Part I

Introduction

1 Medical Imaging

2 Sub-Diffraction-Limit Imaging

Imaging objects becomes more difficult as they get smaller because of the wavelength of light. Once two objects are separated by a distance of an order similar to that of the wavelength (λ) of the light used to view them, it is no longer possible to resolve these two objects apart, instead all that can be seen is a blur of the two objects together.

There have been several techniques developed for distinguishing objects apart on smaller and smaller scales. Many of these involve using different wavelengths of light. For example, instead of being limited by visible light, $\lambda \approx 5{\times}10^{-7}$m, x-ray radiation ($\lambda \approx 10^{-10}$m) or even electrons ($\lambda \approx 10^{-11}$m) can be used to resolve smaller scales in x-ray and electron microscopy respectively. These, however, have the issue that, because the smaller wavelengths imply higher energies, there is the danger of damaging the sample. When imaging biological samples, this can be unreasonable.

2.1 STORM

Other techniques employ different methods of actually capturing the image, or cleaver manipulation of the images that are produced, to get around the limitations of the diffraction problem.

For example the STORM method [Rust et al., 2006] uses a technique where the objects to be imaged are molecules of a flourescent dye. The type of dye molecule used allows the flourecence to be switched on and off, allowing some markers to be imaged separately to others, effectivly increasing the distance between points. Once an image is captured, the point spread function (PSF) of the point is used to locate the single marker, the “on” markers are changed and the image retaken.

References

[Rust et al., 2006] Rust, M. J., Bates, M., and Zhuang, X. (2006). Sub-diffraction-limit imaging by stochastic optical reconstruction microscopy (storm). *Nature methods*, 3(10):793–796.

A Appendix 1

A.1 Appendix 2