Image and Aliasing Tolerant Wideband Spectrum Sensing

Eyosias Yoseph Imana[(1)], Taeyoung Yang[(1)], and Jeffrey H. Reed[(2)]
(1) Wireless @ Virginia Tech, Blacksburg, VA, 24060

Spectrum sensing is integral part of the current and future dynamic spectrum access (DSA) based wireless standards. For example, IEEE 802.22 (WRAN) mandates that all secondary users to sense the spectrum and report to the spectrum manager of the network.

Different types of techniques can be used to implement multi-band spectrum sensing. The first one is by using a Nyquisit sampling based spectrum sensing (Nyquist sensing). However, this technique requires high performance ADCs. To reduce the sampling rate, compressive sampling based spectrum sensing (compressive sensing) can be employed. Compressive sensing allows sampling at sub-Nyquist rates by leveraging sparsity in occupancy of the spectrum. The main short coming of compressive sensing is its strong dependence on the sparsity assumption. This assumption makes the technique impractical for sensing densely or moderately occupied spectrum. The other solution is the use of analog filter-bank which contains multiple filters which are tuned to the different sections of the monitored spectrum. The output of each filter is independently down-converted and sampled using low-rate ADC. However, this technique can become too bulky as the number of bands increases.

This paper uses tune-sense-concatenate (TSC) based wideband spectrum sensing. Unlike the other wideband spectrum sensing techniques, TSC is simple for implementation and suitable for small-sized radios. RF front-ends that used for TSC based sensing, however, have non-ideal characteristics. For example, errors due to image signals during down-conversion and aliasing signals during sampling can degrade the accuracy of spectrum sensing. This paper presents an algorithm which minimizes effects of image and aliasing signals on TSC based wideband spectrum sensing. The algorithm is developed based on the channelized spectrum domain model of RF front-ends.