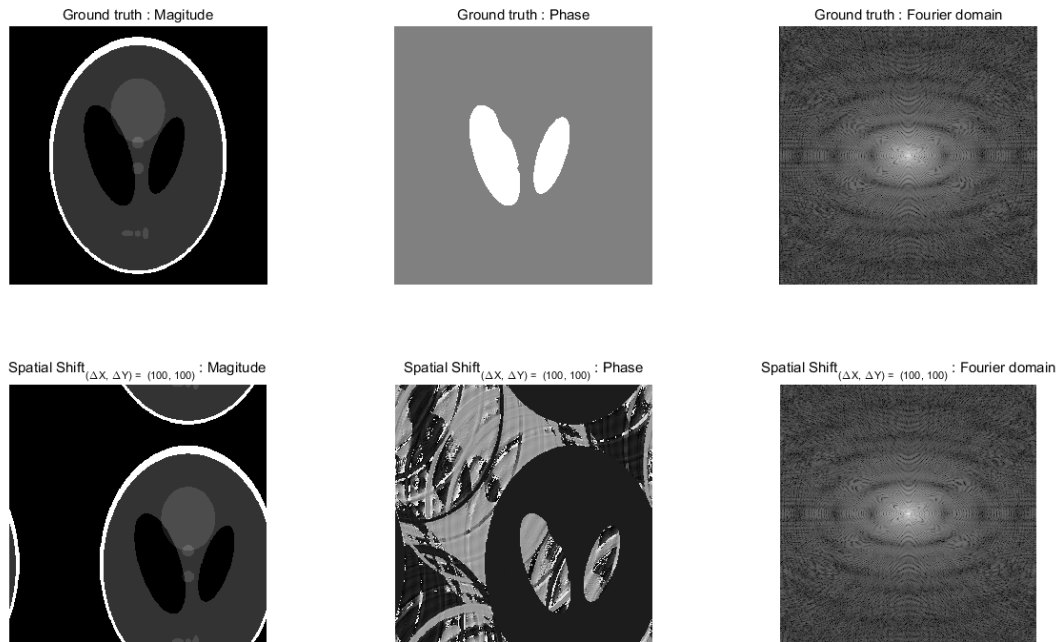
For any real number  $x_0 \in \mathbb{R}$ ,

$$h(x) = f(x - x_0) \quad \leftarrow \mathcal{F} \text{ (Fourier transform)} \rightarrow \quad \hat{h}(\xi) = e^{-2\pi i x_0 \xi} \hat{f}(\xi)$$

### C. Execution

Run `demo_fourier_properties_2_shift_in_spatial_domain.m`

### D. Results



### III. SHIFT IN FOURIER DOMAIN

#### A. Reference

[Shift in Fourier domain, wikipedia](#)

#### B. Definition

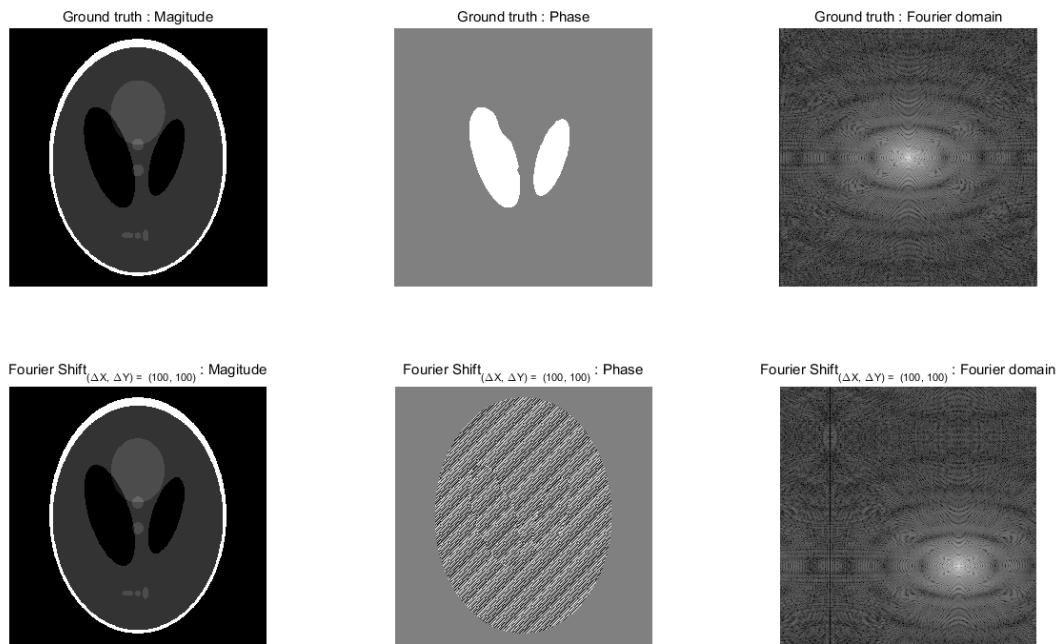
For any real number  $\xi_0 \in \mathbb{R}$ ,

$$h(x) = e^{2\pi i x \xi_0} f(x) \quad \leftarrow \mathcal{F} \text{ (Fourier transform)} \rightarrow \quad \hat{h}(\xi) = \hat{f}(\xi - \xi_0)$$

#### C. Execution

Run `demo_fourier_properties_3_shift_in_Fourier_domain.m`

#### D. Results



## IV. CONVOLUTION THEOREM

### A. Reference

[Convolution theorem, wikipedia](#)

### B. Definition

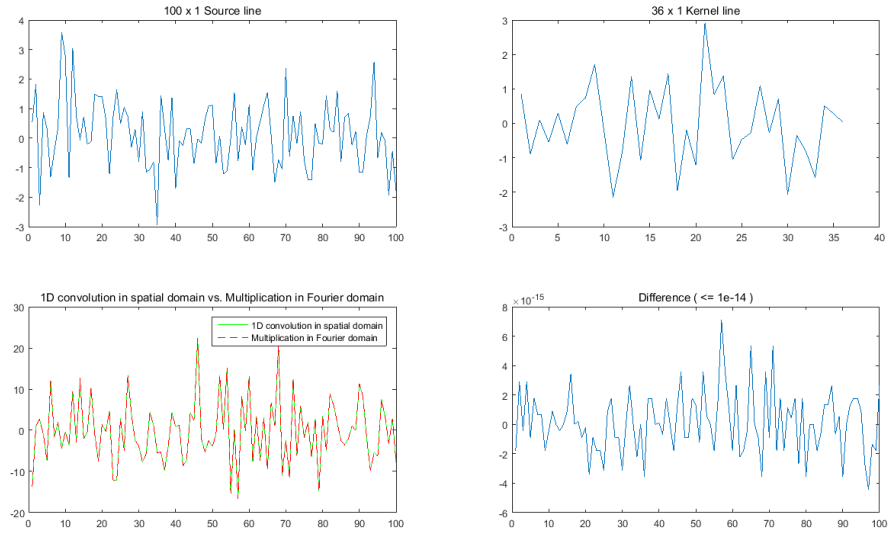
$$h(x) = (f * g)(x) = \int_{-\infty}^{\infty} f(y)g(x-y)dy \quad \leftarrow \mathcal{F} \text{ (Fourier transform)} \rightarrow \quad \hat{h}(\xi) = \hat{f}(\xi) \cdot \hat{g}(\xi)$$

### C. Execution

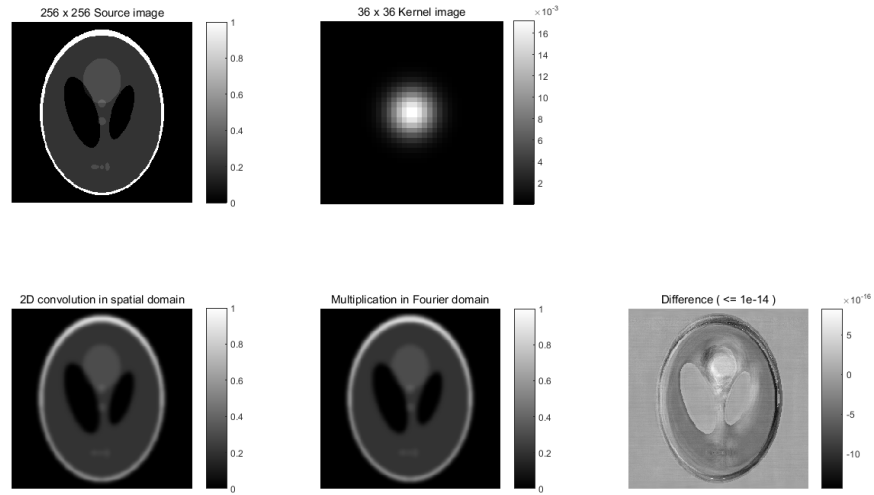
Run **demo\_fourier\_properties\_4\_1d\_convolution\_vs\_multiplication.m**

Run **demo\_fourier\_properties\_5\_2d\_convolution\_vs\_multiplication.m**

### D. Results



(a) 1D example



(b) 2D example