

AFRL RESEARCH TOPIC CALL FY16

RY16-4
(Revised #2)

Research Title: Optimization of RF Sensing & Specificity to the Detection of Sub-threshold Multi-Signals.

1. Individual Sponsor:

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2. Academic Area/Field and Education Level: Electrical Engineering and Computer Science / (MS or Ph.D. level)

3. Objectives: For Multi-signal detection, a powerful platform to characterize subthreshold signals in noise is stochastic resonance. The application of this technique to the domain of distributed RF sensing integration is seriously lacking. It has been shown that an SR filter can amplify the signal to noise ratio characteristics from data for multi-signal detection in communication and radar for low probability of intercept applications.

4. Description: The approach taken in this proposal is different from published methods by developing the following new techniques for subthreshold signals:

- (1) The SR problem is cast within the context of a partial differential equation (PDE). The Fokker-Planck Equation (FPE) is also a well-known PDE.
- (2) The solutions of the PDEs can be optimized and solved by special techniques. Through the use of the solutions of these PDEs, optimal decision rules and improved RF detection will occur for sensory hardware by the following:
 - (a) To *optimize* RF spectrum detection and decision methods incorporating the Fokker-Planck equation to model time-varying probability density functions.
 - (b) To develop *dynamic* RF detection methods via maximum likelihood decision rules using probability density functions. Such rules enjoy statistical optimality properties.
 - (c) To *help obviate* the current detection problem in sensing systems due to noise.
 - (d) To *employ nonlinear dynamical procedures* such as stochastic resonance (SR) to amplify signal to noise ratios for certain test signals for low probability of intercept (LPI) applications.
 - (e) To *study the SR effect* within the context of an unknown waveform ambiguity function.

5. Research Classification/Restrictions: *U.S. Citizens*

6. Interest in Summer USAFA Cadet: No

7. Eligible Research Institutions: *Place an X in all that apply.*

Universities (DAGSI & AFIT) AFIT (only) USAFA