

Tutorial Sessions 3
Advanced digital communication

Exercise 1

Let (R, I) the Cartesian coordinates of received signal in the Non-Line-of-Sight (NLOS) scenario,

$$P(R, I) = \frac{1}{2\pi\sigma^2} e^{-\frac{R^2+I^2}{2\sigma^2}}$$

- Find the **Rayleigh model**, density of probability function $P(r, \theta)$ given the transformation:

$$r = \sqrt{R^2 + I^2} \quad \theta = \text{atan}\left(\frac{I}{R}\right)$$

Exercise 2

For a signal envelope $R(t)$ that follows a Rayleigh distribution with $\sigma=0.5$.

1. Calculate the **instantaneous power** $\text{Pr}(t)$ if the amplitude at time t is $R(t)=1$.
2. compute the **average power** $E[\text{Pr}]$
3. How does the **instantaneous power** $\text{Pr}(t)=R^2(t)$ fluctuate compared to the **average power** $E[\text{Pr}]$?

Describe why the instantaneous power can vary significantly, even though the average power remains constant over time.