

DAGSI Research Topic 1

1. **Research Title:** R&D of a Generalized Deinterleaver for Omnidirectional Antennas
2. **Individual Sponsors:**

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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:** Electronic Warfare Spectrum Management (EWSM) within a highly congested area is a critical component in the current and future battlespace. With better situational awareness, EWSM would greatly contribute to successful and seamless mission operations. Electronic Support (ES) plays a major role in this area. Signal deinterleaving is the second stage of the Electronics Support (ES) signal processing chain after detection. Hence, it is critical to separate out the radio frequency (RF) signal pulse trains for later processing steps. Furthermore, intelligent deinterleaver development is critical for both real-time processing and off-line analysis. The overarching goal of the proposed research project is to develop a generalized deinterleaver for omnidirectional antenna applications to be used in open and closed-loop simulations. To that end, this project will have the following research objectives: (1) conduct a technology survey on the current and most recent deinterleavers, AI/ML algorithms applied to deinterleavers, and their potential integration, (2) build digital model of best-of-breed deinterleavers identified from the survey, (3) analyze the results with emitter models and determine compatibility with the Big Iron Software Framework, (4) develop an intelligent generalized deinterleaver informed by the survey, and (5) verify and test the proposed deinterleaver with emitter models, and compare it with existing deinterleavers.
5. **Description:** Electromagnetic warfare includes characterizing radar system output to understand the electromagnetic operating environment. This characterization is made difficult by agile software-defined radar systems that can react and adapt to changing circumstances. The ability to detect, identify, and characterize emitter waveforms correctly and sufficiently can decrease the burden on the following signal analyze chain. Therefore, deinterleaving is a critical stage for electric warfare support functions. In addition, RF signals from multiple emitters consist of legacy or advanced active and passive components, which increases the difficulty on

the receiving end. Furthermore, receiver antennas and interleaving themes can be drastically different due to hardware specifications and limitations. Based on these two difficulties, intelligent deinterleaver development is proposed to improve performance and address gaps between missing and required input parameters. In general, deinterleaver algorithms match to their antenna type, and there are few deinterleaver algorithms for omnidirectional antennas due to the antenna's limitation. The goal of this research is to develop a generalized deinterleaver for omnidirectional antennas with latest and proven deinterleave technologies.

6. **Research Classification/Restrictions:** Basic Fundamental research, no restrictions anticipated. ARCEM and RFView software tools will be shared with the DAGSI performers.
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.
8. **PR Approved:** AFRL-2024-4682