

ESPTR

(English)

Signal Processing in Telecommunications and Radar

Channel properties

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Communications channel

Channel → (usually) everything between modulator and demodulator:

- (mainly) the transmission medium (space between antennas, or the connecting cable)
- (plus:) antennas, amplifiers, cables, waveguides, couplers, optics....

Channel properties:

- Channel bandwidth
 - Channel noise
 - Channel capacity
 - Bandpass channel & equivalent baseband channel
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Channel model: noise

Model: linear system + added noise; AWGN model

- Thermal noise (mainly receiver) with white PSD

$$\bar{u}_n^2 = 4k_B T R V^2 / \text{Hz}$$

e.g. for room temp. and 10 kHz channel

$$P = k_B T \Delta f = 1.38 \cdot 10^{-23} \text{ J/K} \cdot 300 \text{ K} \cdot 10^4 \text{ Hz} = 4.1 \cdot 10^{-17} \text{ W} = -134 \text{ dBm}$$

rule: $P = -174 + 10 \log(\Delta f)$ [dBm]

- Interfering signals (know nothing, assume white (??) → not always true!)
 - Outer space
 - Atmospheric (“static”)
 - Man-made (EMC problems → computer, broken shaver motor...) impulse noise
 - Other transmissions (unintentional and ECM)

radar only clutter

Channel model: linear

Transmission properties

- Physical parts characteristics
- Propagation characteristics, including propagation losses $P \sim \frac{1}{4\pi R^2}$ (one way)
- Multipath propagation \longrightarrow self-interference

Description:

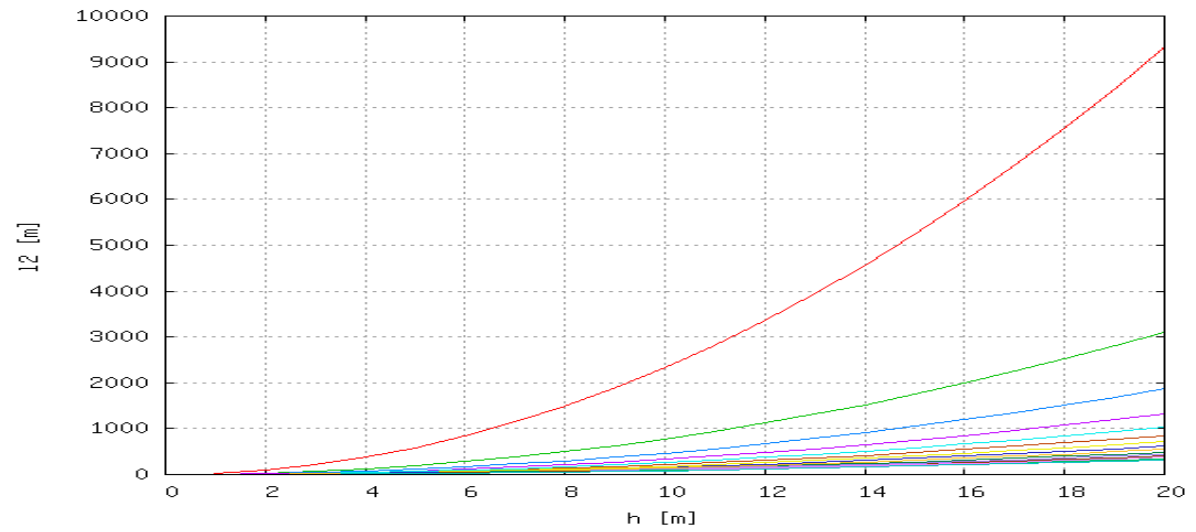
- Time domain: impulse response
- Frequency domain: transfer function (phase is important!)

Non-linear:

- Doppler effect
 - Impulse noise saturating the receiver
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Multipath

(l_2 =distance vs. h =tower height), 7GHz, curves for $[1\ 3\ 5\ \dots\ 15] \cdot \lambda/2$, flat earth



geometry

Effects in baseband

Titan calling