Summary of Recent Radar Spectrum Activities

Eric L. Mokole(1) and Lawrence Cohen(2)
(1) Independent Consultant, Burke, VA, 22015 USA
(2) U.S. Naval Research Laboratory, Washington, DC, 20375 USA

A précis of radar spectrum usage, congestion, and issues with communication systems at RF (1 MHz to 1 THz) will be given, with a focus on the feasibility of harmonious radar-communication co-existence and co-design. Although the very precious and highly sought RF spectrum is used for many diverse and much needed applications (communications, radio and television broadcasting, radio navigation, sensing, countermeasures, etc.), this talk will address only radar and communication applications. Important radar applications include air traffic control, geophysical monitoring of Earth resources from space, automotive safety, severe weather tracking, and surveillance for defense and security. Despite the importance of such radars, spectrum that traditionally has been the almost exclusive province of radars as primary legal users is being fiercely contested worldwide by highly profitable communication systems like commercial cellular systems, which provide a tremendous number of services to all strata of society. The incredible proliferation of cellular systems has been causing extremely spectrally dense environments, and this problem will only increase for the foreseeable future. For example, the IEEE has several communication initiatives and seedlings that will further increase the demand for spectrum (Internet of Things (IoT), Internet of Space (IoS), Smart Village, Special Interest Group on Humanitarian Technology (SIGHT), 5G, etc.). A recent request for assistance by the Federal Communications Commission (FCC) suggests that with the future inclusion of more technologies using the RF spectrum the ambient background noise levels could rise thus impeding the operation of these technologies.

The talk will highlight some attempts within the past decade to achieve improved radar-communication interaction. For example, to mitigate RF power-amplifier-induced adjacent-band interference by radars, spectrally confined transmit waveforms and hardware for RF power-amplifier circuits to implement such waveforms were developed in a laboratory setting at the US Naval Research Laboratory. To realize even better interference reduction, efforts at jointly optimizing the physical transmitter and driving waveforms have been investigated in the last five years by Baylor University and the University of Kansas. In addition, recognizing the need to provide a discussion forum on RF spectrum issues and usage, the International Symposium on Advanced Radio Technologies (ISART) has been conducting annual panels. Since 2013, a DARPA program on Shared Spectrum Access for Radar and Communications (SSPARC) has been attempting to achieve harmonious co-existence and co-design between these modalities. In NATO, the Sensors and Electronic Technology (SET) Panel recently completed two Task Groups, SET-179 “Dynamic Waveform Diversity and Design” and SET-182 “Radar Spectrum Engineering and Management,” and two Specialists’ Meetings, SET-204 “Waveform Diversity” and SET-SCI-230 “Reconfigurable and Scalable Multi-Function RF Systems in a Congested EM Spectrum.” The Task Groups developed experiments and models that exploit transmitter, receiver, and waveform designs toward more optimal spectrum use and mitigating spectrum-management issues.