Range Equation

$f_0 := 2.408 \cdot 10^9 \cdot Hz \quad D := 2.7 \cdot 10^{-3} m \quad \lambda := \frac{c}{f_0} = 0.124 m \quad \gamma_{air} := 2$

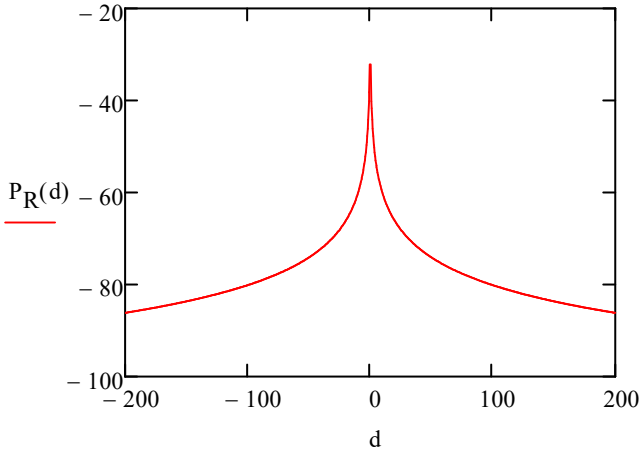
$\gamma_{Shannon} := 5.5$

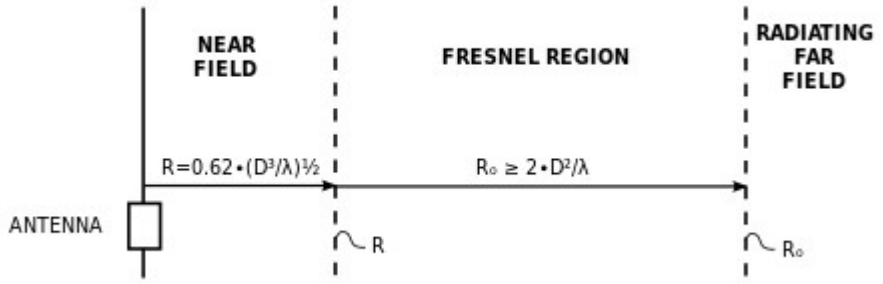
$d_0 := \frac{2 \cdot D^2}{\lambda} = 1.171 \times 10^{-4} m \quad G_t := 1 \quad G_r := 1 \quad P_{tx} := 0.001 \quad L_1 := 1$

(1) $P_{rcvd}(d) = \frac{P_{tx} \cdot G_t \cdot G_r \cdot \lambda^2}{(4\pi)^2 \cdot d^2 \cdot L} = \frac{P_{tx} \cdot G_t \cdot G_r \cdot \lambda^2}{(4\pi)^2 \cdot d_0^2 \cdot L} \cdot \left(\frac{d_0}{d}\right)^2 = P_{rcvd}(d_0) \cdot \left(\frac{d_0}{d}\right)^{\gamma}$

$P_{rcvd0} := \frac{P_{tx} \cdot G_t \cdot G_r \cdot \lambda^2}{(4\pi)^2 \cdot d_0^2 \cdot L_1} = 7.157$

$P_R(d) := 10 \cdot \log\left[\frac{\left[P_{rcvd0} \cdot \left(\frac{d_0}{d \cdot m}\right)^2\right]}{0.001}\right] \quad P_R(157.1) = -84.004$





Doppler spread

$$\text{runningMetersPerPackage} := \frac{12000}{60 \cdot 60 \cdot 4} = 0.833 \qquad \text{packageTime} := 0.25 \qquad c_{\text{lightspeed}} := 2.998 \times 10^{8}$$

$$\text{pEnd}_{\text{length}} := \begin{pmatrix} 200 \\ 0 \end{pmatrix} \qquad \text{pOnePack}_{\text{length}} := \begin{pmatrix} \text{pEnd}_{\text{length}_0} + \text{runningMetersPerPackage} \\ \text{pEnd}_{\text{length}_1} - 0.4 \end{pmatrix}$$

$$\text{dl}_{\text{length}} := \sqrt{\left(\text{pEnd}_{\text{length}_0} - \text{pOnePack}_{\text{length}_0}\right)^2 + \left(\text{pEnd}_{\text{length}_1} - \text{pOnePack}_{\text{length}_1}\right)^2} = 0.924$$

$$v_{\text{lenght}} := \frac{\text{dl}_{\text{length}}}{\text{packageTime}} = 3.697 \quad (13.30920\text{kph}) \qquad v_{\text{height}} := \frac{\text{dl}_{\text{height}}}{\text{packageTime}} = 3.333 \quad (11.99880\text{kph})$$

$$f_{\text{doppler\_length}} := \frac{v_{\text{lenght}}}{c_{\text{lightspeed}}} f_0 = 29.698 \cdot \text{Hz} \qquad f_{\text{doppler\_height}} := \frac{v_{\text{height}}}{c_{\text{lightspeed}}} f_0 = 26.773 \cdot \text{Hz}$$

$$\text{dv}_{\text{extreme}} := \frac{\text{dv}_{\text{extreme}}}{c_{\text{lightspeed}}} f_0 = 1100000\text{Hz} \text{ solve}, \text{dv}_{\text{extreme}} \rightarrow 136951.82724252491694 \quad (493023.6\text{kph})$$

Samples Per Round Theory

$$\text{Runde} := 906.1739$$

$$\text{packages} := \frac{\text{Runde}}{\text{runningMetersPerPackage}} = 1.087 \times 10^{3}$$

$$\frac{2\pi}{\text{packages}} = 5.778 \times 10^{-3}$$

$$\frac{\text{packages}}{4} = 271.852$$

$$\text{outOfRange} := 61$$

$$\text{inRange} := 271.852 - \text{outOfRange} = 210.852$$

Samples Per Round Small Track Test Setup

$$PackagesPerSec := 50$$

$$runningMetersPerPackage\_Tog := \frac{0.2604}{50}$$

$$Runde\_small := 0.435$$

$$packages\_small := \frac{Runde\_small}{runningMetersPerPackage\_Tog} = 83.525$$

$$Length\_in\_range := 2 \cdot (0.131 + 0.05)$$

$$Packages\_in\_range := \frac{Length\_in\_range}{runningMetersPerPackage\_Tog} = 69.508$$

$$outOfRange\_Package\_small := packages\_small - Packages\_in\_range = 14.017$$

$$RelayedPercentage\_small := \frac{outOfRange\_Package\_small}{packages\_small} \cdot 100 = 16.782$$

Samples Per Round Small Track Test Setup

$$Runde\_large := 0.56$$

$$packages\_large := \frac{Runde\_large}{runningMetersPerPackage\_Tog} = 107.527$$

$$outOfRange\_Package\_Out\_Large := packages\_large - Packages\_in\_range = 38.018$$

$$RelayedPercentage\_Large := \frac{outOfRange\_Package\_Out\_Large}{packages\_large} \cdot 100 = 35.357$$

$$TrackRelayPersentage := \frac{RelayedPercentage\_Large}{RelayedPercentage\_small} \cdot 100 = 210.69$$