Towards a Generalized Approach to Segmentation & Counting

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Introduction

Aim: To develop an algorithm capable of performing the same set of segmentation operations on all input images and count the number of resulting objects with acceptable levels of accuracy.

Methodology

Pre-processing

     Conversion to 8-bit

     Background Subtraction

     Contrast Enhancement

Segmentation

     Thresholding

     Binary Erosion & Watershed

Counting
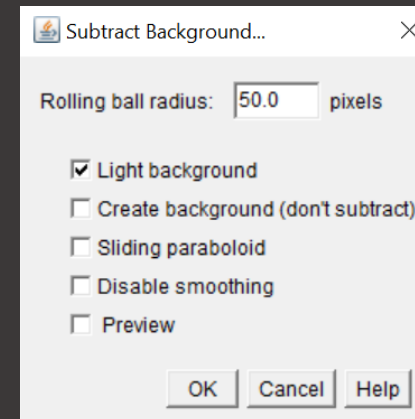
     Labeling

Pre-processing

Conversion to 8-bit

> For faster image processing; no significantly noticeable differences among 16-bit or 32-bit.

Background Subtraction
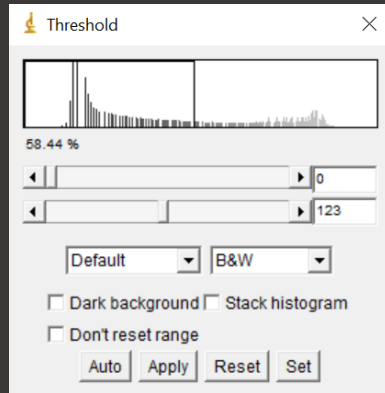
> Input parameters required:
>
> > Rolling ball radius
> >
> > Light/Dark background
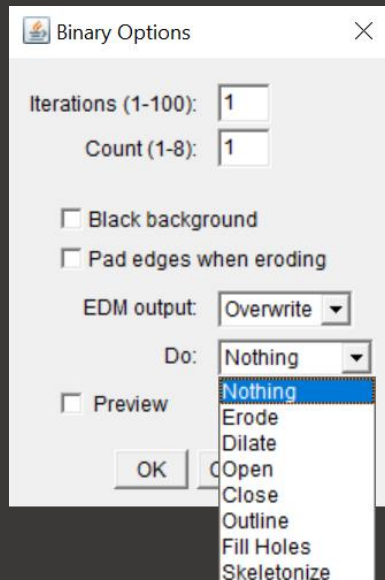

Contrast Stretching

Segmentation

Thresholding

"Auto" for all images – in an attempt to generalization.

Huang – Circular, reflective objects

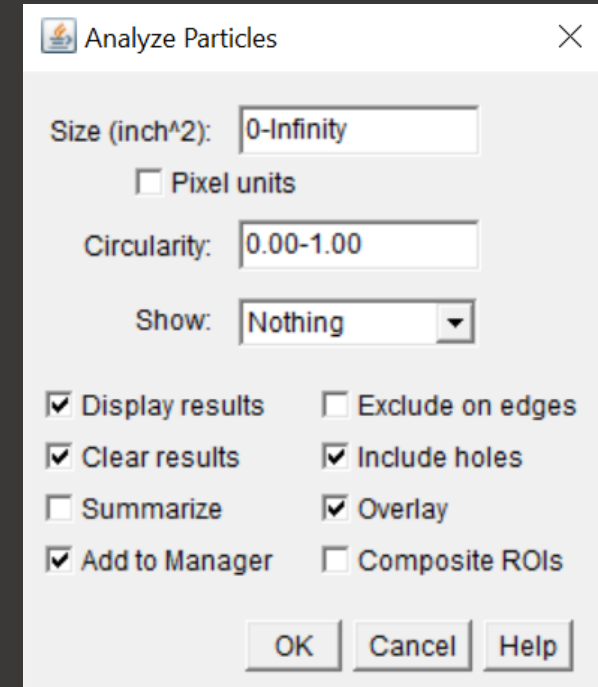Mean – Vertical, rectangular objects

Default

Binary Erosion

Sometimes iterative. Coupled with Despeckle & Outlier Removal.
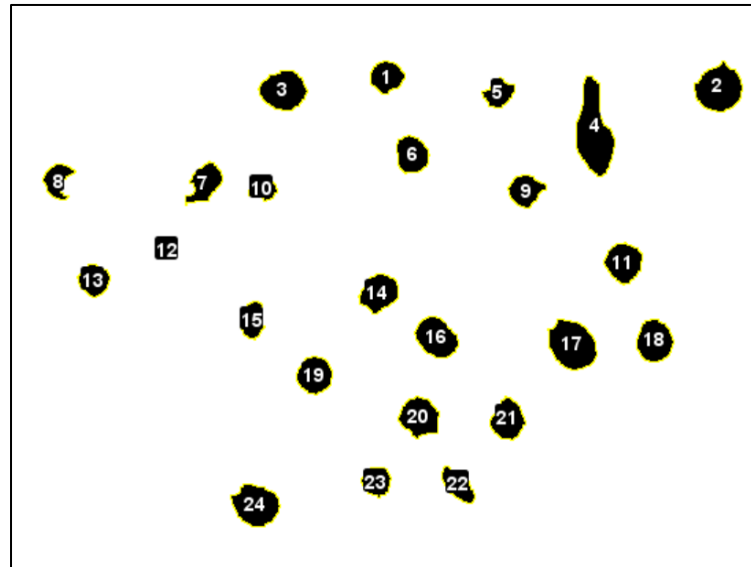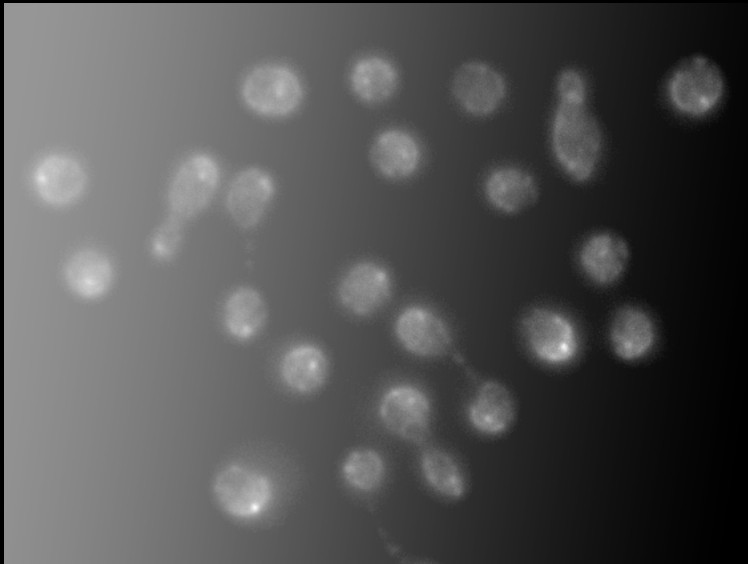
Watershed

Counting & Labeling

Final step of the generalized algorithm.

Particle analysis automated via run("Analyze Particles... ") macro after successful completion of all pre-processing and segmentation operations.

Processed image: yeast2.tif

Conversion to 8-bit
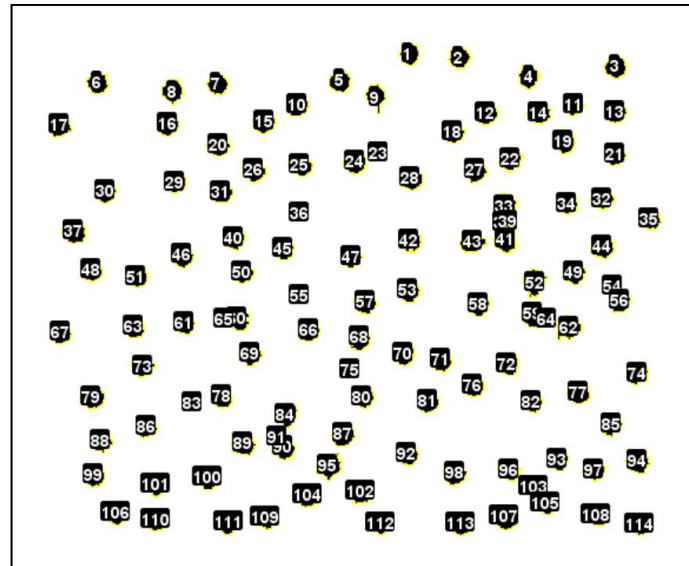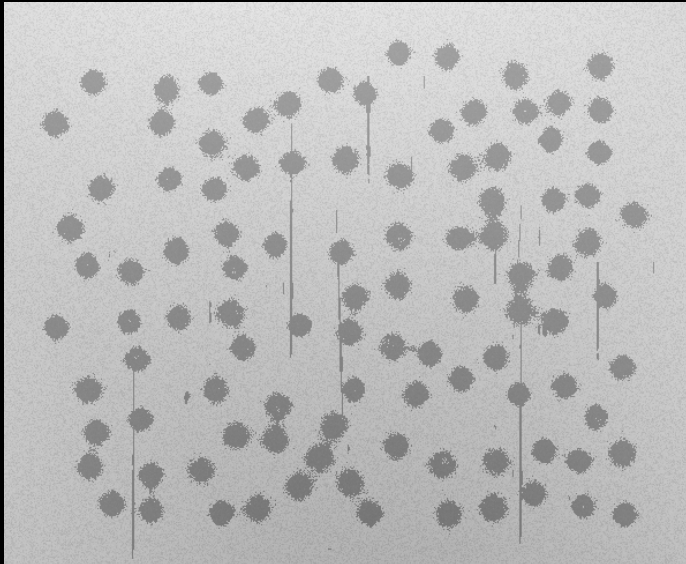
Background Subtraction

Contrast Enhancement

Thresholding

Binary Erosion

Fill Holes

Counting & Labeling

Processed image: spots.tif

Conversion to 8-bit
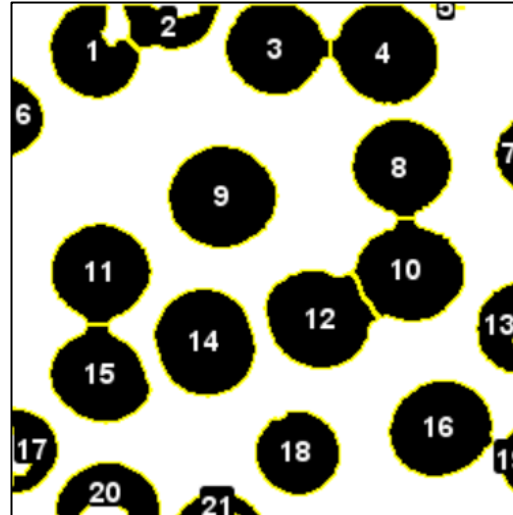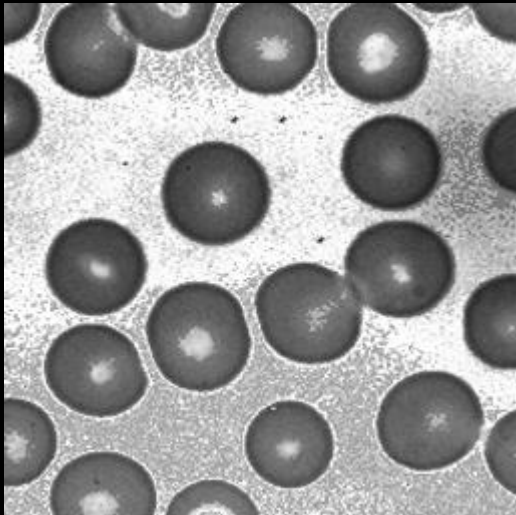
Background Subtraction

Contrast Enhancement

Thresholding

Binary Erosion & Outlier Removal

Counting & Labeling

Conversion to 8-bit

Background Subtraction

Contrast Enhancement

Thresholding

Binary Erosion & Outlier Removal

Watershed

Counting & Labeling

Conversion to 8-bit

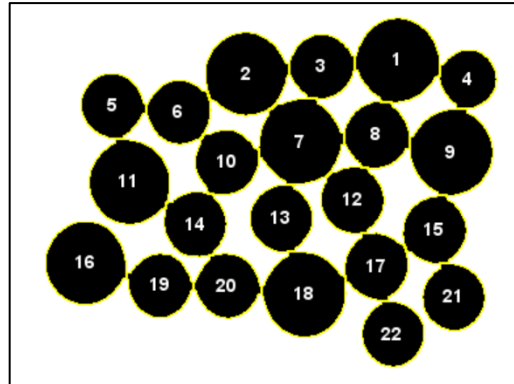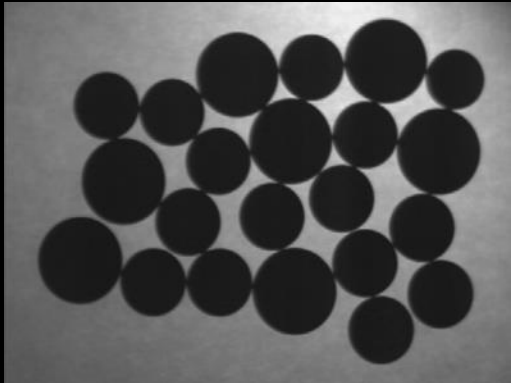Background Subtraction

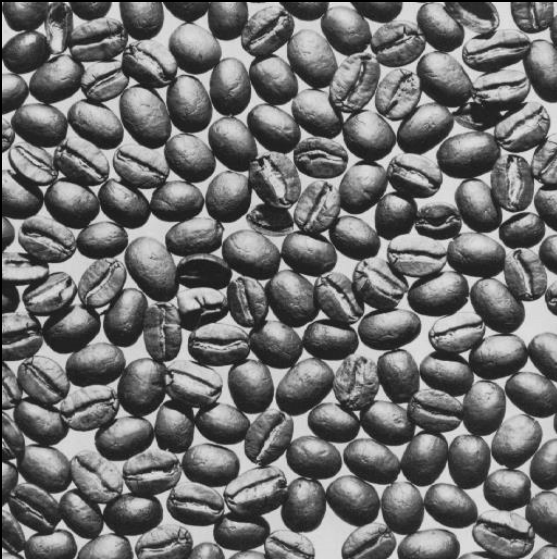Contrast Enhancement
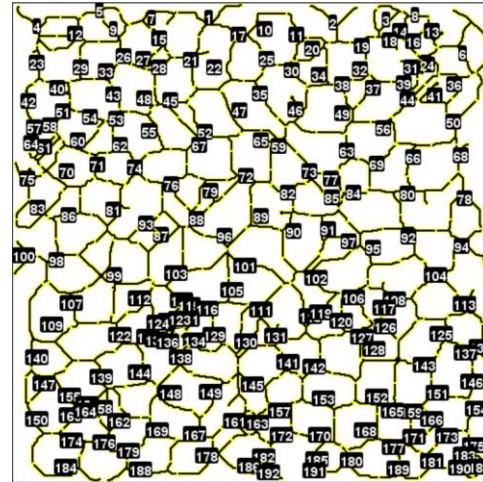
Thresholding

Binary Erosion & Outlier Removal

Watershed

Counting & Labeling

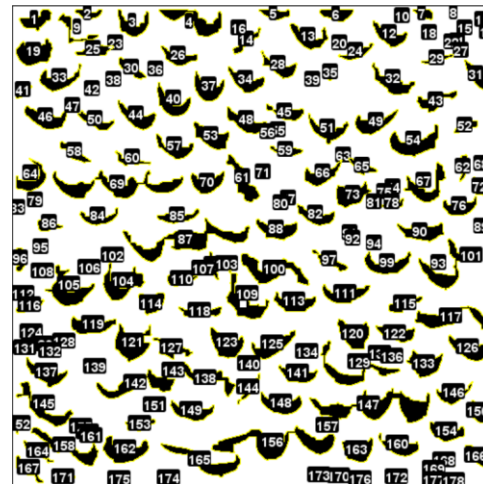# Processed image: coffee.tif

1.

2.

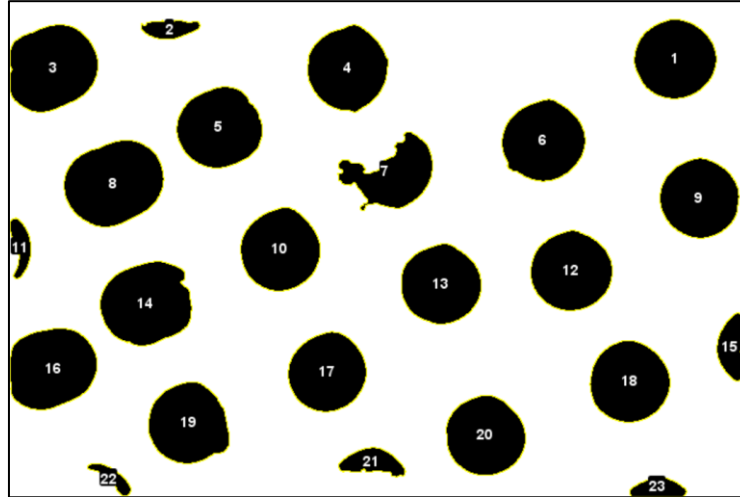Conversion to 8-bit

Background Subtraction

Contrast Enhancement

Thresholding

(Skeletonization)

Binary Erosion & Outlier Removal

Counting & Labeling

Processed image: oreos.jpg

Source: Photography by Cody Guilfoyle Photography for IKEA

Conversion to 8-bit

Background Subtraction

Contrast Enhancement

Thresholding

Fill Holes

Binary Erosion, Despeckle & Outlier Removal

Counting & Labeling

Processed image: toblerone.jpg
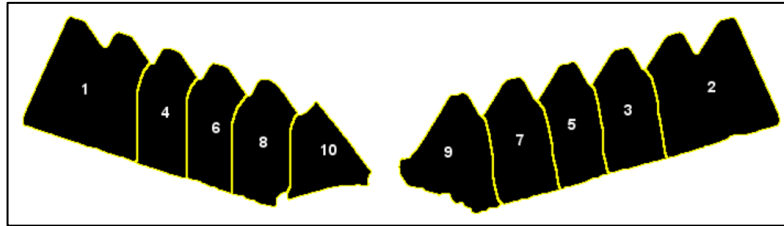
Source: Evan Amos
(Wikimedia Commons)

Conversion to 8-bit

Background Subtraction

Contrast Enhancement

Thresholding

Fill Holes

Binary Erosion, Despeckle &
Outlier Removal

Watershed

Counting & Labeling

Processed image: m&ms.jpg

Source: Scott Ehardt
(Wikimedia Commons)

Conversion to 8-bit

Background Subtraction

Contrast Enhancement

Thresholding

Fill Holes

Binary Erosion & Outlier Removal

Watershed

Counting & Labeling

Processed image: kitkat.jpg

Source: Amazon.com

Conversion to 8-bit

Background Subtraction

Contrast Enhancement

Thresholding

Fill Holes
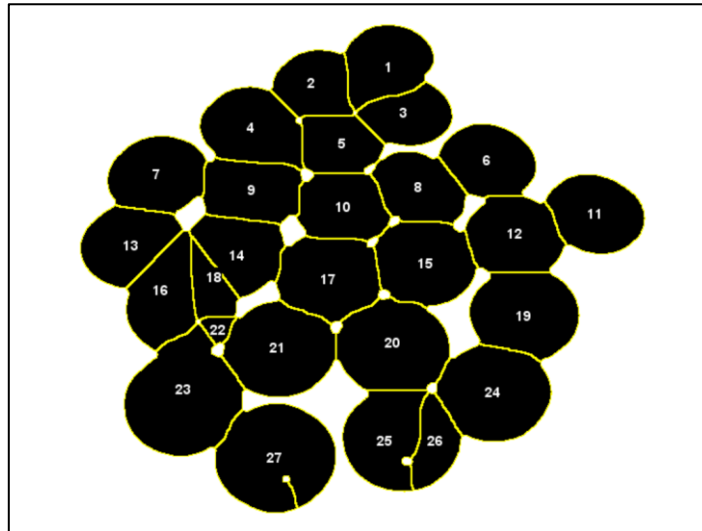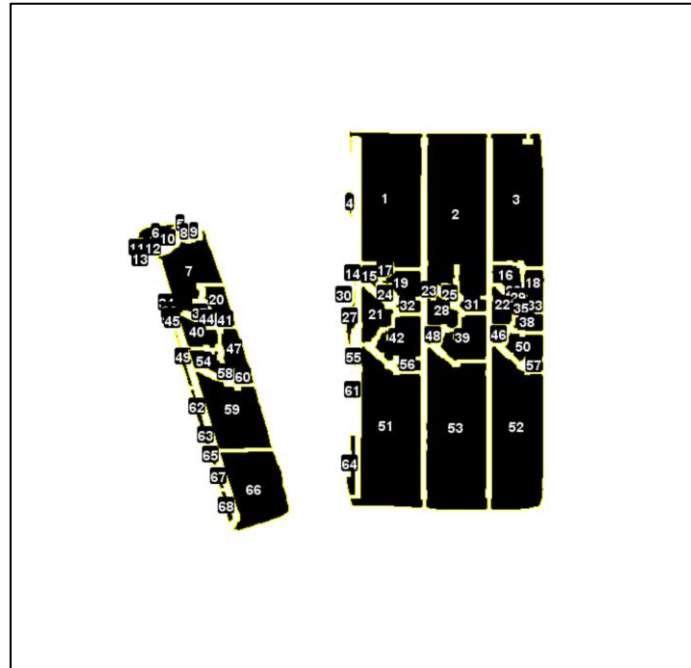
Binary Erosion, Despeckle &
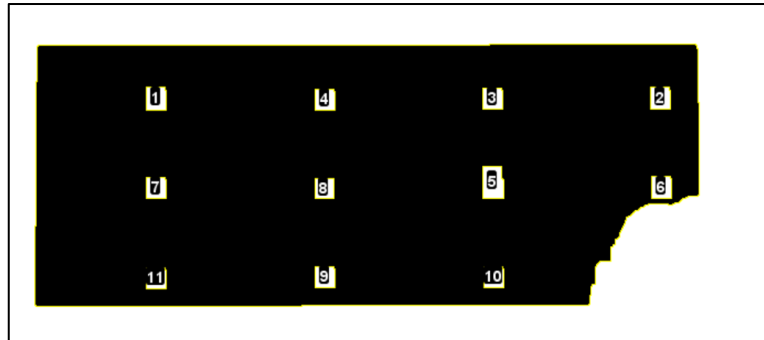Outlier Removal

Watershed

Counting & Labeling

Processed image: hersheys.jpg

Source: Hersheys.com

Conversion to 8-bit

Background Subtraction

Contrast Enhancement

Thresholding

Iterative Binary Closure & Erosion

Counting & Labeling

Conclusion & Future Work

Improving the algorithm to perform same operations on all images with better accuracy.

- Wand (tracing) tool for auto-selecting required objects

- Implementing a uniform dark or bright background for all images

- Finding a better "Fill Holes" alternative (not Dilation)

- Further developing with MatLab

Further reading

https://saadudd.in/projects-dir/Towards%20a%20Generalized%20Approach%20to%20Segmentation%20&%20Counting-report.pdf

Thank you.