Overlapping Cell Nuclei Segmentation in Microscopic Images Using Deep Belief Networks

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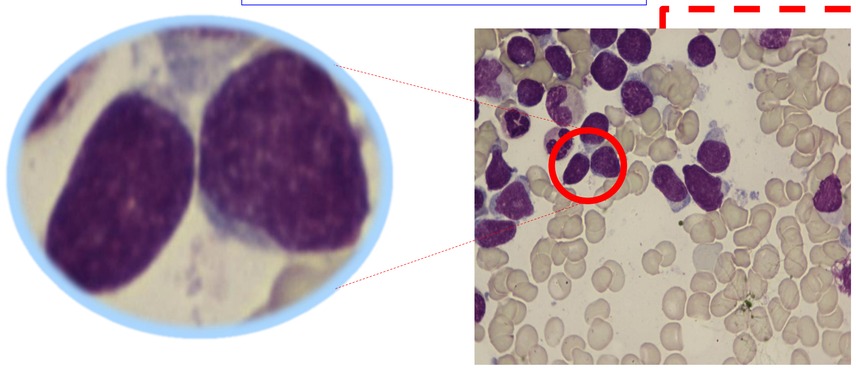
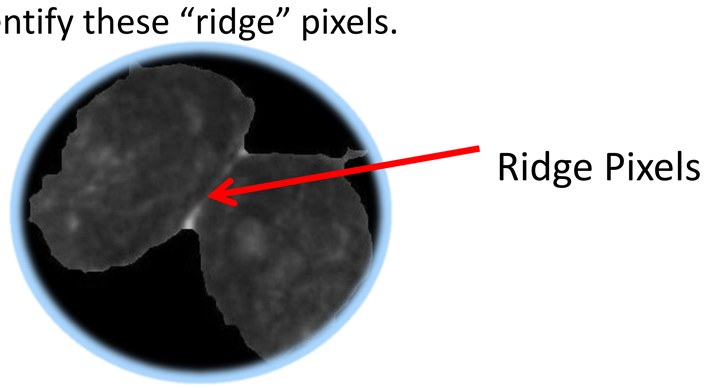
Problem Motivation



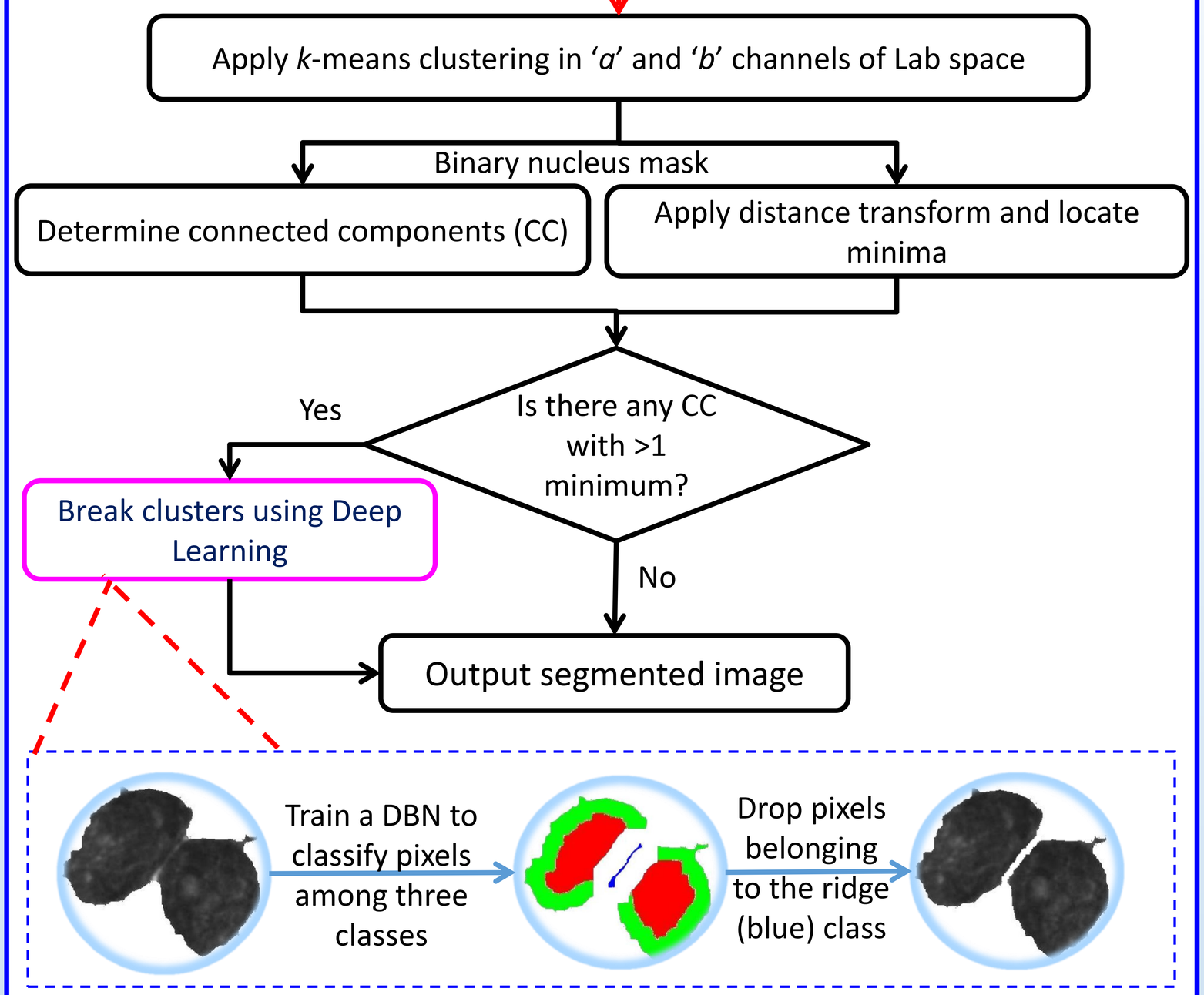
Automated image analysis of cells and tissues is an active research topic in the field of medical informatics. A common problem encountered in the field is cell classification. This requires one to operate on individual cells. Since WBC nuclei usually occur in clusters (shown above), the first step in any such study requires segmentation of individual nuclei from these clusters.

Key Idea

If the set of pixels connecting two overlapping WBC nuclei could be determined accurately, we can break the cluster by dropping them. We train a 4-layer Deep Belief Network to identify these "ridge" pixels.



Proposed Method



Qualitative Results

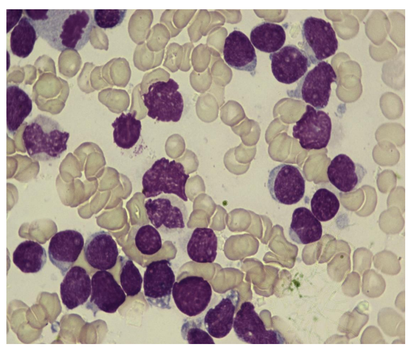
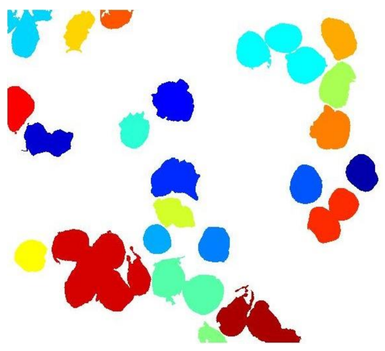
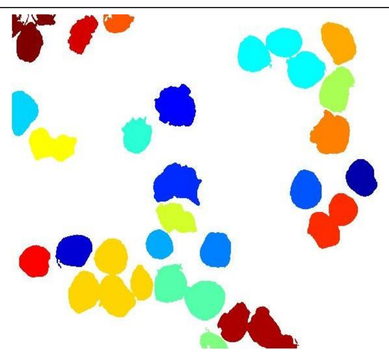
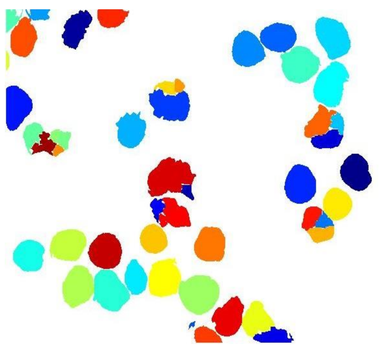
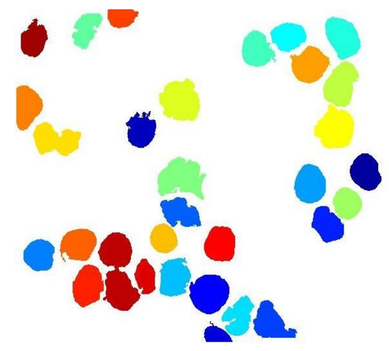
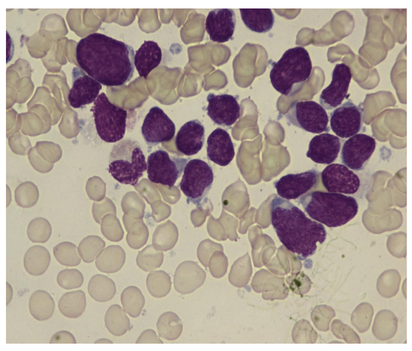
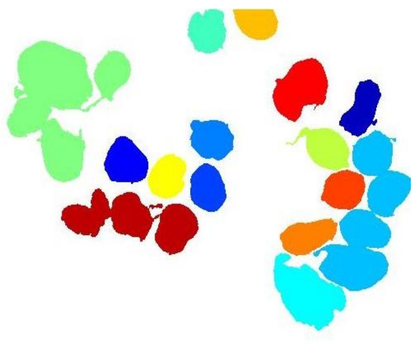
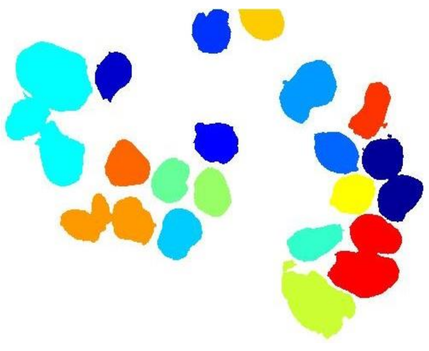
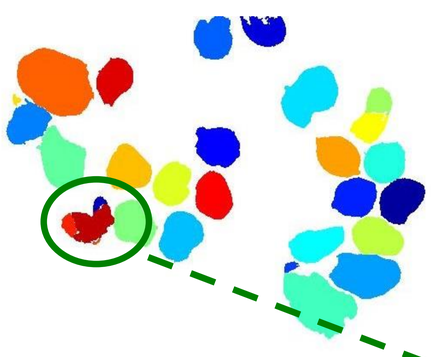
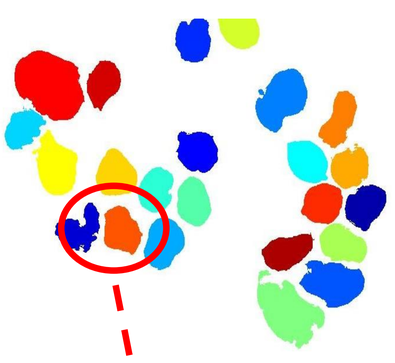
Original Image	Thresholding	*k*-means	Arslan et al. (2014)	Proposed Method
				
				

Table 1: Results on 2 images with different methods

Quantitative Results

Method	Avg. Time per Image (sec)	Segmented	
		Individual cells	Clusters
Total	-	151	31
Thresholding	0.217	78	0
k-means	6.4982	122	0
Arslan et al. (2014)	327.54	126	28
Proposed DBN-4	40.98	151	28

Table 2: Comparative performance of different methods

Method	Avg. Time per image (sec)	TPR	FDR	F-Score
Arslan et al. (2014)	327.55	0.93	0.27	0.81
Proposed DBN-4	40.98	0.97	0.16	0.89

Table 3: Comparison on number of nuclei segmented

References

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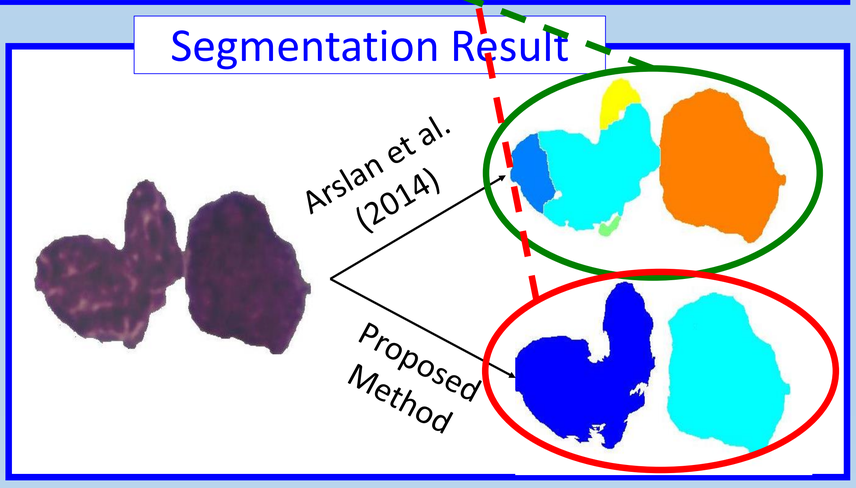
Segmentation Result



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