Fourier Transform: Basics

• State the continuous Fourier transform and its inverse for function $f(x)$.

• Define the magnitude and phase angle for $F(u)$.

• Rewrite $0.5(e^{j\omega_0 x} + e^{-j\omega_0 x})$ and $0.5(e^{j\omega_0 x} - e^{-j\omega_0 x})$ to simpler forms.

$f(x) \leftrightarrow F(u)$	Fill in $F(u)$
$\delta(x) \leftrightarrow$	
$1 \leftrightarrow$	
$\sin(2\pi u_0 x) \leftrightarrow$	
$\cos(2\pi u_0 x) \leftrightarrow$	
$A \text{ if } -T/2 \leq x \leq T/2, \ 0 \text{ otherwize } \leftrightarrow$	
$\sum_{k=-\infty}^{\infty} \delta(x - kT_0) \leftrightarrow$	

Fourier Transform: Properties

• Fill in the righthand sides for the following properties.

$f(x \pm x_0) \leftrightarrow$

$e^{\pm j2\pi u_0 x} f(x) \leftrightarrow$

$f(x)$: real $\leftrightarrow$

$f(x)$: real and even $\leftrightarrow$

$f(x)$: real and odd $\leftrightarrow$

$f(x) * h(x) \leftrightarrow$

$f(x)h(x) \leftrightarrow$

• How can the inverse be computed using the forward Fourier transform?

• How can a 2D Fourier transform be computed using 1D Fourier transforms?

• How can a 2D inverse Fourier transform be computed using 1D forward Fourier transforms?

Fourier Transform: Discrete Version

• State the 1D discrete Fourier transform (DFT) and its inverse for $f(x)$.

• How is the DFT different from the continuous one wrt data interpretation?

• What is aliasing and how can it be avoided?

• What special precaution must be taken when computing convolution by means of a DFT?

Fourier Transform: Computation Complexity

• What are the computation complexities of the 1D and 2D DFTs, resp.?

• How is the fast Fourier transform (FFT) obtained and how fast is it?

• How do you apply the FFT if the data does not contain a power of two number of elements?