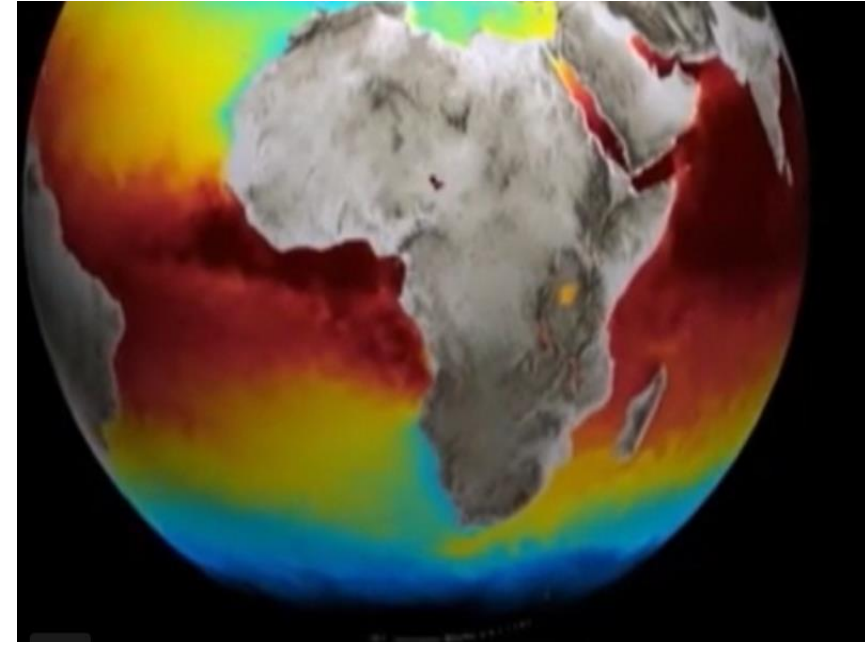


Sampling Training Data for Accurate Hyperspectral Image Classification via Tree-based Spatial Clustering

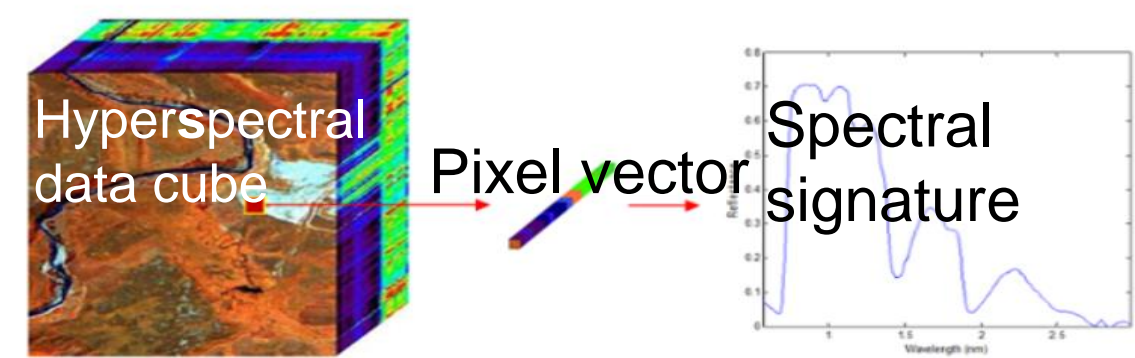
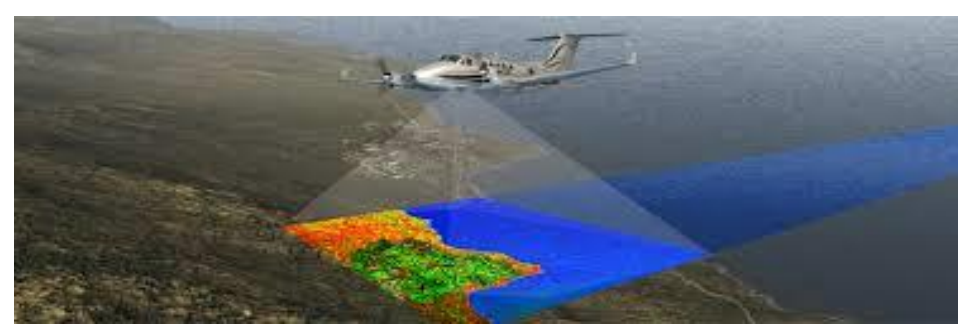
Annalisa Appice - Sonja Pravidovic - Donato Malerba - Antonietta Lanza



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Hyperspectral imaging meets Machine learning



Change detection

Segmentation

Classification

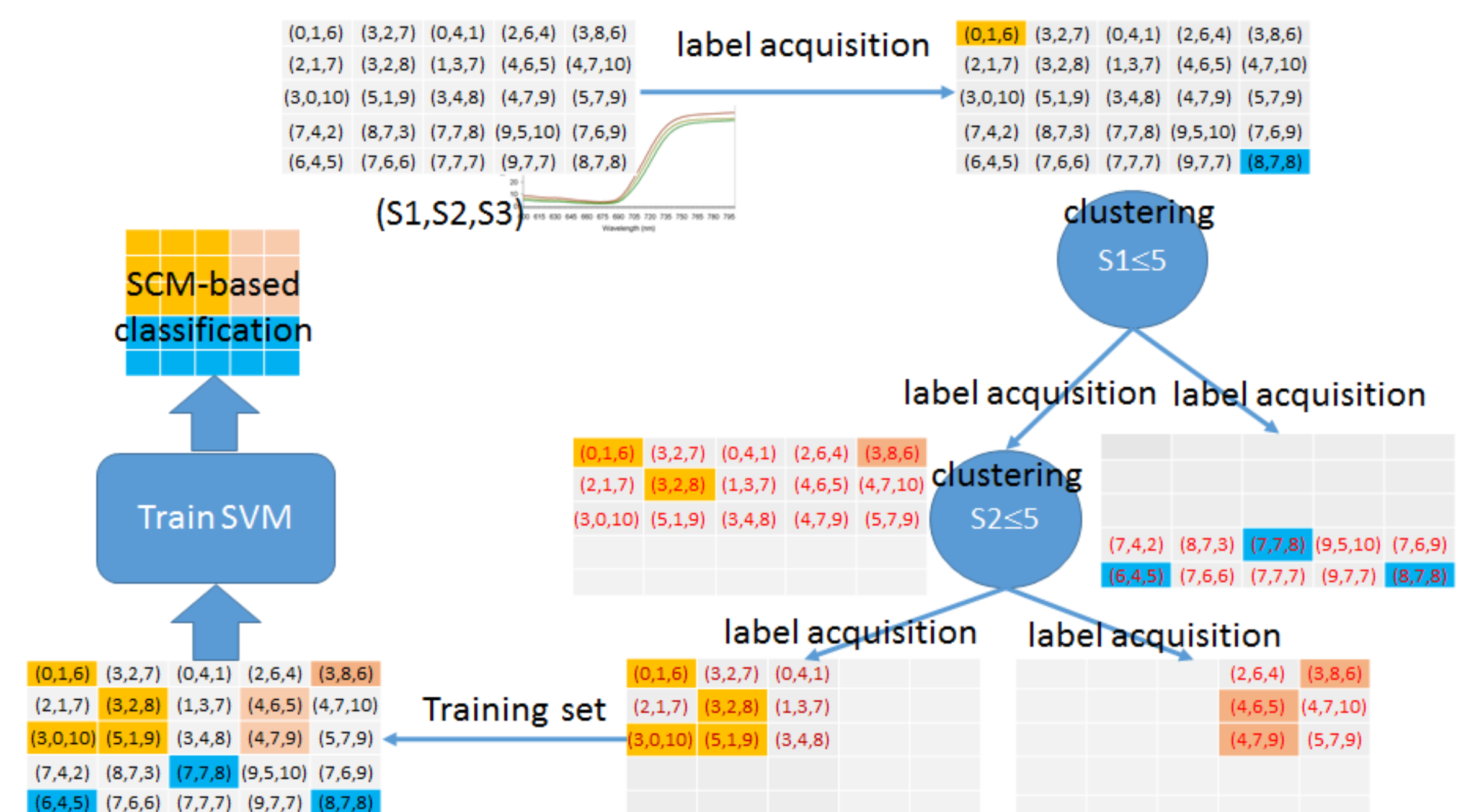
- Spatial information
- High-dimensional data
- Small number of labels

- Supervised learning methods require representative training samples of the unknown class distribution to be accurate
- Exploiting spectral and spatial information to determine a representative training set
 - Local indicators of spectral signature autocorrelation
 - Tree-based spatial clustering
 - Training example acquisition embedded in the clustering phase

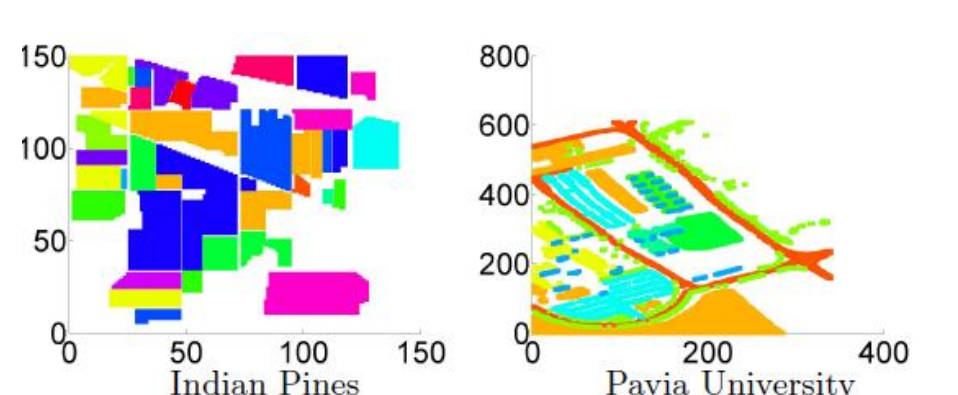
The method

- Top-down Partitioning Clustering conceptually defined on spectral variables
- The objective function of the clustering stage accounts for:
 - variation of the local **spatial autocorrelation** of the **spectral signature** → Local Getis and Ord Index (GI*)
 - variation of the **labels** already acquired along the tree

$$var = \frac{\sum_{S \in S} var(GI^*(S))}{|S|} + var(Y)$$



Empirical study

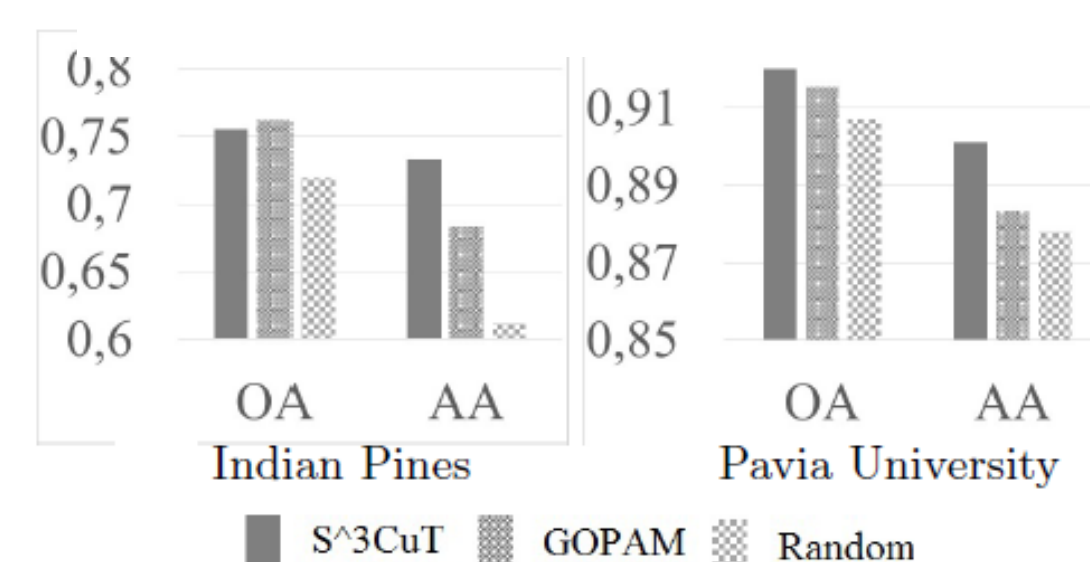


145×145, 16 classes, 201 bands
610×610, 9 classes, 103 bands

- **Random Sampling**
- **GOPAM**: Spectral autocorrelation + PAM + sampling
- **S3CuT**: Spectral autocorrelation + Clustering tree+ Cluster-embedded sampling

accuracy		1%	5%	10%
Indian Pines	OA	.5472±.1074	.7555±.0050	.8814±.0018
	AA	.4408±.2854	.7330±.0503	.8337±.0221
Pavia University	OA	.8569±.0196	.9206±.0023	.9442±.0087
	AA	.7532±.0583	.9012±.0665	.9109±.0011

Computation time (secs)		1%	5%	10%
Indian Pines	Sampling & Labeling	107.02±195.16	182.69±47.37	220.11±659.14
	SVM	10.00±9.44	57.82±274.24	146.92±41.06
Pavia University	Sampling & Labeling	134.55±121.03	179.83±220.67	206.03±154.30
	SVM	13.07±14.11	371.59±173.86	2321.93±3256.90



Authors thank Francesco Dammacco for his support in developing S3CuT