

Title: Performance Optimization of Polarization-Aware Links for Next Generation Wireless Networks

Abstract:

Next-generation networks are expected to coexist with multiple frequencies to support ubiquitous connectivity under diverse propagation conditions. As wireless communication inherently uses polarization sensitive electromagnetic medium, this thesis presents the multiband analysis of polarization-aware communication encompassing LOS dominated infrared (IR) links, NLOS dominated ultraviolet (UV) links, and both LOS and NLOS assisted radio frequency (RF) links. Major hurdle with polarization aware communication is signal depolarization which occurs due to scattering and multi-path fading effects. Thus, intelligent utilization and control of polarization for depolarization mitigation is proposed at different objective frequencies for wireless transmission. Specifically, optimum polarization states are determined for IR and RF links for enhanced beamforming gains. Performance of polarization aware modulation is optimized at UV links. Performance of polarization multiplexing is optimized at RF links. Finally, potential of dual-polarized reconfigurable intelligent surface (RIS) is investigated for channel reconfigurability, allowing polarization beamforming through programmable reflections and enabling enhanced communication performance relative to conventional non-RIS systems. The work carried out in this dissertation aligns with the 6G vision of heterogeneous spectrum, enabling next generation networks to adaptively switch between or jointly utilize multiple links for robust and reliable communication.