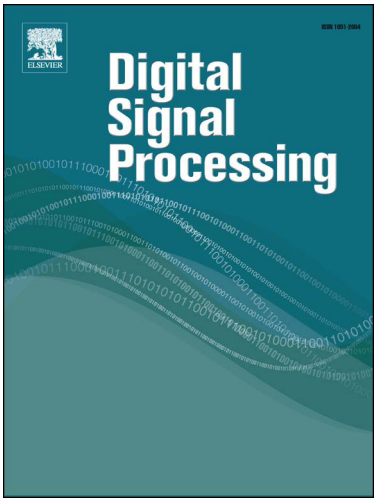
Accepted Manuscript



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PII: S1051-2004(17)30140-9
DOI: http://dx.doi.org/10.1016/j.dsp.2017.06.026
Reference: YDSPR 2150

To appear in: *Digital Signal Processing*

Please cite this article in press as: A.M. Rateb et al., A generic top-level mechanism for accelerating signal recovery in compressed sensing, *Digit. Signal Process.* (2017), http://dx.doi.org/10.1016/j.dsp.2017.06.026

A Generic Top-level Mechanism for Accelerating Signal Recovery in Compressed Sensing

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Abstract

Compressed Sensing (CS) is challenged by the computational complexity associated with signal recovery, especially in applications that involve recovering high-dimensional signals. We present an efficient mechanism based on divide-and-conquer principle for accelerating CS signal recovery with minimal impact on recovery quality. In principle, the proposed mechanism is applicable to any CS recovery algorithm, and achieves linear scaling between recovery time and sensed signal dimension in most cases. In addition to analytic performance guarantees, several numerical experiments were performed to verify the performance of the proposed mechanism. A sample result reports average recovery time improvement by a factor above 50 for recovering a 128×128 test image. This mechanism contributes to reducing recovery time, power consumption and the hardware cost required for CS signal recovery.

Keywords: Compressed Sensing, Divide-and-Conquer, Signal Recovery, Sparse Approximation, Sampling Theory

1. Introduction

The recent years have witnessed a great leap in the types of sensors and the dimensionality of data they generate. Examples include sensors employed in fields such as imaging, medical imaging, communications, surveillance, remote sensing and many others. These sensors, which operate by sampling signals at or above Nyquist rate, produce enormous amounts of data that is usually not efficient to store or transmit in their native representations. The necessity and difficulty of moving, storing, processing and analyzing these floods of data has become a problem being recently referred to as the big data problem [1]. The traditional way most digital acquisition systems deal with this issue is by compressing these data before storing or transmitting them, taking advantage of the fact that most natural signals can be approximated by a low-dimensional representation over some transform domain [2]. This adds an extra computational task to be performed by the sensing module each time a signal is acquired. Furthermore, employing high sample rates requires high-speed analog-to-digital converters, which are highly power-consuming and expensive. These luxuries are not available for sensing nodes or frontends with computational, power and cost limitations such as sensing nodes in wireless sensors networks [3].

Compressed Sensing (CS) [4, 5, 6] merges acquisition and compression into a single stage by directly acquiring data in a "compressed" form, where conventional sampling is replaced by projecting the signal

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