

1) Title of the tutorial:

Non-Convex Optimization for Practical Signal Design in Radar Systems with Emerging Applications

2) Instructors name and affiliation

Presenter 1

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3) a 300 word abstract describing the proposed topic and including an outline of the contents

Transmit signal design plays a key role in enhancing classical radar tasks including detection, classification, identification, localization, and tracking performance over classical systems. Further, waveform design is a key enabler of the emerging paradigm on joint radar-communications. It refers to the signal adaptation in several domains, such as spatial, temporal, spectral, and polarization. In this context, waveform optimization is coupled with the advent of MIMO radars that make the design problems more challenging.

The main goal of the tutorial is to highlight the challenges in radar waveform design and motivate a framework by the application of non-convex optimization principles to overcome the challenges under practical constraints. In this context, the tutorial focusses on key applications and highlights a variety of optimization approaches including majorization minimization (MM) and coordinate descent (CD), dealing with

important applications in radar systems. To further bring the optimization closer to implementation and early adaptation in systems, practical constraints, such as finite energy, unimodularity (or being constant-modulus) and finite or discrete-phase (potentially binary) alphabet are included in the optimization problems as constraints.

Outline

- Part I: Review of the optimization problems in radar systems (50 mins)
- Part II: MM framework for waveform optimization in radar systems (50 mins)
- Part III: CD framework for waveform optimization in radar systems (50 mins)
- Part IV: Waveform optimization for co-existence of MIMO radar and MIMO communications (50 mins)
- Part VI: Summary and open challenges (10 mins)

After attending the tutorial, participants will be able to understand:

- An overview of optimization theory and its application in radar systems, including waveform design for target detection and estimation as well as transmit beam pattern design, joint sensing and communications including co-existence MIMO communications.
- Current challenges and design criteria associated with waveform design in radar systems.
- Key hardware design aspects and constraints of the practical radar systems considered in the optimization problems.
- Emerging research challenges and applicability of different approaches to meet these challenges in modern radar systems.

4) Target audience and assumed knowledge

The tutorial is suitable both for young students who are approaching optimization theory and innovative radar signal processing designs as well as for radar scientists, engineers and practitioners which need a rigorous and academic point of view on the fundamentals of several algorithms and their implementation that will be present in the modern radar systems. The tutorial assumes no specific technical expertise on the part of audience except basic knowledge of radar systems and statistical signal processing.