Ain Shams University
Faculty of Science

Processing of Some Microscopic Images Using Coherent Scanning Laser Microscope

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B.Sc. (Physics)

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Abstract

Name: Lena Khaled Hammad Mohamed

Title: Processing of Some Microscopic Images Using Coherent Scanning Laser Microscope

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In this thesis, image processing of some blood images is investigated using the Coherent Scanning Laser Microscope (CSLM). It consists of two objectives arranged in tandem where the examined object is located in the common short focus. The object is mechanically scanned in its plane in synchronization with the electronic scanning in the detection plane in order to construct the image. The Resultant Point Spread Function (RPSF) is the product of the PSF corresponding to each objective while the Coherent Transfer Function is the convolution product of the objective apertures. While in the ordinary optical microscope only the PSF is governed by a solely objective lens while the collector or condenser lens governs the coherence. The CSLM has better lateral and axial resolution than the ordinary optical microscope.

In this work, an introduction is given in chapter 1 followed by three chapters. The basics of the CSLM are outlined in chapter 2. In chapter 3, we have selected two different models of apertures one in the form of the concentric unequal ratio of annuli and the second has longitudinal successive black and white strips made inside a circular aperture. We have computed the PSF in the two cases of modulation for the sake of lateral resolution improvement which extracted from the cut-off spatial frequency of the

diffraction pattern. Consequently, the RPSF is obtained in case of confocal imaging provided with equally modulated apertures. A comparison of the PSF with circular and annular apertures is made. In addition, we have computed the coherent transfer function (CTF) for the CSLM using the above models. The effect of depth of focus for the considered B/W concentric annuli is investigated. In chapter 4, Erythrocytes blood images using the above-modulated apertures are applied on the CSLM and the corresponding reconstructed images are obtained. In addition, numerical and contour images are obtained from the input images. All the images are processed based on Fourier transform techniques and convolution operations. A Mat- Lab code is used in the computations. Finally, a conclusion and discussion are given.

Keywords: Coherent Scanning Laser Microscope, Point Spread Function, Modulated aperture, Image processing.

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Chapter one

Introduction

1.1 Introduction and previous work.

Microscopy is the mechanical field of using microscopes to view objects that cannot be seen with the naked eye as shown in figure (1.1). There are three familiar branches of microscopy: optical, electron, and scanning probe microscopy. Optical and electron microscopy includes the diffraction, reflection, or refraction of electromagnetic radiation, electron beams interrelating with the specimen, and the collection of the scattered radiation to create an image. This process may be carried out by wide-field irradiation of the sample (for example standard light microscopy and transmission electron microscopy) or by scanning of a suitable beam over the sample (for example confocal laser scanning microscopy and scanning electron microscopy). Scanning probe microscopy contains the interaction of a scanning probe with the surface of the object of notice. The development of microscopy revolutionized biology, gave increase to the field of physical sciences [1].

Figure (1.1): Conventional optical microscope.

Optical or light microscopy includes passing visible light transmitted through or reflected from the sample through a single or multiple lenses to allow a magnified view of the sample.[2] The resulting image can be detected directly by the eye, imaged on a photographic plate or took digitally. The single objective lens with its attachments along with the suitable lighting equipment makes up the basic light microscope. The latest development is the digital microscope, which uses a CCD (Charge-Coupled Device) camera to focus on the show of interest and the image is shown on a computer screen.

Figure (1.2): Coherent Scanning Laser Microscope (CSLM).