# Detection and classification of intracellular particles

## ～by using ellipse extraction and labeling ～

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All cells are detected by using the ellipse extraction method, and the feature values of the particles are measured by the connected component labeling method. The particles are classified by position of the cells and the distance to all other particles. The detection of all cells is especially important for the correct classification of the particles.

## 1. Introduction

The method is based on the following presumptions: ( i ) The distance between the particles is within a defined range. ( ii ) Each particle belongs to the nearest cell.

## 2. Algorithm

The cell positions are defined by the position of their centers which are determined by using EC(Edge Code).

The processing uses a median filter(15×15 pixel) image(Fig.1).

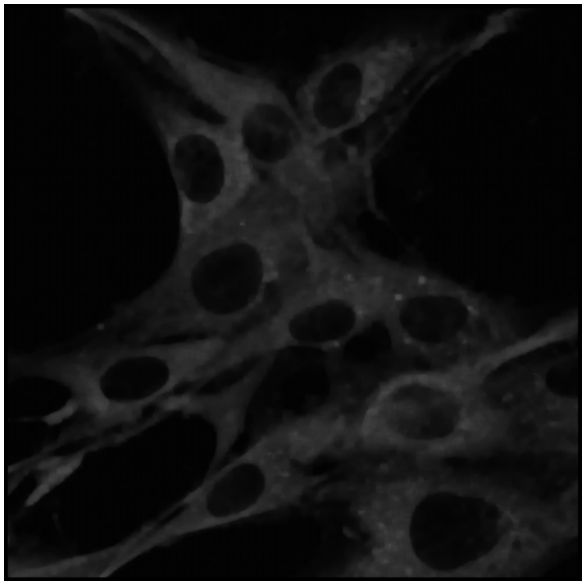

Fig.1 Median filter

EC which is the direction of a concentration gradient determines the direction of vote(Fig.2).

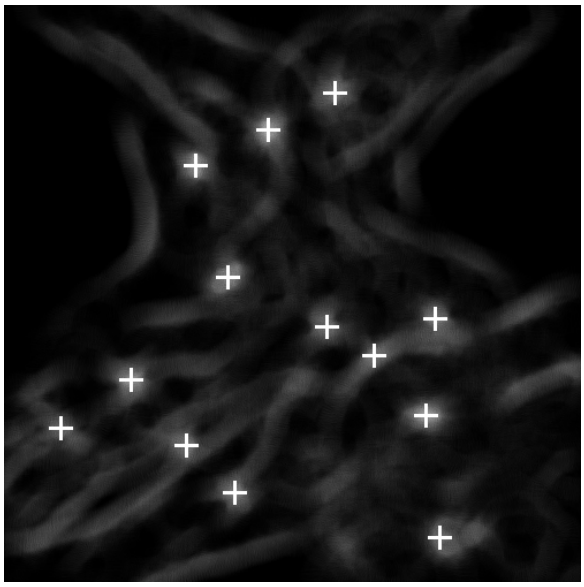

Fig.2 Vote image

Next, the feature values of the particles are measured by connected component labeling.

The processing uses a LOG(Laplacian Of Gaussian) filter image.

The values for each particle are the position of its center and the size of its area(Fig.3).

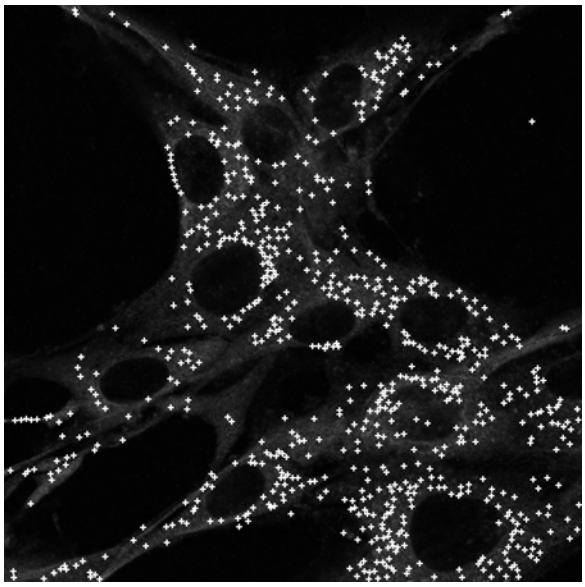

Fig. 3 Particle position

Finally, clustering defines the particle groups.

In a first step, the particles are defined into particle groups near to each other(Fig.4).

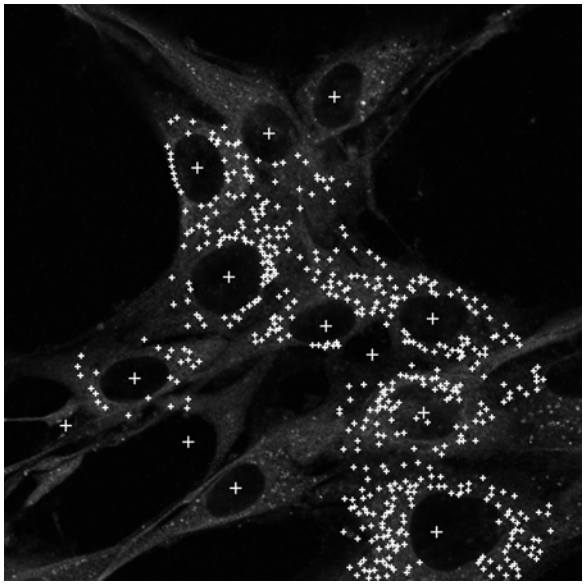

Fig. 4 Clustering image

This group number might be changed in a second step which finally divides the particles into groups according to their nearest cell(Fig.5).

## 3. Result

Fig.5 and Table 1 are the measurement result of the test images.

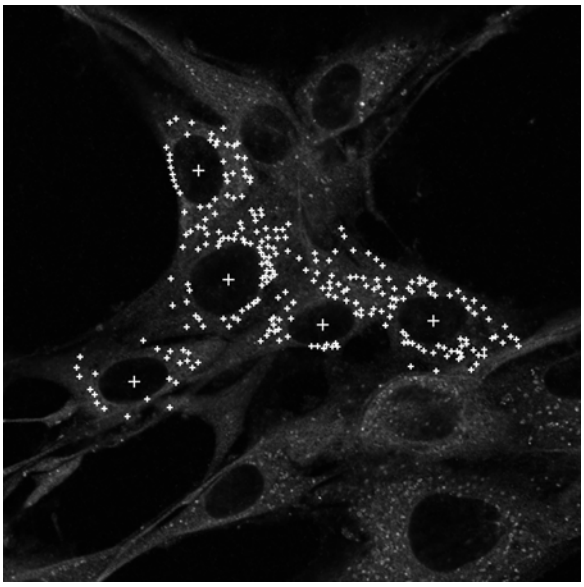

Fig. 5 Result image

Table.1 Result

| Success rate (average) | |
|---|---|
| Classification | 96 [%] |
| Position | 76 [%] |
| Radius | 63 [%] |
| Error rate(average) | |
| Over detection | 23 [%] |
| Speed | |
| Average | 0.25 [msec/image] |

※CPU: Intel Core 2 Duo T9400 2.53GHz
OS:WindowXP

## 4. Conclusions

The position data of all the cells makes the classification of the particles more correct. However, I think the features other than the distance are also necessary because of the perfect classification.

Bibliography

[1]Shiro Fujieda: Position Measuring Algorithm Supported by EC Technology, Visual Inspection Engineering Workshop VIEW2001, pp.42-46.