DAGSI Research Topic

1. **Research Title:** Simulating Software-Defined Radar Transmitters using Genetic Algorithms
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level**

Electrical Engineering, Computer Engineering, Computer Science,
Software and Systems Engineering (MS or PhD level)

4. **Objectives:** Software-defined radar (SDR) systems are more flexible and agile than their hardware-only counterparts, offering several operational advantages, including the ability to switch between different radar modes, faster development time, and ease of upgrading. One disadvantage is that nation-state adversaries can use this technology to make transmitted radar waveforms and behavior difficult to predict, analyze, and characterize. The overarching goal of the proposed research project is to simulate the operation and actions of a software-defined radar emitter that will be part of a close-loop simulator. To that end, this project will have the following research objectives: (1) develop the ability to simulate the actions of an agile SDR using genetic/evolutionary algorithms to generate novel functionality, (2) develop test cases and associated metrics that will improve radar characterization and classification by generating novel software-defined emitter output, removing human bias in the test creation process as much as possible, and (3) develop or leverage a co-evolutionary/co-adapting counterpart to the agile SDR simulator that will allow testing of the effectiveness of the SDR being developed.

5. **Description:** Electromagnetic warfare includes characterizing radar system output to understand the electromagnetic operating environment. This characterization is impeded by agile software-defined radar systems that can react and adapt to changing circumstances. The ability to predict radar responses to test the robustness of characterization algorithms prior to operational use is required to optimize performance. Therefore, the ability to simulate the actions of an agile software-defined emitter that is part of a close-loop simulator is essential to test these algorithms. Genetic/evolutionary algorithms that operate on the software that controls the radar system output offers the potential to generate novel and previously unencountered functionality and improve detection and characterization algorithms prior to

their deployment in a contested and congested electromagnetic environment. These algorithms also potentially allow one to predict the trajectory of evolving threats that might ordinarily go unnoticed. The goal of this research is to model agile and adaptable software-defined radar systems to predict their behavior prior to encountering them during mission operations and better prepare for unanticipated adversarial actions and behaviors.

6. **Research Classification/Restrictions:** Basic Fundamental research, no restrictions anticipated.

7. **Eligible Research Institutions:** Air Force Institute of Technology, University of Cincinnati, University of Dayton, Wright-State University, or other state universities with a suitable research background.

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