Feature Extraction from CS Data*

Siddharth Gupta
Grant Lee
Veena Padmanabhan
Heather Johnston

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Abstract

Our goal is to create intelligent motion detection for compressed sensing.

1 Can Random Noise Yield Specific Information?

The novel challenge with using random basis projections for intelligent motion detection is that there is no spatial information about the image or movie in the compressed sensing data. Traditional pixel-based cameras provide a graph of light intensity over position and, logically, most pixel-based detection approaches use the information about where the motion occurs to help classify it. [1] The CS data provides us not with intensity at a point, but with the similarity (inner product) between the original pixel image and a selection of basis elements composed of random noise spread throughout the image plane. Intelligent detection for CS, therefore, must use approaches radically different from detection used on conventional video.

2 Simplicity for Low Power

A key feature of CS systems is the potential for extremely low power consumption. To keep the overall power of the system low, any computations we perform must be low power as well. For practical application, the algorithms chosen must be simple to compute.

3 Investigation Goals

Working in a very new field, we began our project with the open-ended goal of researching what types of motion can be detected using compressed sensing and of implementing at least one such measurement. After much deliberation and trial, we chose to implement speed detection, specifically calculating the speed of a known object along the direction of motion. (Different shapes complicate the problem, as we will discuss.) Looking ahead to more sophisticated detection, we also wanted an extensible system to use the results of several relevant calculations to automatically characterize motion.

Though beyond the scope of our investigation, our motivation is a camera running our intelligent detection system capable of determining if a desired type of motion is observed. We pursue algorithms which could be implemented in real time at the data collection point.

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[1] For some interesting work in intelligent detection with traditional cameras, see the work of James W. Davis and Aaron F. Bobick out of the MIT Media Laboratory in the late 1990s.