Non-Dynamic Blebbing Single Unattached Human Embryonic Detection in the complex cell clusters

Benjamin Guan[1], Bir Bhanu[1], Prue Talbot[2]
{xguan001,bhanu}@ee.ucr.edu, prudence.talbot@ce.ucr.edu
[1]Center for Research in Intelligent Systems, University of California, Riverside, CA 92521
[2]Stem Cell Center Research for Better Health, University of California, Riverside, CA 92521

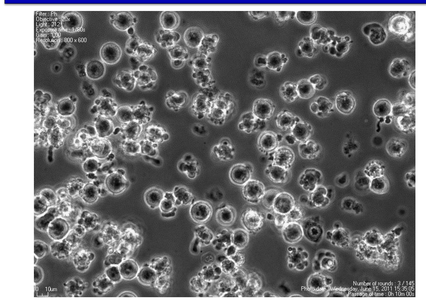
Summary

Human Embryonic Stem Cells (HESCs) have an important role in the futuristic medicine. A regenerative medicine with HESCs can be used to treat various diseases such as the following:

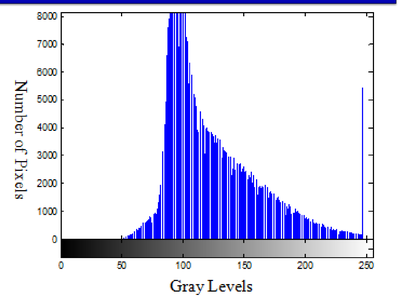
- ❖Cancer
- ❖Parkinson's disease
- ❖Huntington's disease
- ❖Type 1 diabetes mellitus etc.

Our proposed method for Non-dynamic blebbing single unattached HESCs (NDBSU-HESCs) detection is intended to easy the workload of biologists. Our method can produce the statistics for the death rate of NDBSU-HESCs under various chemical agents. The NDBSU-HESCs are healthy normal cells. Our method consists of three classifiers, and the process of each classifier is explained accordingly in this poster.

Problem Formulation



Original Image



Histogram of the Original Image

As shown in the original image, there are two major hindrances for cell detection and they are:

1) Low SNR (Signal to Noise Ratio) of phase contrast images.
2) NDBSU-HESC recognition when neighboring cells are undergoing chemical reaction.

Our contribution is to reduce the effects of the above hindrances for NDBSU-HESC detection. We are using three classifiers to improve the detection accuracy.

Technical Approach

First Classifier (Bayesian Classifier):

1) Normalization of the Original Image
2) Gradient Magnitude
3) Entropy
4) Normalized Euclidean Distance
5) Inner Cell Region Detection With

$$F(x,y) = \log\left(P_{(W|X)}(x,y)P_X(x,y) + 1\right) \quad (1)$$

Second Classifier:

1) First Constraint

$$K_f(i) = \begin{cases} \frac{1}{J}\sqrt{\sum_j K_{Coef}(i,j)^2} & \sqrt{\sum_j K_{Coef}(i,j)^2} \le J \\ 1 & else \end{cases} \quad (2)$$

2) Second Constraint

$$K_{fm}(l) = \begin{cases} 1 & K_{Coef}(i,1) \ge K1 \; or \; K_{Coef}(i,1) \le K2 \\ 1 & K_{Coef}(i,2) \ge E_{Max} \\ 1 & K_{Coef}(i,3) \le C_{Min} \\ K_{EuclidMin} & esle \end{cases} \quad (3)$$

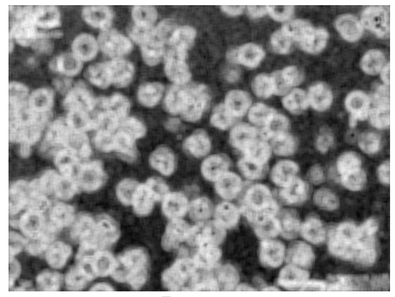
Third Classifier:

1) Correlation coefficient calculation between the possible NDBSU-HESC region and the training data.
2) NDBSCU-HESCs detection by correlation coefficient thresholding.

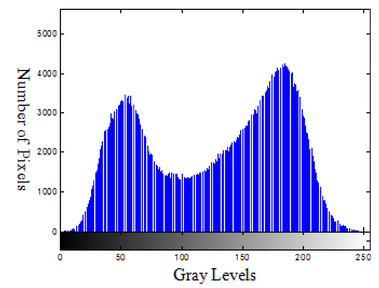
Experimental Result

Data Collection:

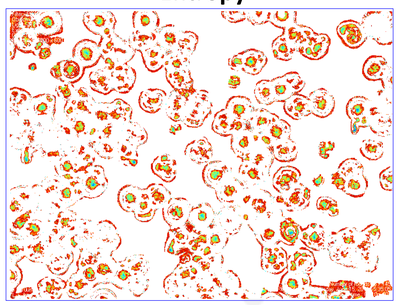
1. videos of Human Embryonic Stem Cells were Collected with the BioStation IM.
2. The videos were captured under an objective of 20x with a 600x800 resolution.
3. Each frame was taken 10 minutes apart.
4. The videos are mainly consist of NDBSU-HESCs undergoing chemical reaction.



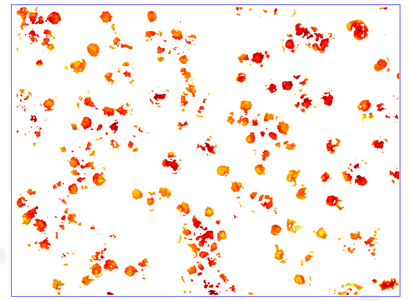
Entropy



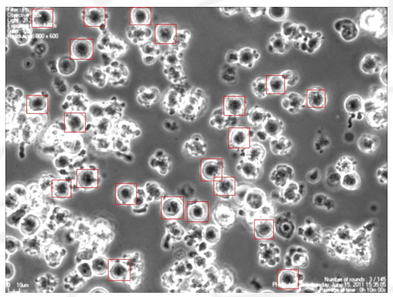
Histogram of Entropy



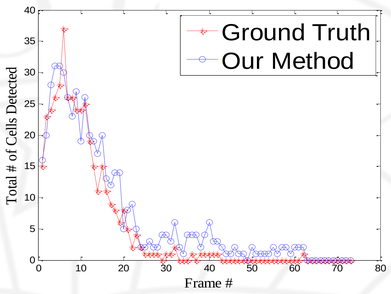
Probability Map without Prior Probability



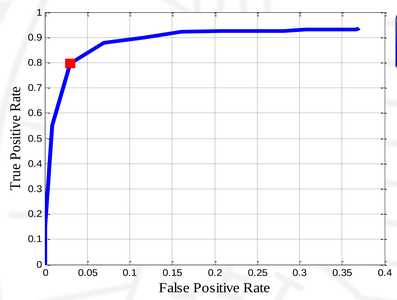
Probability Map with Prior Probability



Detected NDBSU-HESCs



Cell Count Comparison of an Video



ROC Plot for an Video

Conclusion

Benefits:

- ➢High true positive rate
- ➢Low false positive rate

Dependents:

- ➢Accuracy in training data
- ➢Quantity of training data

Future Work

- ➢Develop a model based training data
- ➢Getting more frames per minute

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