Title of the course:

Advanced Waveform Design and Optimization Techniques; An application to pulse compression in weather radar systems

Duration: Half Day

Availability to have on-line attendees: Yes.

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Abstract:

The meteorological industry is transitioning towards Solid State Weather Radar (SSWR) systems, which emit minimal transmission power to reduce environmental impact and system costs. However, accurately estimating reflectivity for each polarization and reducing the blind range pose significant challenges for SSWR systems utilizing pulse compression. This short course will explore advanced radar waveform design and optimization techniques, focusing on Pulse Compression, Integrated Side Lobe (ISL) mitigation, and Peak Side Lobe (PSL) reduction. Participants will gain insights into radar waveform fundamentals, techniques for mitigating ISL and reducing PSL, and principles of waveform diversity in MIMO radar systems. Practical demonstrations using real weather radar data will provide a comprehensive understanding of these principles.

Goals of the course:

- Getting familiar with advanced radar waveforms including LFM, binary phase, and polyphase sequences.
- Learn metrics for quantifying different waveforms, emphasizing their importance in weather radar applications.
- Understand basics of convex and nonconvex optimization techniques, including coordinate descent, gradient descent, and majorization minimization.
- Learn how to effectively apply nonconvex optimization techniques to design weather radar waveforms and improve sensitivity and accuracy in pulse compression.
- Understand the principles and benefits of waveform diversity in MIMO radar systems.

Expected background of trainees:

Participants should have a basic understanding of radar principles and signal processing techniques. Familiarity with radar systems and weather radar concepts would be beneficial. Pre-course readings on radar fundamentals and pulse compression techniques are recommended for a deeper understanding.