

From Waves to Insights: AI-enhanced mmWave systems

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ABSTRACT

The use of millimeter-wave frequencies for 5G networks has been a primary contributor for transitioning Si-based phased array technology from R&D to real-world deployments. While the commercial use of millimeter-wave sensing so far has been dominated by low-cost, compact MIMO radars for automotive and industrial applications, the on-going wide deployment and advancement of Si-based phased arrays for communications opens a new horizon of opportunities for sensing and event recognition. These opportunities are even more compelling when considering the use of algorithms based on artificial intelligence (AI) and machine learning (ML) techniques. While the exploration of AI/ML to RF applications started decades ago, their development has accelerated recently with the increasing availability of advanced AI knowledge, high-capacity compute infrastructure, and wireless testbeds for generation and training data sets. In this context AI/ML techniques are on a solid trajectory to become an integral part of the next generation of wireless systems.

This talk will present an overview of the opportunities and recent results at the intersection of mmWave phased arrays and AI. First, the presentation will cover the fundamentals and KPIs of 3D radar systems using phased arrays including associated key circuit design and packaging design techniques. Examples of such 3D radar systems at 28-GHz, 60-GHz and 94-GHz will be provided. Next, the presentation will describe how the full potential of such systems can be realized through synergistic co-design with AIML algorithms and edge computing assets. Key examples of emerging applications based on these vertically integrated antennas-to-software/AI systems will be provided including multi-spectral imaging, 5G mmWave joint sensing and communications, and AI-based recognition of human gestures and concealed objects.