

## **Semi-Coupled Dictionary Learning for Image Cross-modality Transform and Recognition (PI: Prof. Zhang Dapeng David; 2012/13)**

In many practical applications, we may need to transform images across different modalities. For examples, transforming a sketch drawn based on the verbal description of the suspect into a photo for matching, and transforming a picture into a painting of certain style. Image cross-modality transform, which aims at converting images in one modality into images of another modality, has been attracting much attention from the communities of image processing, computer vision and machine learning. Meanwhile, cross-modality image recognition is also an important issue in many applications such as biometrics, remote sensing, etc. Images under different modalities, even describing the same scene, can be significantly different, making the cross-modality image transform and recognition very challenging. Depending on the given tasks, existing schemes usually achieve the goals by using techniques such as patch-based matching, feature-based regression, coupled subspace learning and coupled dictionary learning. These methods, however, are limited in characterizing the complex intrinsic mapping between the different modalities, and limited in preserving image modality-specific local structures.

In this project, we propose a semi-coupled dictionary learning (SCDL) model, and use it to solve both cross-modality image transform and image recognition problems. Under SCDL, a pair of dictionaries and a mapping function will be simultaneously learned. The pair of dictionaries can well characterize the signal structural domains of the two modalities, while the mapping function can reveal the intrinsic relationship between the two modality domains. In the proposed SCDL model, the two dictionaries will not be fully coupled, and hence much flexibility can be given to the mapping function for a flexible transform across modalities. With different regularizations in the domains spanned by the dictionary pair, the proposed

SCDL model can be adapted to tackle different tasks, such as image synthesis and recognition. In particular, we will investigate in detail some representative image cross-modality transform problems, including image interpolation, image analogies, and boundary detection, as well as some representative cross-modality image recognition tasks, including photo-sketch and sketch-photo face recognition, multi-spectrum face recognition, and multi-pose face recognition. Our preliminary results on image interpolation and multi-modal face image transform have shown the effectiveness of the SCDL model. More promising results will be achieved after our deep investigations of SCDL modeling and its implementation in this project.