Project Summary

New Theory and Methods for Low-Dimensional Signal Modeling, Sensing, and Processing

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Research Objective: The rapid growth of sensing and imaging technology combined with the need for near real-time action based on the sensed data has rendered automated processing, understanding, and decision-making vital to our national security. One of the most exciting new sensing/processing approaches is *compressive sensing* (CS), which combines low-dimensional signal models, randomized dimensionality reduction, and large-scale computational signal recovery algorithms to greatly reduce data acquisition costs. This research program aims to explore, characterize, optimize, and introduce new tradeoffs amongst the components of the CS framework, in order to broaden its applicability, improve its performance in the wild, and enable radically new sensing and processing capabilities.

Technical Approach: This research program is organized into three closely coupled research thrusts that leverage our 25 years of expertise in signal and image processing, statistics, mathematics, and sensor design:

Thrust 1: New low-dimensional signal models of unprecedented realism will leverage the recent rapid progress in signal denoising and machine learning.

Thrust 2: New signal inference algorithms will rapidly and efficiently convert compressive measurements to conclusions.

Thrust 3: New dimensionality reduction (sensing) systems will be learned from data or optimally designed to match a sensing architecture.

Anticipated Outcomes: The basic theory for CS developed in this project will have foundational impact in statistics, mathematics, and signal processing. The results of this project will be immediately deployable in a range of different sensing applications in the DoD, scientific, and consumer spaces.

Impacts: Our new theory will provide concrete pathways to the development of radically new sensor systems that will substantially increase the performance and capabilities of DoD data acquisition and processing systems while lowering their cost and complexity of deployment.