Classification of Cells Based on Scale-space Features and Semi-supervised Machine Learning

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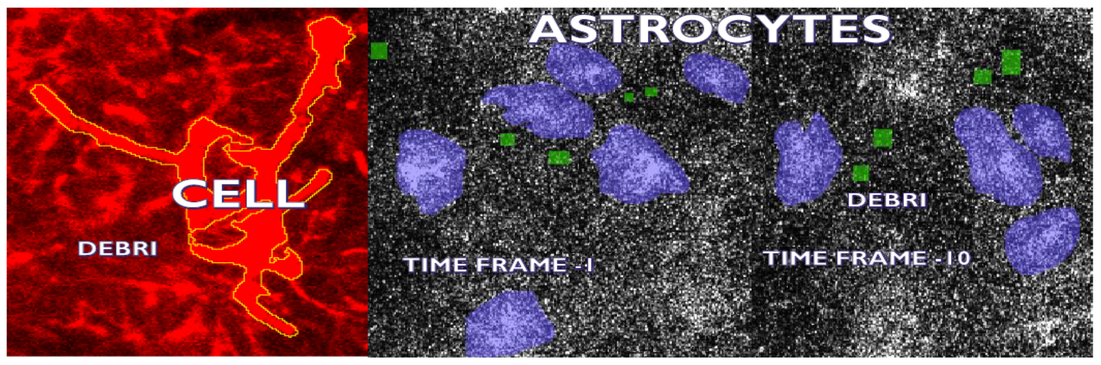
Problem Outline

SUPERVISED LEARNING

- MultiClass Problem

INSTANCE

- Pixel Characterized By Feature Vector



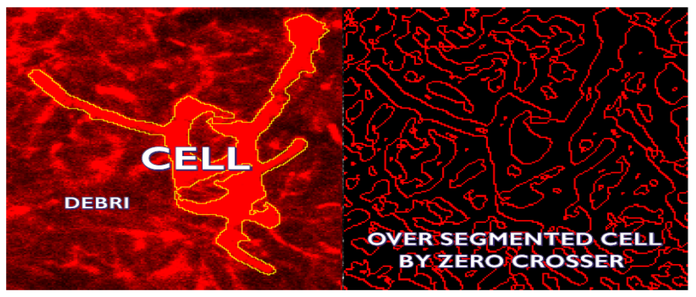
ANATOMICAL IMAGE TIME LAPSE IMAGES

OBJECTIVE

- Build an interactive framework that adapts to every learning task without assumption's about number of classes and types of objects represented.
- "Learning by example" given like debris around cell, cytoplasm, nucleus etc.
- Segment images in an objective manner.

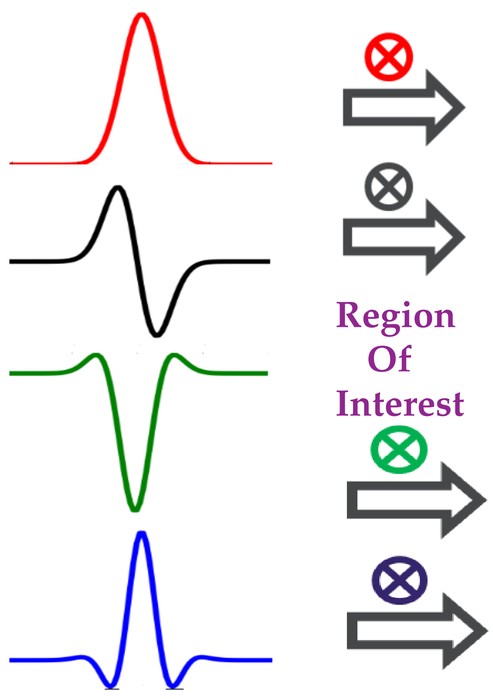
Motivation

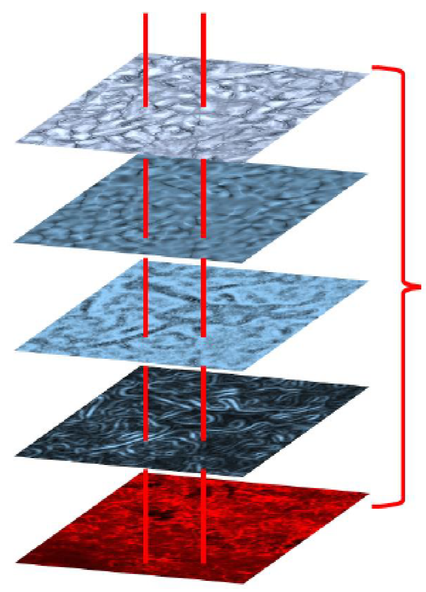
- Experts segment Anatomical & Time Lapse Images manually.
- Tools in literature are very domain specific.
- Most of the tools are based on original intensity which varies alot among images.

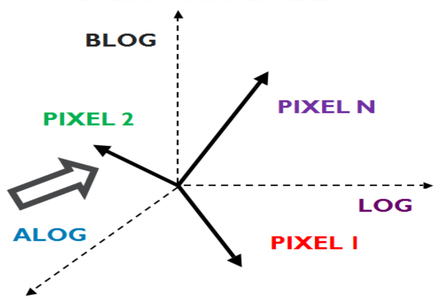


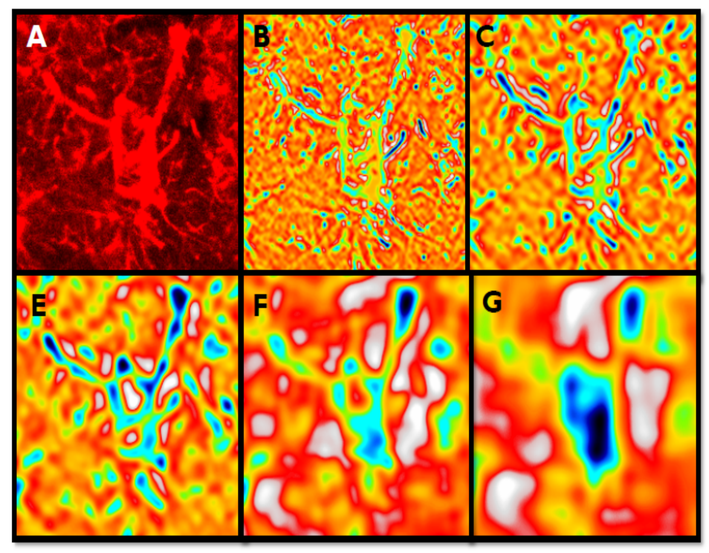
Example of ZeroCrosser for Segmentation

Features Extraction









A: Initial Image.
B-F: Laplace of Gaussian, i.e. Mexican hat
SCALE: 2,4,8,16,32.

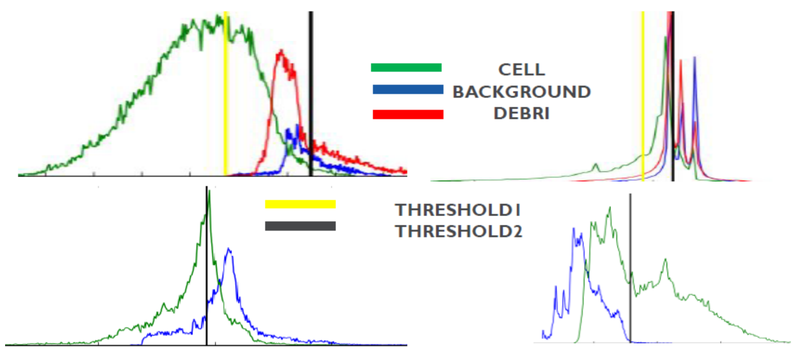
Comparision between Thresholding & Learning

THRESHOLDING

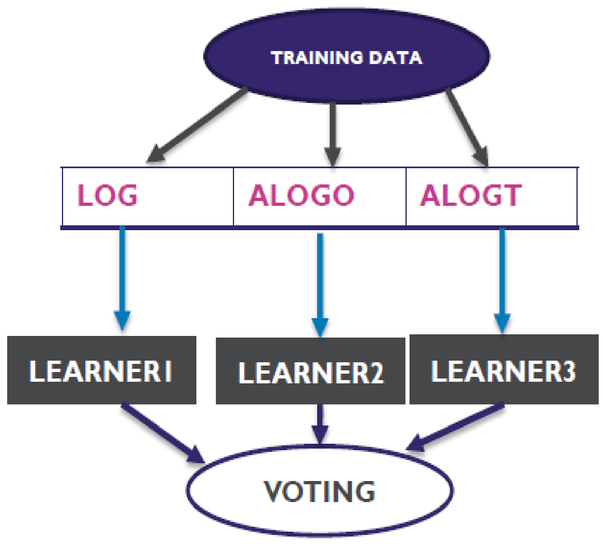
Objects can be separated from each other by selecting a Threshold value minimizing a cost function

LOCAL
Different threshold values for each Scale & Filter

GLOBAL
One threshold value for each Scale

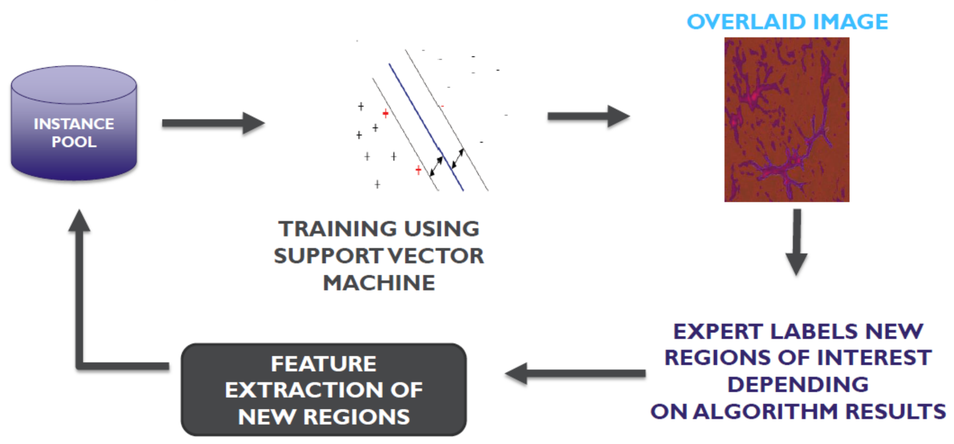


VOTING



ACTIVE LEARNING

Interactively collect new training examples by querying human user



Comparision Results

EXTERNAL VALIDATION

ROC & PR CURVES SVM APPROACH

	LOCAL APPROACH			GLOBAL APPROACH			VOTED APPROACH			SVM APPROACH		
Anatomical Image	Recall	Precision	F1	Recall	Precision	F1	Recall	Precision	F1	Recall	Precision	F1
Background	0.58	0.72	0.65	0.74	0.58	0.65	0.64	0.68	0.66	0.589	0.701	0.640
Cell	0.72	0.93	0.81	0.66	0.89	0.75	0.77	0.88	0.82	0.805	0.979	0.884
Debri	0.72	0.50	0.59	0.49	0.50	0.50	0.58	0.49	0.53	0.735	0.546	0.626
Avg	0.67	0.72	0.68	0.63	0.66	0.64	0.67	0.68	0.67	0.720	0.746	0.720
Time Lapse Images												
Background	0.82	0.65	0.73	0.77	0.59	0.67	0.82	0.62	0.71	0.735	0.768	0.751
Astrocytes	0.64	0.81	0.71	0.55	0.74	0.63	0.60	0.81	0.69	0.815	0.786	0.800
Avg	0.72	0.74	0.72	0.65	0.67	0.65	0.70	0.73	0.70	0.778	0.778	0.780

Summary & Conclusion

Presented Approach is

- **Task Independent:** not only limited to one specific task.
- **Cell Type Independent:** not only limited to specific type of cell.

Future efforts will include implementing the Structural SVM or Relational Learning for finding the suitable patterns in astrocytic arbors.