

Preface

Radio frequency spectrum is a scarce and critical natural resource that is utilized for many services including surveillance, navigation, communication, and broadcasting. Recent years have seen tremendous growth in the use of spectrum especially by commercial cellular operators. Ubiquitous use of smartphones and tablets is one of the reasons behind an all-time high utilization of spectrum. As a result, cellular operators are experiencing a shortage of radio spectrum to meet bandwidth demands of users. On the other hand, spectrum measurements have shown that much spectrum not held by cellular operators is underutilized even in dense urban areas. This has motivated shared access to spectrum by secondary systems with no or minimal impact on incumbent systems. Spectrum sharing is a promising approach to solve the problem of spectrum congestion as it allows cellular operators access to more spectrum in order to satisfy the ever-growing bandwidth demands of commercial users.

The US spectrum regulatory bodies, the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA), are working on an initiative to share 150 MHz of spectrum, held by federal agencies, in the band 3550–3700 MHz with commercial wireless operators. This band is primarily used by the Department of Defense for air-, ground-, and ship-borne radar systems that are critical to national defense. Field tests have shown that spectrum sharing between radars and communication systems require large separation distance in order to protect them from harmful interference. This excludes large population of the US from reaping the benefits of spectrum sharing and has little to no business value for commercial operators. Thus, novel methods are required to ensure spectrum sharing between the two systems without the need of large protect distances.

In order to efficiently share spectrum between radars and communication systems at the same time and in the same geographical area, this book proposes novel methods that transform radar signal in such a way that it does not interfere with communication systems. This is accomplished by projecting the radar signal onto null space of the wireless channel between radar and communication system. Basically, nulls are formed in radar beam pattern in the direction of communication

systems. The proposed signal shaping/design approach not only meets radar objectives but also meets spectrum sharing objectives. However, there is a trade-off as signal shaping or designing new radar signal, with spectrum sharing constraint, results in some performance degradation for radars. Therefore, it is of interest to study the impact of projection on radar performance. Performance metrics such as probability of target detection, Cramer–Rao bound and maximum likelihood estimate of target's angle of arrival, and beam pattern of radar are studied for performance degradation. The results show minimal degradation in radar performance and significant reduction in exclusion zones, thus, showing the efficacy of the proposed approach.

Spectrum sharing between radars and communication systems is an important cross-disciplinary research area of federal and commercial interest. The methods proposed for spectrum sharing in this book allow radars and communication systems to operate in a geographical area without the need for exclusion zones, required to protect both systems from each other interference, and promise highly sought-after capacity gains for communication systems.

Arlington, VA, USA
September 2016

Awais Khawar
Ahmed Abdelhadi
T. Charles Clancy

Spectrum Sharing Between Radars and Communication
Systems

A MATLAB Based Approach

Khawar, A.; Abdelhadi, A.; Clancy, T.C.

2018, XV, 102 p. 24 illus., 22 illus. in color., Softcover

ISBN: 978-3-319-56683-2