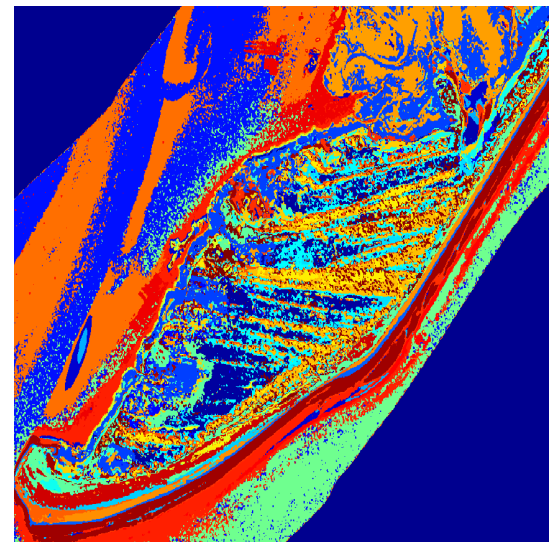


Sparsity Models for Hyperspectral Imaging and Compressive Sensing LIDAR

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Virtually all types of imaging (including remote sensing) deal with high-dimensional signals that have low-dimensional structure that can be exploited. While classic models rely only on signals being bandlimited, more recent signal models are based on the notion that most signals can be written as a sum of just a few elements from a suitable dictionary (known as "sparsity"). Sparsity models have been successful at accounting for many aspects of the mammalian visual system, as well as underlying many state-of-the-art algorithms in signal processing and machine learning. In this talk we will explore two applications of sparsity models to remote sensing. First, we will see how algorithms modeled on learning in neural systems can be used to discover statistical structure in airborne hyperspectral imagery. This unsupervised learning process will be shown to automatically discover material structure in the images, enable super-resolution of multispectral imagery to hyperspectral resolutions, and form classification features that generalize better with very few training samples. Second, we will explore a LIDAR architecture that utilizes a sparsity model to incorporate a coded aperture in the imaging process (leveraging recent results in the field of "compressed sensing"). Using a modified version of the DIRSIG simulator, we show that this sensor architecture attempts to combine the best aspects of scanning and flash LIDAR systems. This system achieves substantial improvements in the tradeoff between temporal and spatial resolution in a traditional scanning system, using no mechanical scanning systems or complex arrays of sensor elements.

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