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Expected RIP: Conditioning of The Modulated Wideband Converter

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Abstract

The sensing matrix of a compressive system impacts the stability of the associated sparse recovery problem. In this paper, we study the sensing matrix of the modulated wideband converter, a recently proposed system for sub-Nyquist sampling of analog sparse signals. Attempting to quantify the conditioning of the converter sensing matrix with existing approaches leads to unreasonable rate requirements, due to the relatively small size of this matrix. We propose a new conditioning criterion, named the expected restricted isometry property, and derive theoretical guarantees for the converter to satisfy this property. We then show that applying these conditions to popular binary sequences, such as maximal codes or Gold codes, leads to practical rate requirements.

I. Introduction

Signal dimensions in today's applications are growing faster than technology capabilities. The Nyquist rate of analog wideband signals, for example, already exceeds the conversion rate of existing devices. The modulated wideband converter (MWC) is a recent sub-Nyquist sampling system which exploits frequency sparsity to reduce the conversion rate [1]. Figure 1 depicts a block diagram of the converter, which is further described in Section II. The key idea underlying the MWC is that if the signal is periodically-modulated prior to sampling, then the sampling rate can be substantially reduced with respect to the Nyquist rate. The MWC consists of simple mixers and lowpass filters which are easy to implement.

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