Foreword to the Special Issue on Radio Frequency Interference: Identification, Mitigation, and Impact Assessment

Our capacity to exploit the electromagnetic spectrum allows us to probe the universe and disseminate information. As these goals are intertwined, so are the shared resources afforded to each. Careful management of the electromagnetic spectrum results in the ability to perform precise remote measurements of the Earth and the cosmos, while using the same spectrum to send high-powered communications transmissions; however, the potential for measurement contamination still exists. Remote sensing observations experience radio-frequency interference (RFI) due to sharing of allocated bands, limitations in hardware, and transmissions outside of allocations. Corrupted measurements may be difficult to identify, particularly at low levels of interference. As the need for high-precision measurements expands, principally for ocean and terrestrial sensing but also for radio astronomy, investigators have developed new methods for sharing spectrum and for identifying and mitigating RFI. For heritage hardware, postprocessing software methods have proven invaluable for identifying RFI, with some measured success in mitigation. For future sensors, digital receivers offer flexibility in handling RFI. Beyond the identification and mitigation of RFI, monitoring the radio-frequency environment informs scientific users of the expanding nature of RFI and shapes future policy, and understanding how contamination and mitigation affect measurements furthers data quality.

The desire to measure an expanding list of features of the Earth and the universe results in an increasing need for high-precision measurements. Consequentially, the ability to discern radio-frequency contamination, particularly at low levels, is key to compiling long-term and consistent data records. Those who design sensors and data-processing software must work to ensure the quality of observations, while users must understand how RFI and its mitigation impact data. As society expands its use of the electromagnetic spectrum, which is a limited resource, the potential for interference in remote scientific observations increases. Outside of spectrum management, which focuses on policy-level decisions informed by scientific and societal need, the subject of RFI may be divided into three distinct, but interconnected, topics: identification, mitigation, and impact assessment. While many instances of measurement contamination may result in obvious outliers in the data, low-level RFI is much more insidious. The inability to discern small amounts of contamination can skew environmental and climate data records. Mitigation allows for the use of contaminated measurements after the removal of RFI and is an important and evolving aspect of operating in a congested radio-frequency environment. Informing those who work with remote sensing instruments and data, both from the engineering and usage arenas, requires careful monitoring of RFI. In many instances, monitoring RFI is reactive, as there may be no knowledge of an interferer until it begins to transmit. In some cases, monitoring the environment results in the removal of unsanctioned transmitters. Finally, understanding the impact of RFI and the mitigation of RFI on data records ensures the integrity of research that makes use of remote sensing and radio astronomy measurements.

To catalog the important work being performed to identify, monitor, and mitigate RFI and to assess the impact of interference, the Frequency Allocations in Remote Sensing technical committee has coordinated a special issue covering this subject. The papers contained within this special issue cover a combination of software and hardware solutions to the RFI problem, detail the challenges in monitoring RFI, and attempt to quantify the impact that interference has on measurements. We hope that this issue will serve as a valuable resource to sensor designers, algorithm developers, and data users.

We would like to thank the authors in this special issue for their high-quality work and enthusiastic response. Of course, this issue would not have been possible without the generous contributions of the reviewers, who provided thorough reviews in a timely manner.

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Digital Object Identifier 10.1109/TGRS.2013.2282862
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