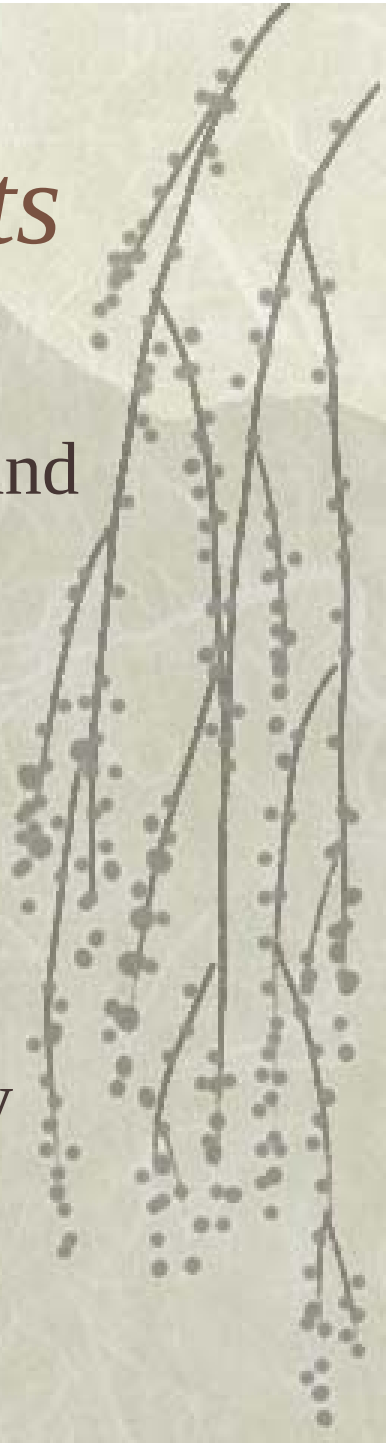
Current Research Interests

Stephen G. Wilson

- Channel coding to approach Shannon's bound (turbo and LDPC codes)
  - (C. Cole, S. Yalamarthy)
- Hardware architectures for fast decoding
  - (R. Zarubica)
- Space-time transmission to mitigate fading
  - (S. Ponnaluri)
- Distributed MIMO, or cooperative diversity
  - (O. Dogan)

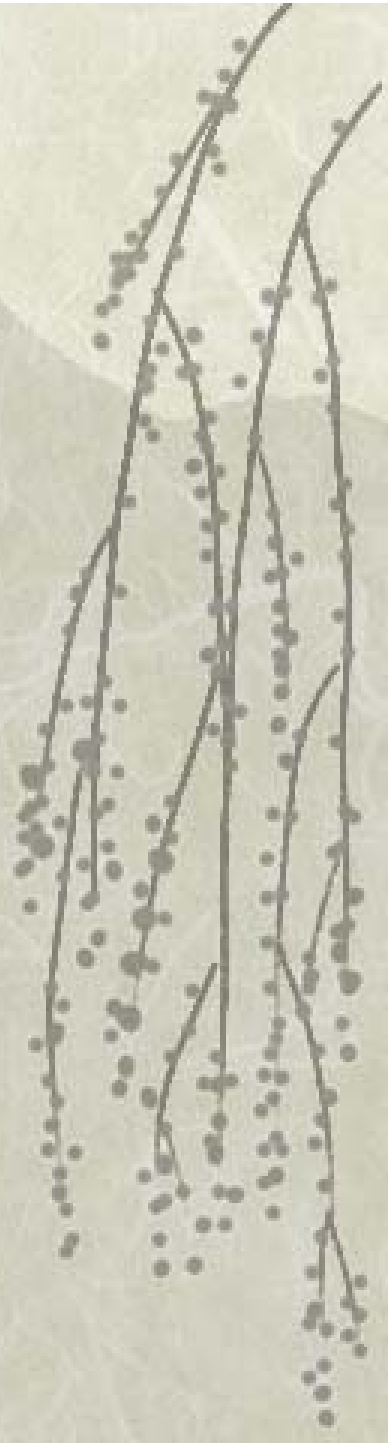


Current Research Interests

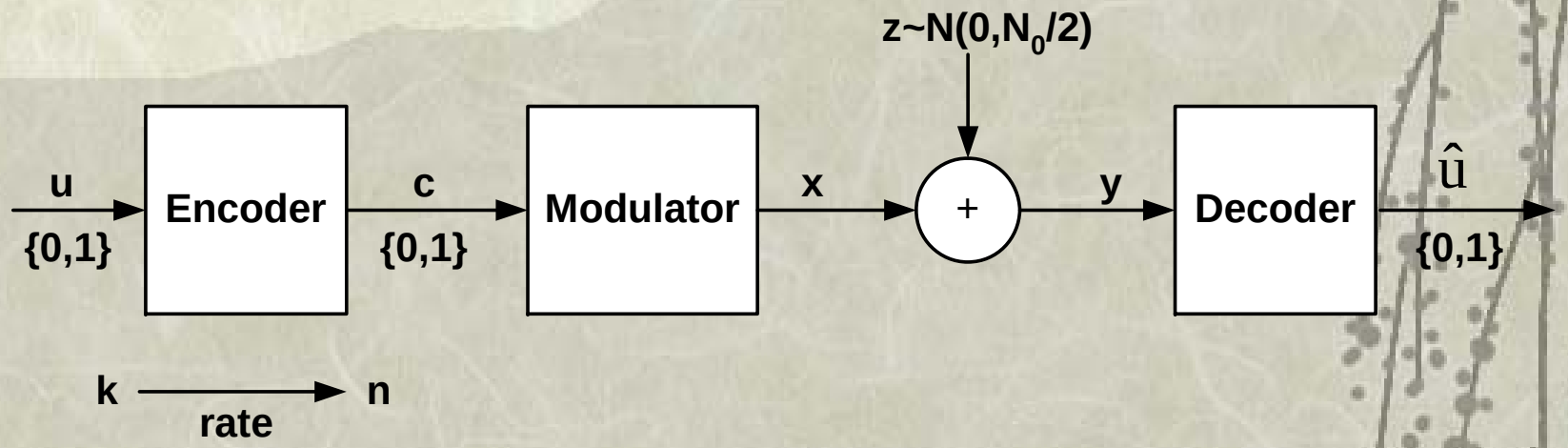
- Free-space optical communication
  - (N. Cvijetic, S. Happel)
- Coded aperture imaging with millimeter waves
  - W. Jin

Common Threads

- Math
  - Probability
  - Linear Algebra
- Physics
  - Channel Modeling
  - Device Modeling



The Hunt for Optimal Data Transmission



Q: What is the smallest signal to noise ratio (E_b/N_0) I can use and still be reliable?

- Shannon (1948) showed the Gaussian channel has capacity

$$C = \frac{1}{2}\log_2\left(1 + 2\frac{E_s}{N_0}\right)$$

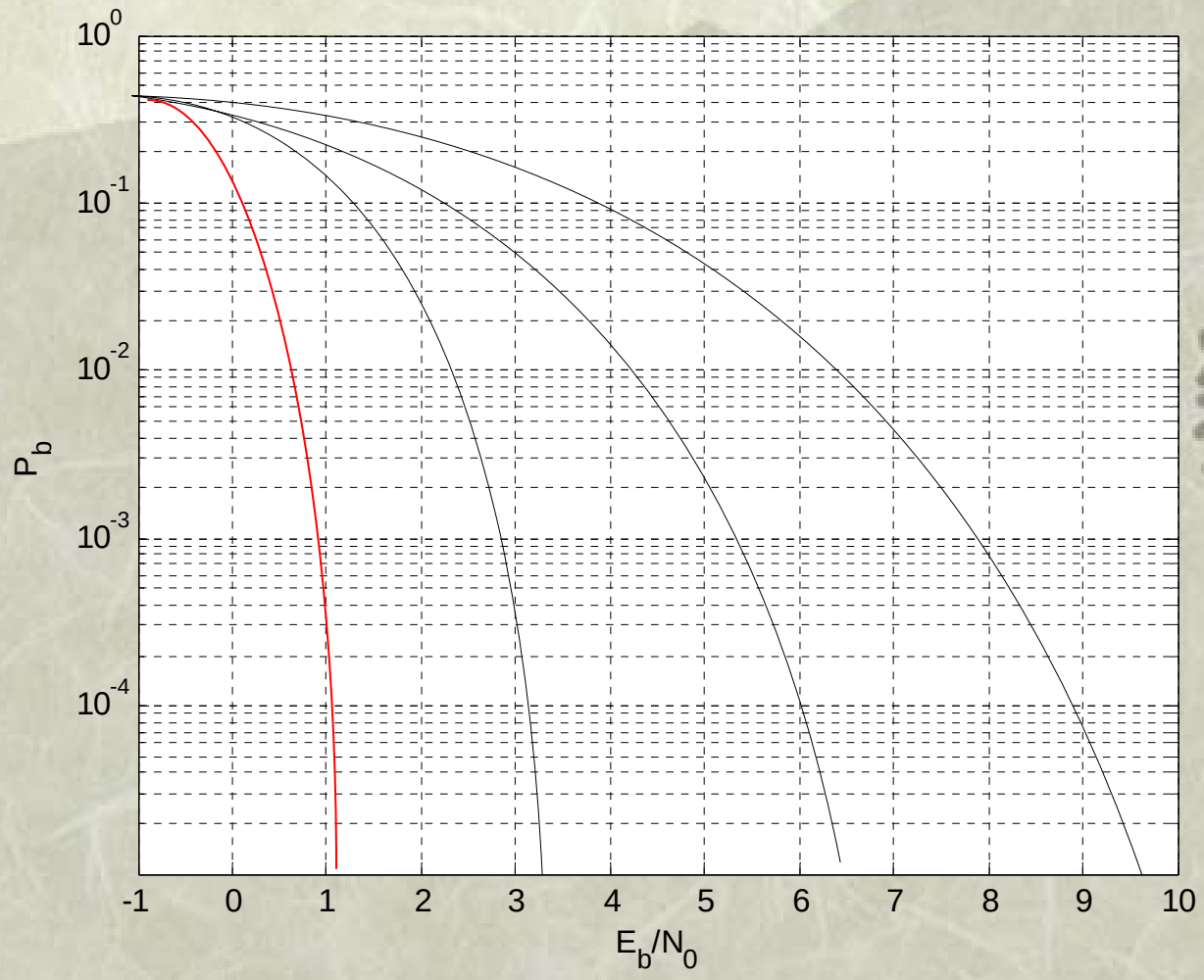
and that if $R < C$ while letting $n \to \infty$ we can build reliable transmission.

$R \square C$ $\qquad R = \frac{1}{2}\log_2\left(1 + 2\frac{RE_b}{N_0}\right)$

$$\left(\frac{E_b}{N_0}\right)^* = \frac{2^{2R-1}}{2R}$$

For *R=1/2* codes, $(E_b/N_0)^*$ =1 or 0 dB!

- Proof was non-constructive, and 50 years of coding research has made fairly slow progress


10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
P_b
-1
0
1
2
3
4
5
6
7
8
9
10
E_b/N_0