Receiver Noise

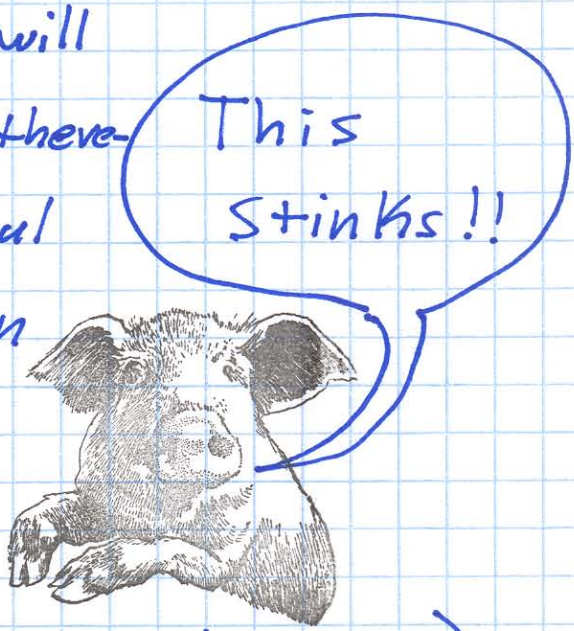
Say we reject <u>completely</u> the image signal and all spurious signals. ∴ a single signal will appear at the detector/demodulator.

Q: One signal! ∴ assuming a perfect detector, the demodulated signal $\hat{i}(t)$, will have <u>no</u> error (i.e., $\hat{i}(t) = i(t)$), <u>right</u>???

A: No! Unfortunately, there will <u>always</u> be another signal at the detector ⇒ noise!

Noise at the detector will always be present, and therefore the detected signal $\hat{i}(t)$ will always contain error ϵ, where:

$$\epsilon = \hat{i}(t) - i(t) \neq 0$$

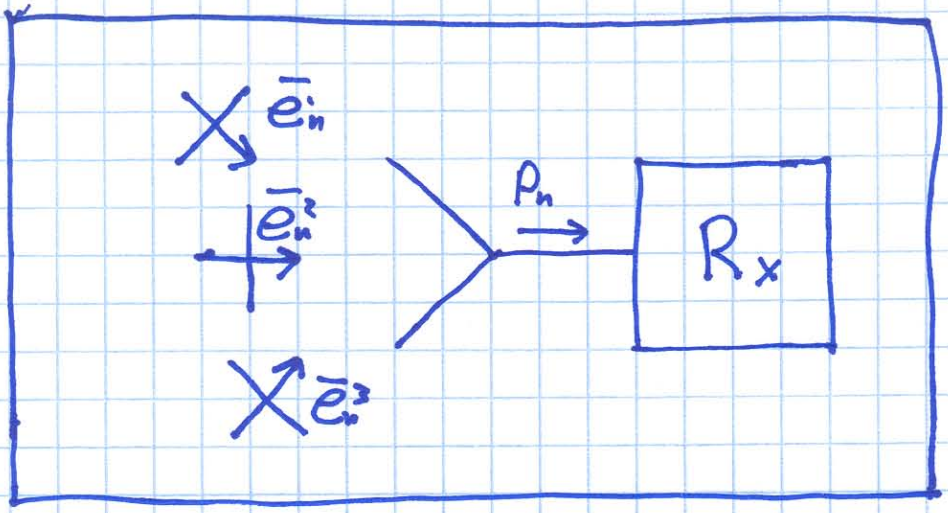


{We can reduce this error, but we cannot eliminate it!!}

Q: Where does this noise come from??

A: Two sources! External and Internal.

External noise - is noise that is coupled into the Rx through the receiver antenna.



- In addition to the human-made signals occupying virtually every frequency of the RF/μwave spectrum, the entire e.m. spectrum is awash in random energy (i.e. noise).
- This random energy has niether a specific frequency, nor direction, but instead is spead out across all directions and frequencies!
- As a result, we can point our antenna in a specific direction,

and we can tune our receiver to a specific frequency, but we will still receive a portion of this e.m noise!

Q: What is the source of this external noise??

A: There are 3 sources! - terrestrial, extra-terrestrial, and human-made.

Terrestrial noise - Every warm object radiates e.m. energy (one method of heat transfer)!!

{Definition of warm ⇒ above absolute zero.}

- The power and frequency of the emitted e.m. noise depends on the temperature of the object.
- For objects on the Earth, the temperature is such that objects radiate mainly in the infared region of the e.m. spectrum
- But, objects on the Earth also emitt some energy across the entire e.m. spectrum (e.g., optical and u-wave regions).

Extra-ternestrial - There are very warm objects in space! E.G., the sun, stars, planets, etc. They also radiate e.m. noise that (eventually) reaches the Earth.

Human-made - We humans make alot of noise (both e.m. and otherwise). In addition to the information signal, transmitters radiate noise that was internally generated!

Internal Noise

The receiver itself generates noise!!

Q: Why? A: We will find out that resistors and semiconductors generate noise.

{Any device which absorbs power will also emitt power (in the form of noise).}