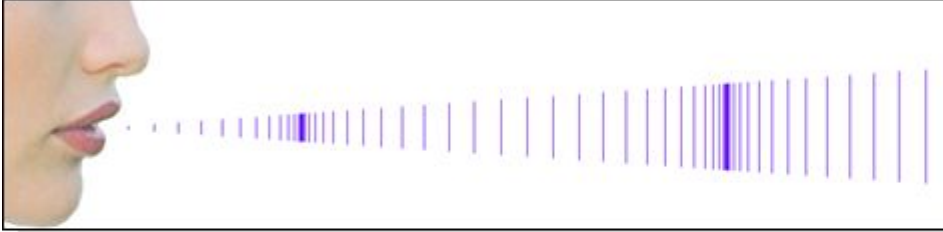


# Fourier-1D

# Sinyal

Zamanla deęiřen ve deęiřimi ölçülebilen bir olgu. Sinyaller salınımlıdır (dalgalı-sinüs). Aksi halde hiçbir bilgi içeremezler.

ses



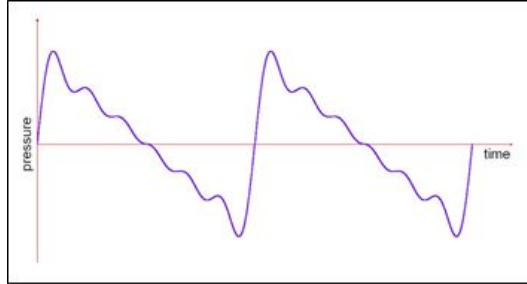
görüntü



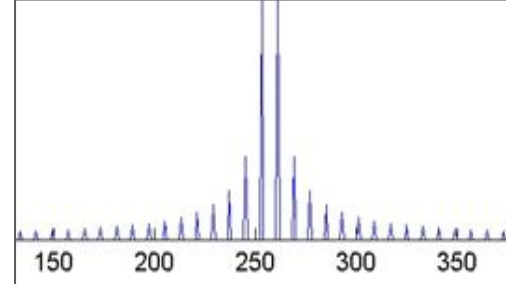
# Sinyal sunumu

Zaman alanı

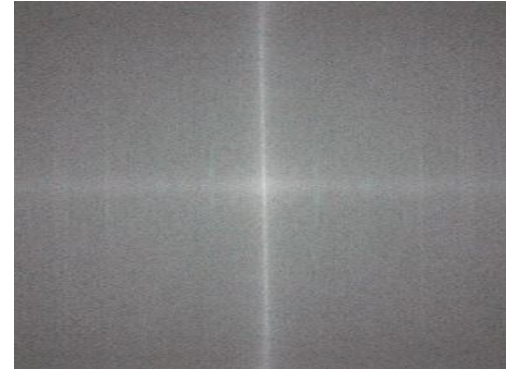
1D



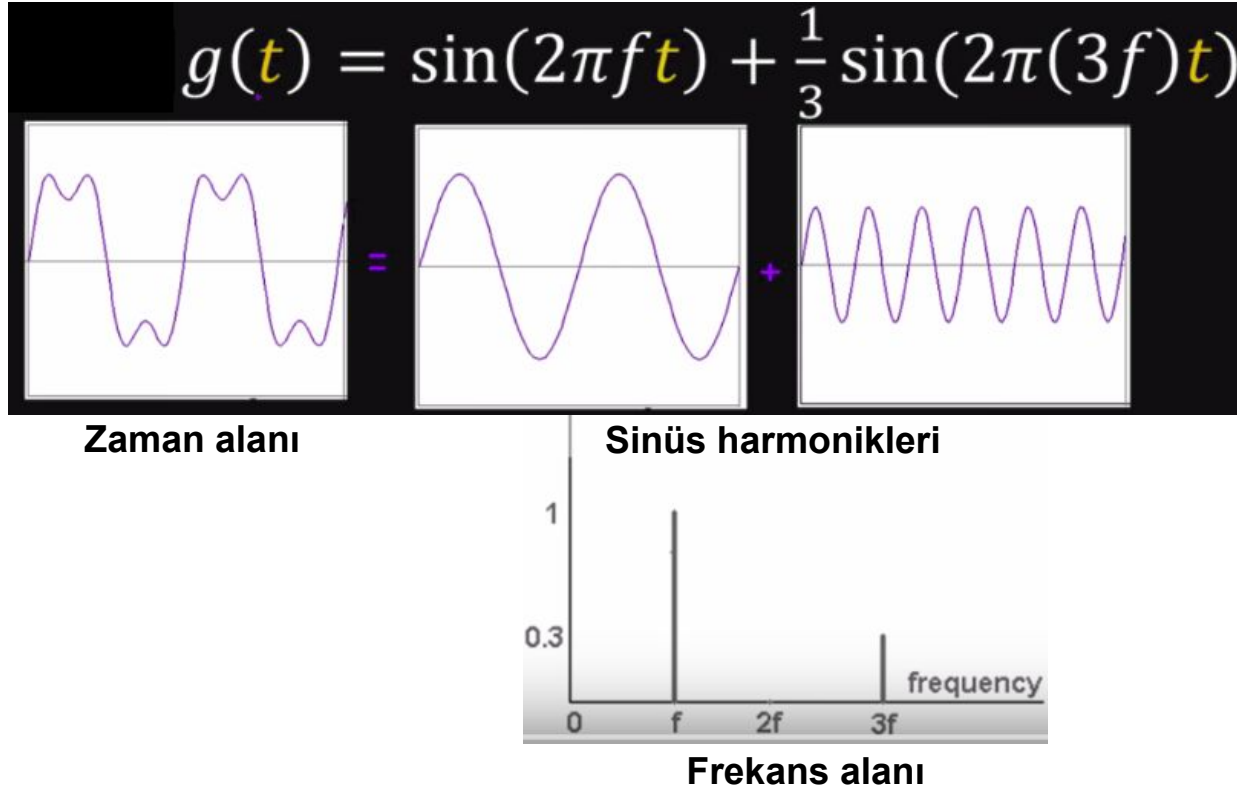
Frekans alanı



2D



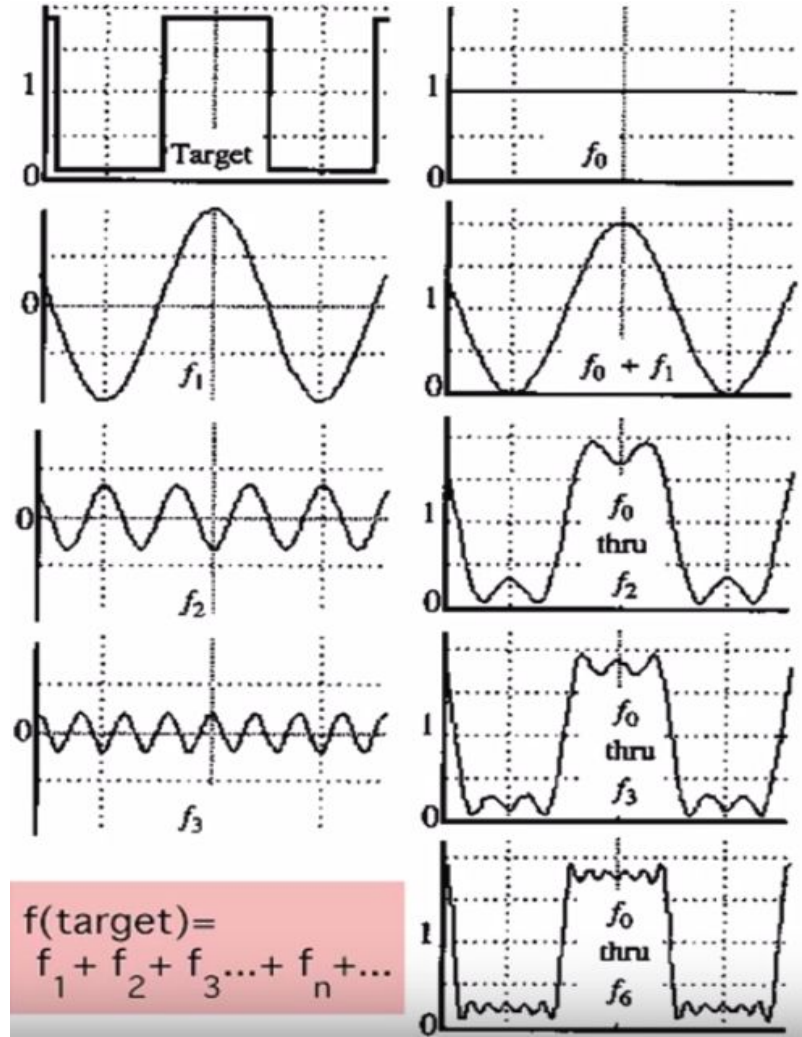
# Frekans alanını anlayalım



# Sinüsler toplamı

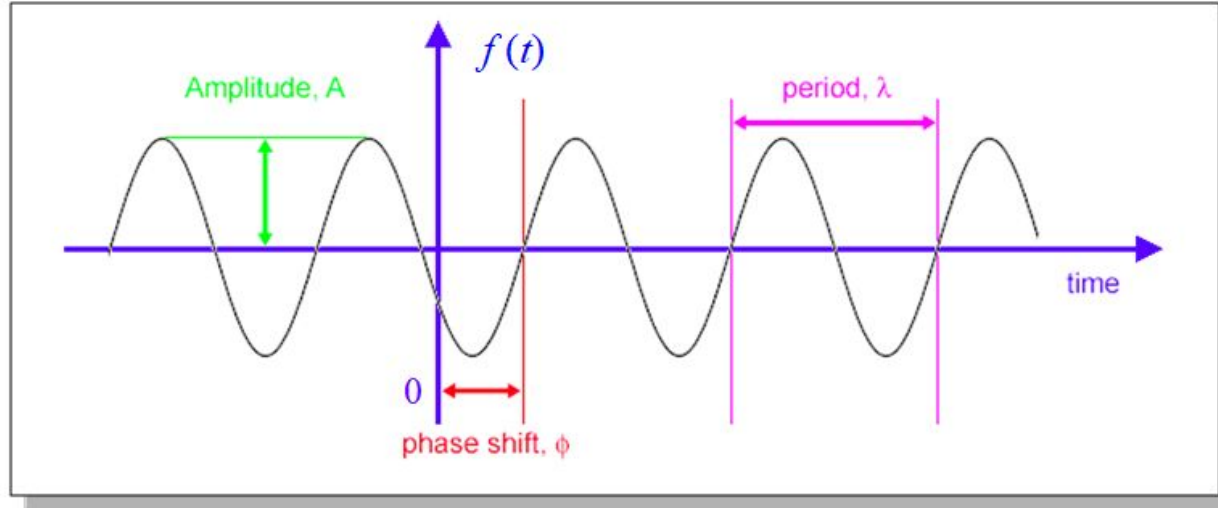
Zaman alanındaki herhangi bir  $f(x)$  sinyali yeteri kadar sinüsler (sinüzoidler) toplamıyla elde edilebilir. Her bir sinüzoid aşağıdaki gibi ifade edilir:

$$A \sin(\omega x + \varphi)$$



$$f(\text{target}) = f_1 + f_2 + f_3 + \dots + f_n + \dots$$

# Sinüzoid



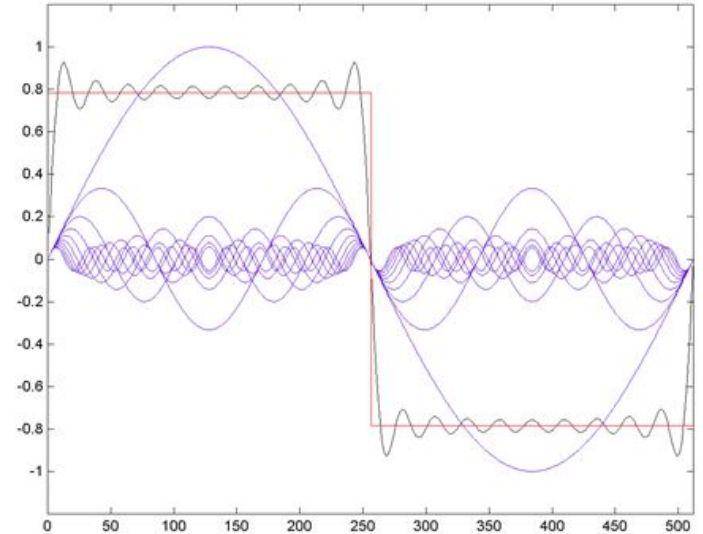
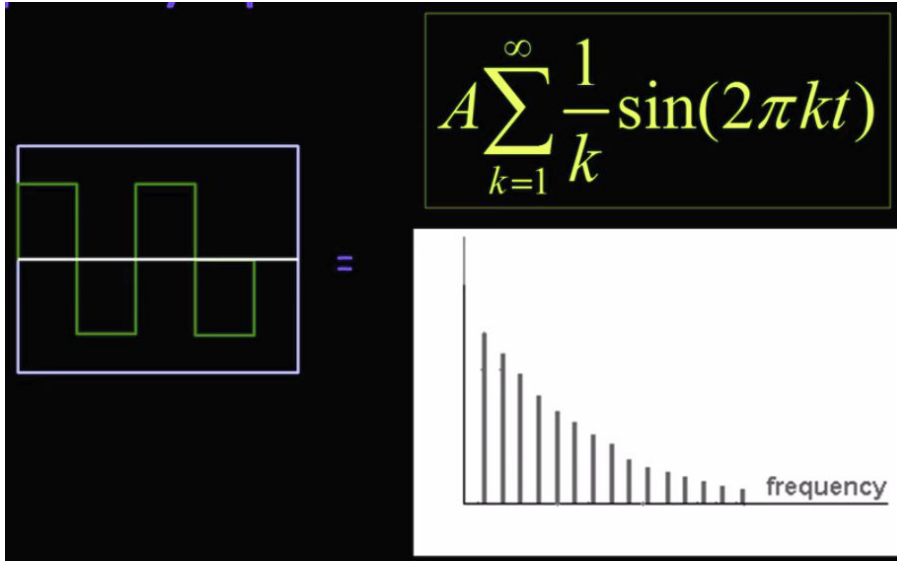
$$f(t) = A \sin\left(\frac{2\pi}{\lambda} t - \phi\right)$$

$1/\lambda$  Sinüs'ün frekansı (Hz)

$2\pi/\lambda$  Açısal frekans (rad/s)

# Sinüsler toplamı

Zaman alanındaki herhangi bir  $f(x)$  sinyali yeteri kadar sinüsler (sinüzoid) toplamıyla elde edilebilir.



# Zamandan Frekansa Dönüşüm



$F(\omega)$  bir karmaşık sayıdır.

$$F(\omega) = R(\omega) + iI(\omega) \quad A = \pm \sqrt{R(\omega)^2 + I(\omega)^2}$$
$$\varphi = \tan^{-1} \frac{I(\omega)}{R(\omega)}$$

$R(\omega)$  gerçekteşen **Cos** sinyalin,  $I(\omega)$  sanal teşen **Sin** sinyalin ifade eder.



# Euler gösterimi

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

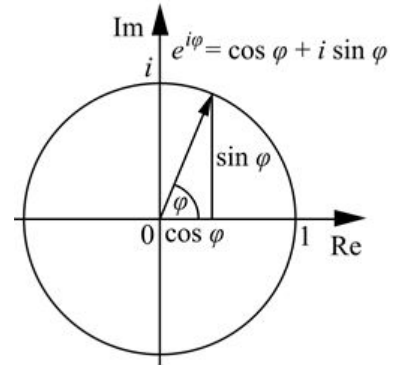
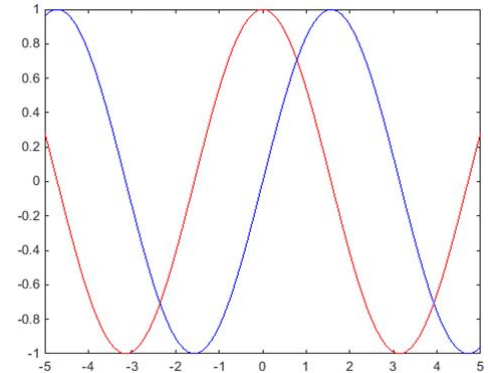
$$\text{Again: } e^{ik} = \cos k + i \sin k \quad i = \sqrt{-1}$$

$$\begin{aligned} \langle f, g \rangle &= \int_{-\lambda/2}^{\lambda/2} f(t) \left[ \cos\left(\frac{2\pi}{\lambda} t\right) - i \sin\left(\frac{2\pi}{\lambda} t\right) \right] dt \\ &= \int_{-\lambda/2}^{\lambda/2} f(t) e^{-i\frac{2\pi}{\lambda} t} dt \\ &= \int_{-\lambda/2}^{\lambda/2} f(t) e^{-i\omega t} dt \end{aligned}$$

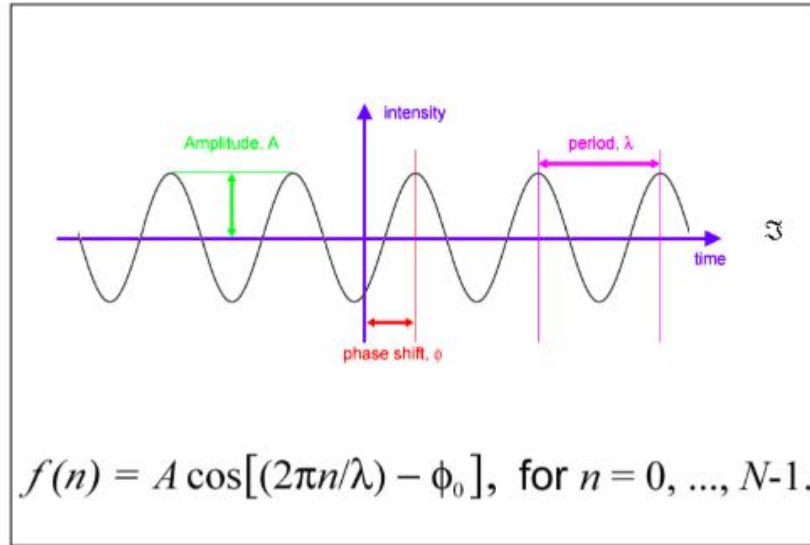
$$\omega = \frac{2\pi}{\lambda}$$

3 farklı sunum

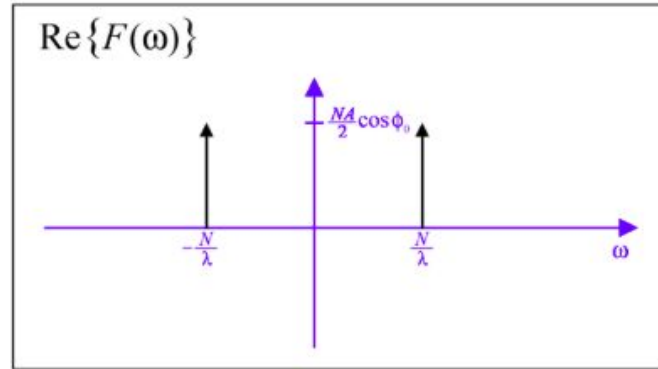
$$e^{-i\frac{2\pi}{\lambda} t} = \cos\left(\frac{2\pi}{\lambda} t\right) - i \sin\left(\frac{2\pi}{\lambda} t\right)$$



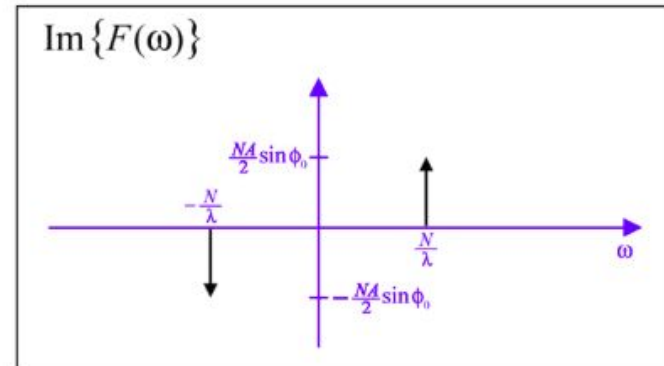
gerçek + sanal?



Bir cosinüsün fourier serisi karmaşık genlikli bir çift impulse dır.

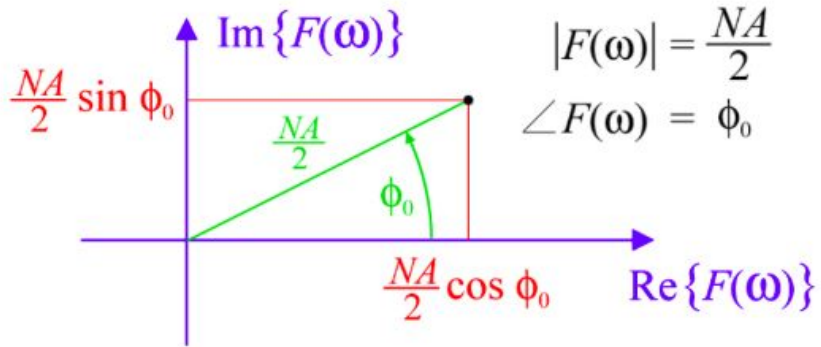


$$F(\omega) = \left(\frac{NA}{2} \cos \phi\right) [\delta(\omega + N\pi) + \delta(\omega - N\pi)] + i\left(\frac{NA}{2} \sin \phi\right) [-\delta(\omega + N\pi) + \delta(\omega - N\pi)]$$



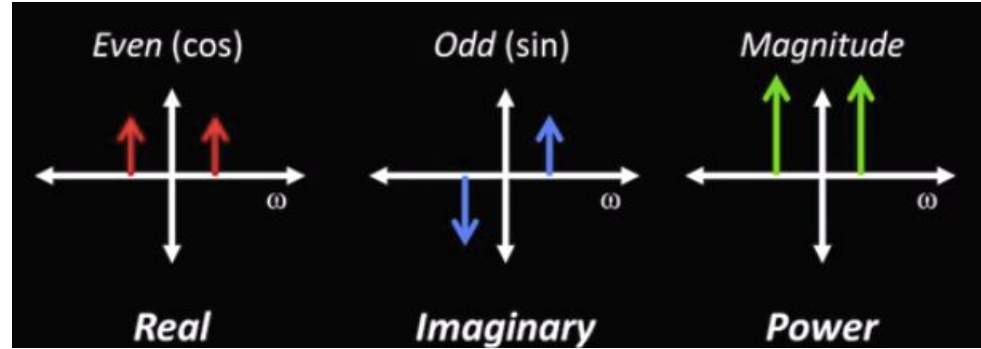
# Gerçek + Sanal dan Genlik ve Faz'a

Complex Value at  $\omega = +N/\lambda$



$$F(\omega = +N/\lambda) = \frac{NA}{2} \cos \phi_0 + i \frac{NA}{2} \sin \phi_0$$

..genlik  $NA/2$  ve faz  $\phi_0$ .



# Ayrık Fourier

The *Discrete FT*:

$$F(k) = \frac{1}{N} \sum_{x=0}^{x=N-1} f(x) e^{-i \frac{2\pi kx}{N}}$$

# Fourier taban kümesi (basis sets)

