Modeling the Interference of Pulsed Radar at OFDM-Based Communications Systems

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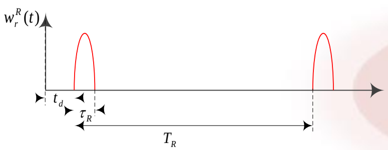
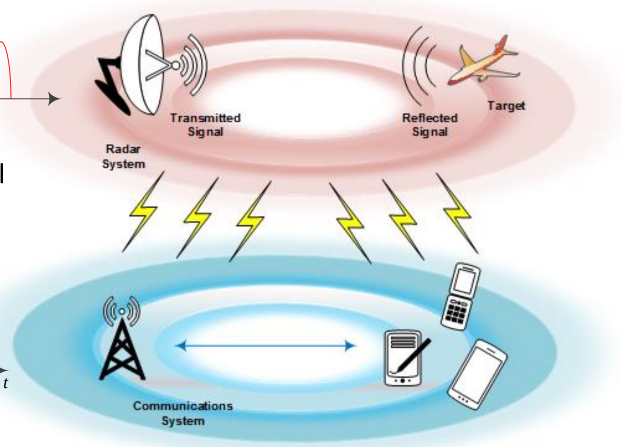
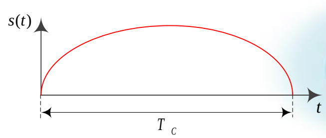
NSF-ECCS 1443967, EARS: Collaborative Research: Let's share CommRad -- spectrum sharing between communications and radar systems



Typical radar signal (low duty cycle)





Typical telecomm. signal (high duty cycle)

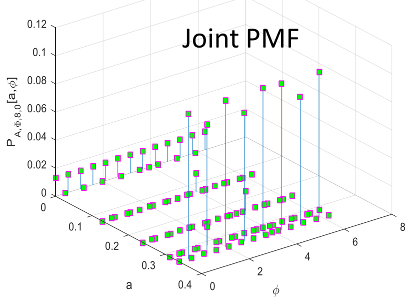
Problem Statement and Motivation

- The shortage of spectral resources has motivated the emerge of proposals calling for spectral coexistence between systems that used to operate over indep. bands.
- We focus on spectrum sharing between comm. and radar systems, particularly on modeling the effect of radar interference at the Rxof a communications system.
- The literature lacks an accurate theoretical model of pulsed radar interference from the perspective of an OFDM receiver. The adopted model in some works (e.g., [1-3]) models the radar signal as additive interference of known deterministic amplitude and an unknown random phase uniformly distributed in [0,2π].
- This work finds the exact model of the radar interference for specific scenarios.

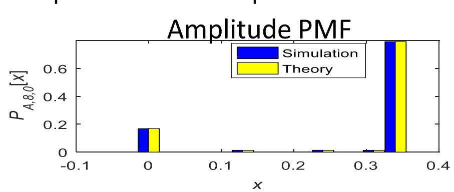
[1] N. Nartasilpa, D. Tuninetti, N. Devroye, and D. Erricolo, "Let's share commrad: Effect of radar interference on an uncoded data communication system," in 2016 IEEE Radar Conference (RadarConf), May 2016, pp. 1–5.
[2] N. Nartasilpa, D. Tuninetti, and N. Devroye, "On the error rate of a communication system suffering from additive radar interference," in 2016 IEEE Golbecom, Dec 2016, pp. 1–5.
[3] D. Tuninetti, N. Devroye, and D. Erricolo, "Characterization of the effect of radar interference on an uncoded data communication system," in 2016 IEEE AP-S, Dec 2016, pp. 1–5.

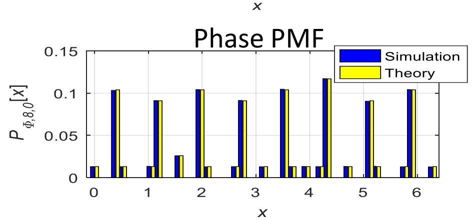
Technical Approach

- We consider an OFDM-based multi-carrier communications system, and model the additive radar interference (I) after being processed by a conventional OFDM Rx.
- We derive the PMFs of the amplitude and phase of I at the o/p of the OFDM Rx.



An example for the joint PMF and the marginal ones of I over the 7th subcarrier during the first OFDM block.





Key Achievements and Future Goals

- Both the amplitude and the phase of the radar signal are random and their PMFs can be accurately estimated in a numerical manner.
- For a rectangular pulsed radar signal, the following applies:
  - The PMFs of the amplitude and the phase can be expressed in closed forms.
  - The PMF of the amplitude consists of a mixture of a small number of delta functions, and one of which dominates the probability. Hence the amplitude can be approximated by a deterministic function of k.
  - The PMF of the phase is a combination of two discrete uniform functions.
- **Future goals:** (i) Finding the best mechanisms of mitigating the radar interference either at the Tx, the Rx or both, (ii) Characterizing the performance and capacity of a communications system suffering from a radar-like interferer, and (iii) Considering practical radar systems and modeling the signals used therein.

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