Internship: Phase-Noise-Resilient Architectures for Large MIMO FMCW Automotive Radars

Job Responsibility:

The internship focuses on the exploration and evaluation of next-generation automotive radar architectures that combine the benefits of large-scale MIMO imaging and phased-array beam steering.

- Investigate the impact of phase noise accumulation and multipath propagation in large MIMO FMCW radar systems employing DDMA and related techniques.
- Develop mathematical models and simulation frameworks to analyze radar system performance, including angle resolution, Doppler resolution, detection capability, and phase-noise robustness.
- Research and evaluate hybrid radar architectures that combine MIMO imaging capability with directional phased-array transmission.
- Explore beam-scanning strategies, DDMA-based transmission schemes, sparse transmit activation methods, and subarray-based beamforming concepts.
- Design and perform MATLAB and/or Python simulations to compare alternative radar architectures and quantify associated system trade-offs.

Project Deliverables

- Literature review on MIMO radar, phased-array radar, DDMA processing, and phase-noise effects.
- Simulation framework for evaluating hybrid radar architectures.
- Analysis of trade-offs between angular resolution, Doppler resolution, frame rate, phase-noise robustness, and implementation complexity.
- Evaluation of array configurations, beam scheduling approaches, and waveform design alternatives.
- Final technical report and presentation summarizing findings and recommendations.

Link with more details

Learning Objectives

During this internship, the student will gain hands-on experience in:

- Advanced FMCW automotive radar systems and signal processing.
- MIMO radar, phased-array beamforming, and imaging radar concepts.
- Array signal processing and direction-of-arrival estimation techniques.
- System-level radar architecture design and performance optimization.
- Research methodologies involving theoretical analysis, simulation, and engineering trade-off evaluation.

Job Qualification:

- **The candidate must be pursuing a Master's degree in Electrical Engineering, Signal Processing, Applied Mathematics, Physics, or a related technical discipline.**
- Strong interest in radar systems, wireless communications, signal processing, and sensing technologies.
- Familiarity with FMCW radar, MIMO radar, phased arrays, beamforming, antenna arrays, and RF impairments such as phase noise is highly beneficial.
- Good understanding of FFT-based processing, range-Doppler processing, detection theory, estimation theory, array signal processing, and direction-of-arrival estimation.
- Experience with MATLAB and/or Python for modeling, simulation, visualization, and algorithm development.
- Knowledge of structured software development practices and version control tools such as Git is a plus.
- Self-motivated, curious, analytical, and comfortable working on open research questions with both independent and collaborative work styles.
- Strong written and verbal communication skills, with the ability to document technical findings and present results clearly.

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