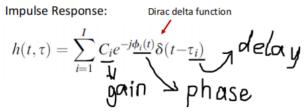# Rayleigh fading & Rician fading

- 多径信道follows the Rayleigh distribution. 如果有些scattering components比大部分的components都强，或者有LOS component，衰落则为Rician fading.

- time-varying impulse responce can be defined as:

Impulse Response: Dirac delta function

$$h(t,\tau) = \sum_{i=1}^{I} C_i e^{-j\phi_i(t)} \delta(t-\tau_i)$$

gain   phase   delay

信号周期：

$$Signal \ \ duration, \ \ T \approx \frac{1}{B}$$

Example 1:

Consider a wireless LAN operating in a factory near a conveyor belt. The transmitter and receiver have a LOS path between them with gain α_0, phase ϕ_0, and delay τ_0. Every T_0 seconds, a metal item comes down the conveyor belt, creating an additional reflected signal path with gain α_1, phase ϕ_1, and delay τ_1. Find the time-varying impulse response $c(\tau, t)$ of this channel.

Solution: For $t \neq nT_0$ ($n = 1, 2, \ldots$), the channel impulse response simply corresponds to the LOS path. For $t = nT_0$, the channel impulse response includes both the LOS and reflected paths. Thus, $c(\tau, t)$ is given by

$$c(\tau, t) = \begin{cases} \alpha_0 e^{j\phi_0} \delta(\tau - \tau_0) & t \neq nT_0, \\ \alpha_0 e^{j\phi_0} \delta(\tau - \tau_0) + \alpha_1 e^{j\phi_1} \delta(\tau - \tau_1) & t = nT_0. \end{cases}$$

Rayleigh Distribution

瑞利分布用于建模值只能大于或等于零的随机变量。

瑞利分布具有以下特征：

- 均值：

- 方差：

Rician Distribution

- Explain the Rician distribution

A Rician distribution is one way to model the paths scattered signals take to a receiver. FM radio waves, microwaves, and satellite transmissions.
The distribution also models Rician fading, which is a way to show how signal cancellations affect radio propagation.

Rayleigh and Rician fading channels

- Rayleigh and Rician fading适用于对真实现象的建模，这些现象包括 multipath scattering effects, time dispersion, and Doppler shifts that arise from relative motion between the transmitter and receiver.

Rayleigh fading

当接收信号的包络为瑞利分布时，信号发生瑞利衰落。
发生瑞利衰落的接收信号的概率密度函数：

comulative distribution function(cdf)累积分布函数：

Rician fading

当多径传播信道有很强的LOS元素时，产生Rician衰落。
它的概率密度函数：

Rician分布通常用一个参数k来描述，k被称为Rician factor，表示为：

Example 2:

Example 3: