Tutorial: **Introduction to Automotive Radars**

Syllabus

1. Introduction
    a. Active safety features
    b. Autonomous driving
    c. Scenarios and required performance
    d. Sensing challenges
    e. Technology trends
    f. Various sensing modalities
2. Automotive radars
    a. History
    b. Challenges
    c. Trends in automotive radar
    d. Performance requirements
3. EM propagation in automotive radar scenarios
    a. Multipath
    b. Clutter
4. Concepts
    a. Linear frequency modulation radar
    b. Phase modulation radar
    c. Distributed radar
5. Radar equation
    a. Losses
    b. Signal-to-Noise ratio
    c. Examples
6. Automotive radar processing chain
7. Automotive target detection
    a. Problem definition
    b. Distributions
    c. Swerling models in automotive targets
    d. Constant false alarm ratio (CFAR)
8. Range and Doppler measurements and resolution
    a. Range estimation problem and performance
    b. Doppler estimation problem and performance
    c. Liner frequency modulation and waveform considerations
9. Automotive radar antennas
    a. Printed antenna, MMIC
    b. Antenna array
    c. Linear array
    d. Planar array
    e. Antenna architecture
10. Direction of arrival measurements and Beamforming
11. Automotive MIMO radar
12. Automotive targets tracking and clustering
13. Packaging challenges
14. Interferences

15. Target classification
16. Applications
    a. Parking
    b. Adaptive Cruise control
    c. Driver monitoring
17. Sensor fusion

Audience:

-Junior engineers that are seeking career in the exponentially growing industry of Automotive Radars

- Experienced radar engineers seeking to expand the knowledge from military radars to civil radar applications

- Researchers that are looking to explore challenges in the modern automotive radars to develop new methods to address these challenges

Learning outcomes:

- Automotive radar current and future scenarios and applications
- Challenges in current automotive radars
- Gaps in application of the classical radar approaches to the automotive radar applications
- Modern automotive radar approaches and architectures
- Automotive radar system design considerations
- Automotive radar antenna design
- Automotive radar waveforms
- Processing chain of the modern fast-LFM automotive radar
- Considerations of the automotive radar fusion with other sensing modalities

Bio

Igal Bilik received B.Sc., M.Sc., and Ph.D. degrees in electrical and computer engineering from the Ben-Gurion University of the Negev, Beer Sheva, Israel, in 1997, 2003, and 2006, respectively. From 2006–2008, he was a postdoctoral research associate in the Department of Electrical and Computer Engineering at Duke University, Durham, NC. Since 2008, he has been an assistant professor in the Department of Electrical and Computer Engineering at the University of Massachusetts, Dartmouth. His recent research interests include statistical signal and sensor array processing with application to sonar, radar, and communication systems and automatic target classification. Currently, he is with Advanced Technical Center in Israel of General Motors, where he is leading a Smart Sensing and Vision Research Group, responsible for developing perception algorithms and novel sensing systems for active automotive safety, autonomous driving, and driver monitoring systems. His research interests include signal processing for automotive radars. Dr. Bilik received the Best Student Paper Awards at IEEE RADAR 2005 and IEEE RADAR 2006 conferences and Student Paper Award in the 2006 IEEE 24th Convention of Electrical and Electronics Engineers in Israel.