HYRES

Sparsity Modelling

$$\begin{bmatrix} \mathbb{D}_{1,1} & \cdots & \mathbb{D}_{1,t} \\ \vdots & \ddots & \vdots \\ \mathbb{D}_{m,1} & \cdots & \mathbb{D}_{m,t} \end{bmatrix}$$: Basis Matrix

λ: Regularization Parameter

Optimization Function

$$\min(\|\mathbb{X} - \mathbb{D}\mathbb{Z}\|^2 + \lambda\|\mathbb{Z}\|_1)$$

$$\begin{bmatrix} \mathbb{X}_{1,1} & \cdots & \mathbb{X}_{1,n} \\ \vdots & \ddots & \vdots \\ \mathbb{X}_{m,1} & \cdots & \mathbb{X}_{m,n} \end{bmatrix}$$ Hyperspectral Image

$$\begin{bmatrix} \mathbb{D}_{1,1} & \cdots & \mathbb{D}_{1,t} \\ \vdots & \ddots & \vdots \\ \mathbb{D}_{m,1} & \cdots & \mathbb{D}_{m,t} \end{bmatrix}, \lambda$$

$$\begin{bmatrix} \mathbb{Z}_{1,1} & \cdots & \mathbb{Z}_{1,m} \\ \vdots & \ddots & \vdots \\ \mathbb{Z}_{n,1} & \cdots & \mathbb{Z}_{n,m} \end{bmatrix}$$ Sparse Coefficient Matrix

$$\begin{bmatrix} \mathbb{D}_{1,1} & \cdots & \mathbb{D}_{1,t} \\ \vdots & \ddots & \vdots \\ \mathbb{D}_{m,1} & \cdots & \mathbb{D}_{m,t} \end{bmatrix} \times \begin{bmatrix} \mathbb{Z}_{1,1} & \cdots & \mathbb{Z}_{1,n} \\ \vdots & \ddots & \vdots \\ \mathbb{Z}_{t,1} & \cdots & \mathbb{Z}_{t,n} \end{bmatrix}$$

$\mathbb{X}_{sparse-modelling}$

Low Rank Modelling

$$\begin{bmatrix} \mathbb{X}_{1,1} & \cdots & \mathbb{X}_{1,n} \\ \vdots & \ddots & \vdots \\ \mathbb{X}_{m,1} & \cdots & \mathbb{X}_{m,n} \end{bmatrix}$$ Hyperspectral Image

$$[\mathbb{U}_{i,j}]_{m \times r}, \quad [\mathbb{S}_{i,j}]_{r \times r}, \quad [\mathbb{V}_{i,j}]_{n \times r}$$

$\mathbb{X} = \mathbb{U} \times \mathbb{S} \times \mathbb{V}^T$

PCA / SVD

$\mathbb{S}_{low-rank}$

$$\begin{bmatrix} \mathbb{U}_{1,1} & \cdots & \mathbb{U}_{1,r} \\ \vdots & \ddots & \vdots \\ \mathbb{U}_{m,1} & \cdots & \mathbb{U}_{m,r} \end{bmatrix} \times \begin{bmatrix} \mathbb{S}_{1,1} & \cdots & \mathbb{S}_{1,n} \\ \vdots & \ddots & \vdots \\ \mathbb{S}_{r,1} & \cdots & \mathbb{S}_{r,n} \end{bmatrix}$$

$\mathbb{X}_{low-rank}$

m: Number of Spectral Bands in HSI

n: Number of Image Pixels in HSI

r: Number of Low Rank Components

$$\mathbb{X}_{restored} = \mathbb{X}_{low-rank} \times \mathbb{Z}_{sparse}$$