

Efficient Sampling of Sparse Wideband Analog Signals

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Abstract

Periodic nonuniform sampling is a known method to sample spectrally sparse signals below the Nyquist rate. This strategy relies on the implicit assumption that the individual samplers are exposed to the entire frequency range. This assumption becomes impractical for wideband sparse signals. The current paper proposes an alternative sampling stage that does not require a full-band front end. Instead, signals are captured with an analog front end that consists of a bank of multipliers and lowpass filters whose cutoff is much lower than the Nyquist rate. The problem of recovering the original signal from the low-rate samples can be studied within the framework of compressive sampling. An appropriate parameter selection ensures that the samples uniquely determine the analog input. Moreover, the analog input can be stably reconstructed with digital algorithms. Numerical experiments support the theoretical analysis.

I. INTRODUCTION

Radio frequency (RF) technology enables the modulation of a narrowband signal by a high carrier frequency. As a consequence, manmade radio signals are often *sparse*. That is, they consist of relatively small number of narrowband transmissions spread across a wide territory of spectrum. A convenient description for these signals is the *multiband model* where the frequency support of a signal resides within several continuous intervals in a wide spectrum but vanishes elsewhere.

This work was supported in part by the Israel Science Foundation under Grant no. 1081/07 and by the European Commission in the framework of the FP7 Network of Excellence in Wireless COMMunications NEWCOM++ (contract no. 216715). JAT was supported in part by DARPA and ONR. This work has been submitted to the IEEE for possible publication. Copyright may be transferred without notice, after which this version may no longer be accessible.

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