Real-Time Synthesis Approach for Coexistence of Radar and Communications in the Spatial-Spectral Domain

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Coexistence and spectrum sharing in unpredictable dynamic fifth-generation (5G) environments require real-time agility more than ever. Many frequency bands previously allocated exclusively for radar are being re-allocated for sharing with wireless communications. Radar systems will be required to not only operate as effectively as possible, but also possess technology that allows for real-time adaptability and spectrum sensing to mitigate the interference it could cause to other systems sharing the same frequency band. As a result, radar systems that adhere to ambiguity function constraints, power-added efficiency constraints (PAE), and spatial-spectral mask constraints will become increasingly necessary as wireless transmissions move to 5G.

Our previous work discussed implementing a spatial-spectral mask constraint on a radar system in an environment in which multiple receivers were located around the radar's same operating frequency band. The additional degree of freedom in optimizing radar performance as well as spectral coexistence was given in the spatial domain allowing confinement of wireless transmissions to be a function of both transmission angle and transmission frequency. The previous work assumed a fixed antenna beampattern and optimized the radar waveform to achieve good range resolution and conform to spectral constraints based on co-located communications receivers in the direction of transmission.

This work considers optimization of the antenna beam pattern as another degree of freedom in achieving spectral coexistence. The previous work showed results of the optimized radar waveform using only an ideal antenna beam pattern as well as a helix antenna beam pattern. The wide beam width of the helix antenna pattern unfortunately only provided adequate radar range resolution performance when the number of communications receivers was significantly reduced. This work discusses optimized antenna array patterns with narrower beam widths and real-time adaptability to ensure adequate radar range resolution performance as well as compliance with spatial-spectral mask constraints.