APPLICATIONS OF DIP IN BIOLOGY

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OUTLINE

- Introduction
- Biology Application in Image Processing
- Biology Application in Image Analysis
- Biology Application in Virtualization
- Conclusion

INTRODUCTION

- Background illustration
  - Images play an increasingly important role in many fields of science and its countless applications.
  - Biological image data sets grow exponentially in size and carry more and more information.
  - A growing need for computerized image processing and analysis in biology area.
  - Biologically highly relevant information may easily go unnoticed or get destroyed by improper use of image processing and analysis tools.

INTRODUCTION

- Illustration of the meaning of commonly used terms

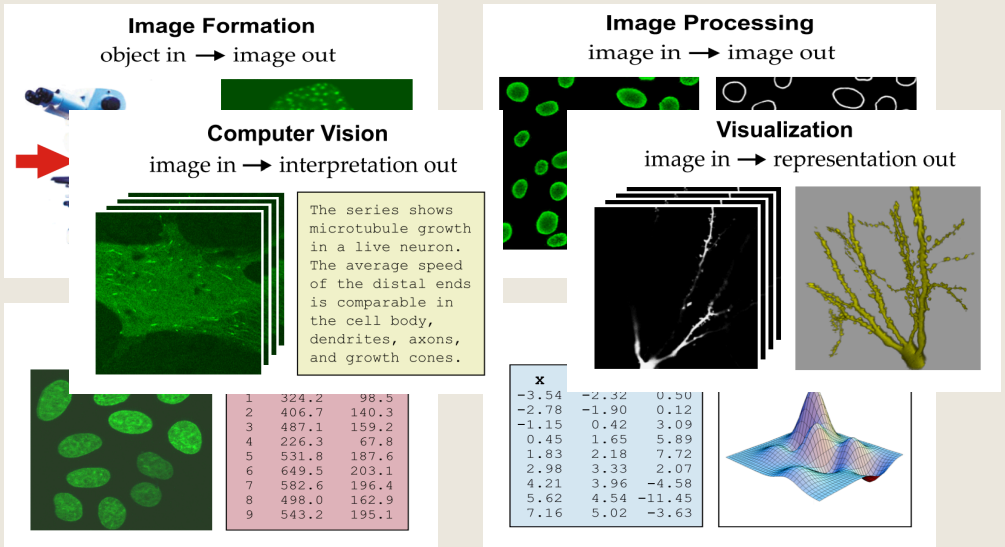


IMAGE PROCESSING

- Intensity Transformation
- Local Image Filtering
- Geometrical Transformation
- Image Restoration

Intensity Transformation

- Examples of intensity transformations based on a global mapping function：

$$O(x, y) = M(I(x, y))$$

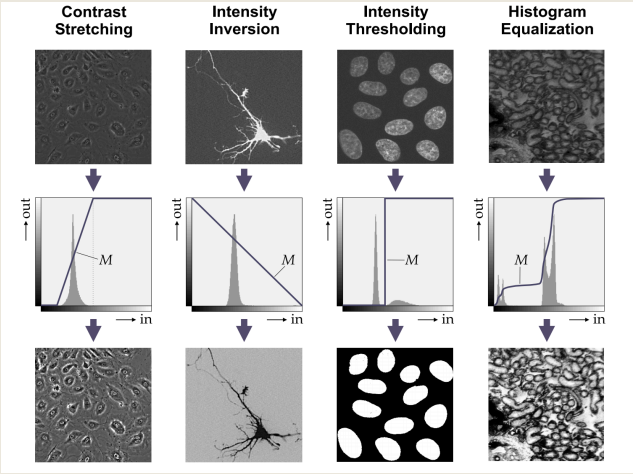


IMAGE PROCESSING

Local Image Filtering (Neighborhood operations)

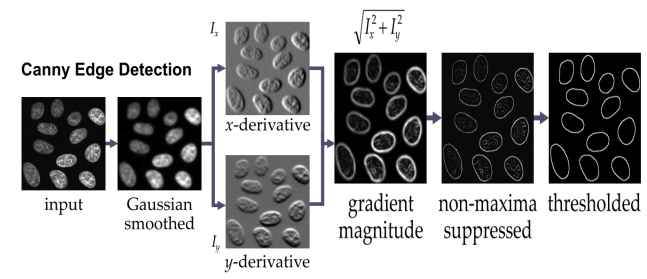


IMAGE PROCESSING

Many interesting morphological filters can be constructed by taking differences of two or more operations, such as in morphological edge detection.

- Examples of binary morphological filtering in biology

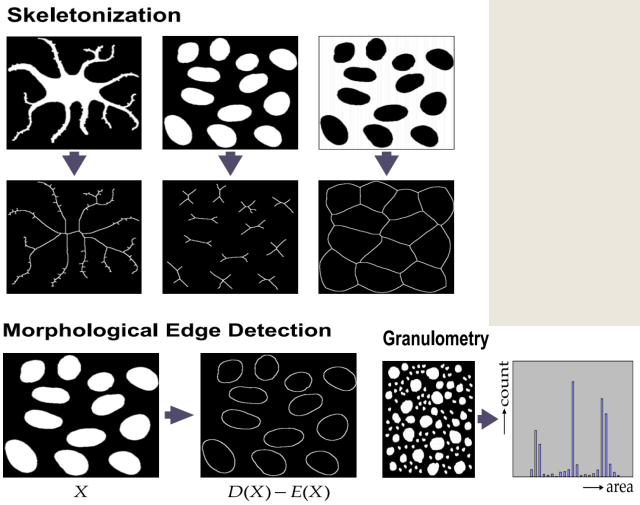


IMAGE PROCESSING

- Gaussian filtering blurs not only noise but all image structures.
- Median filtering is somewhat better at retaining object edges but has the tendency to eliminate very small objects.
- Nonlinear diffusion filtering was designed specifically to preserve object edges while reducing noise.
- Deconvolution methods aim to undo the blurring effects of the microscope optics and to restore small details.

- **Image restoration**
- Examples of the effects of image restoration operations

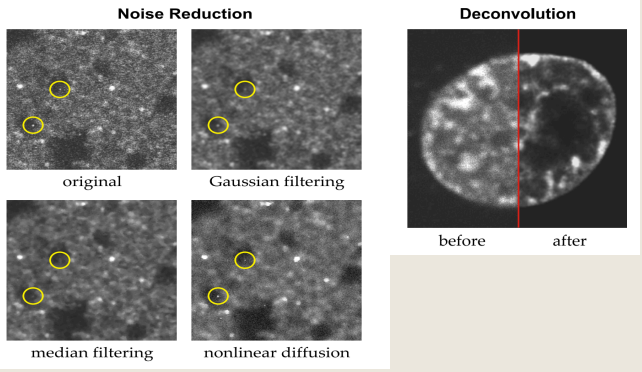
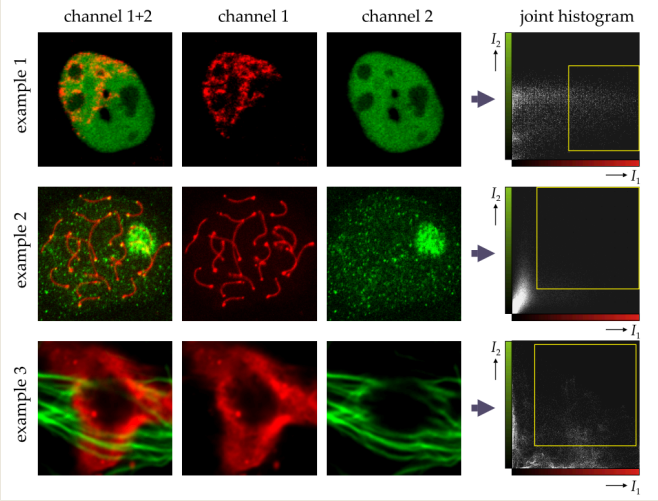


IMAGE ANALYSIS

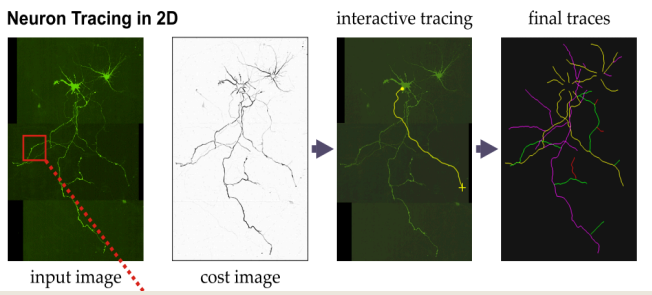
The image processing operations do not answer any specific biological questions. Addressing such questions requires much more involved image processing and analysis algorithms, consisting of series of operations working closely together in "interrogating" the data and extracting biologically meaningful information.

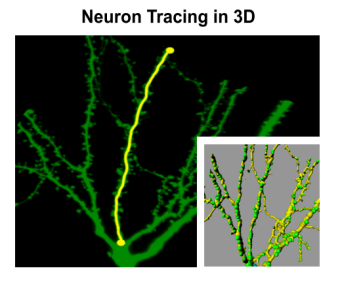
- Colocalization Analysis
- Neuron Tracing and Quantification
- Particle Detection and Tracking
- Cell Segmentation and Tracking

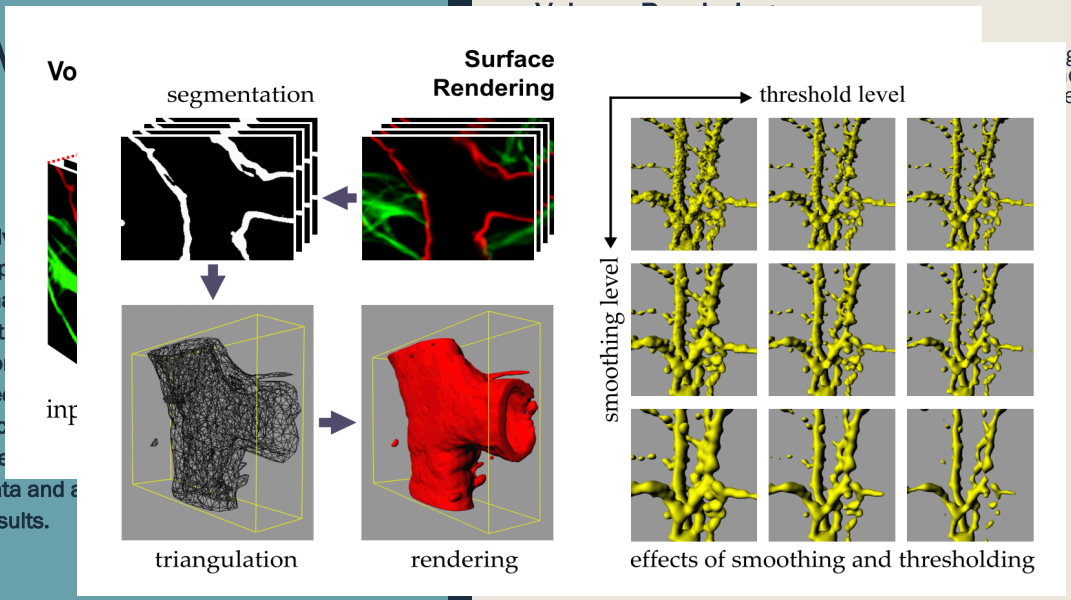
- Colocalization Analysis
  - Commonly used measures for quantitative colocalization analysis

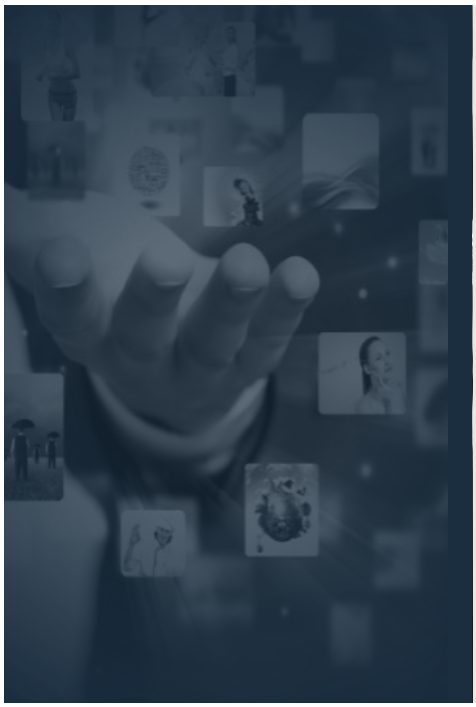


- Neuron Tracing and Quantification
  - Tracing of neurite outgrowth using interactive segmentation methods.









CONCLUSION

- In our present-day life, image processing and analysis technology is employed in surveillance, forensics, military defense, vehicle guidance, document processing, weather prediction, quality inspection in automated manufacturing processe,etc.
- It seems reasonable to predict that another 50 years of multidisciplinary efforts involving vision research, psychology, mathematics, physics, computer science, and artificial intelligence will be required before we can begin to build highly sophisticated computer vision systems that outperform human observers in all respects.
- Currently available methods may already be of great help in reducing manual labor and increasing accuracy, objectivity, and reproducibility.

REFERENCE

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THANK YOU