Combined Reconstruction and Segmentation in Compressive Spectral Imaging

Bob Plemmons[1]
Dept. of Computer Science and Mathematics
Wake Forest University, U.S.A.
plemmons@wfu.edu
http://www.wfu.edu/~plemmons

A spectral imager captures the power spectral density of light as a function of wavelength w and spatial location (x, y). In other words, it acquires a 3D data cube (tensor) of information, (x, y; w), about the scene being imaged. Knowledge of the spectral content at various spatial locations is invaluable for identifying the composition and structure of objects in the scene being observed. This talk describes our numerical methods for the joint reconstruction and segmentation of spectral images taken by coded aperture snapshot spectral imagers (CASSI). In a snapshot, a CASSI captures a two-dimensional (2D) array of measurements that is an encoded representation of both spectral information and 2D spatial information of a scene, resulting in significant savings in acquisition time and data storage. The reconstruction process decodes the 2D measurements to render a three-dimensional spatio-spectral estimate of the scene, and is therefore an indispensable component of the spectral imager. A two-step iterative shrinkage/thresholding method with total variation regularization is used for reconstructing the spectral datacube. This processes is combined with a variational fuzzy segmentation method to form a joint reconstruction/segmentation model. The advantages of this joint model are illustrated with numerical tests on both simulated and real compressive sensing data.

[1]The presentation represents joint work with David Brady, David Kittle, Fang Li, Michael Ng, Sudhakar Prasad, Ashwin Wagadarikar, and Peter Zhang.