Spectrum Sharing between Radar and Communication Systems

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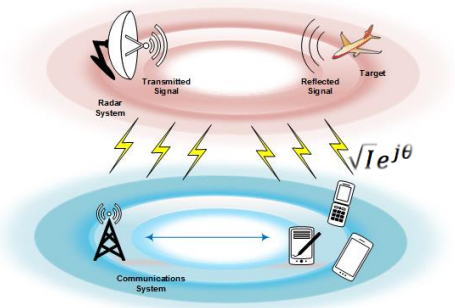
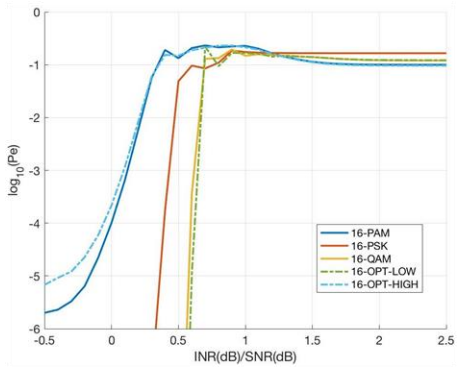
NSF ECCS1443967 EARS Collaborative Research Lets share CommRad - Spectrum Sharing Between Communications and Radar Systems

Problem Statement and Motivation



$$Y = \sqrt{S}X + \sqrt{I}e^{j\theta} + Z$$

SER for M=16 and S = 30 dB



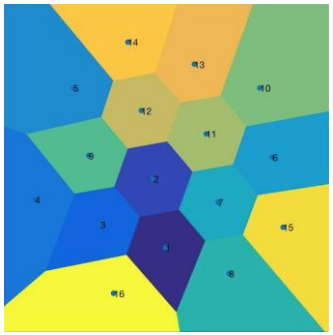
- Increased demand for wireless services necessitates the spectrum co-existence between radar and communication systems
- How an unaltered radar pulse affects the performance of an uncoded communication RX in terms of the Symbol Error Rate (SER)
- Optimize a *signal constellation* that achieves lowest SER:
  - **Weak radar interference (INR << SNR):**
    - radar interference is treated as Gaussian noise
    - *optimal constellation* has a shape of concentric hexagons
  - **Moderate radar interference (INR ≈ SNR):**
    - yields the highest SER
  - **Strong radar interference (INR >> SNR >> 1):**
    - radar signal is completely canceled along with part of comm signal resulting in an irreducible error floor
    - *optimal constellation* has a shape of an unevenly-spaced PAM

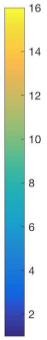
Technical Approach

- Derive the SER for the optimal ML decoder and its approximations using the communication theoretic approach

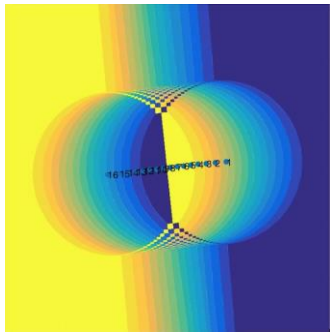
Decoding Regions for M=16 Optimal Constellations

SNR = 30 dB and INR = 15 dB





SNR = 30 dB and INR = 75 dB



Key Achievements and Future Goals

- N. Nartasilpa, D. Tuninetti, N. Devroye, and D. Erricolo, “Let's share CommRad: effect of radar interference on an uncoded data communication system,” in Proc. of IEEE RadarCon, May 2016.
- N. Nartasilpa, D. Tuninetti, N. Devroye, and D. Erricolo, “On the error rate of a communication system suffering from additive radar interference,” in *Proc. of IEEE GlobeCom*, Dec 2016.
- N. Nartasilpa, D. Tuninetti, N. Devroye, and D. Erricolo, “Signal constellation optimization in the presence of radar interference and Gaussian noise,” in submitted to *Proc. of IEEE ICC*, May 2017.

- Extensions to more practical models such as fading channels, OFDM channels, MIMO channels, and channel-coded systems.

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