WAVELENGTH-SCANNING FIBER OPTICS CONFOCAL MICROSCOPY FOR LENS' THICKNESS MEASUREMENT

INTRODUCTION:

The standardization of lens industry recommended every lenses must be inspected which included lens' thickness measurement. Typical technique for measuring lenses could be caused a scratch to the lens, some errors and it took too much time. So, there is a new technique that has been used to measure the lens' thickness, it is non-contact laser scanning microscopy lens' thickness measurement. However, if the scanning technique can be eliminated, it will be more accuracy because scanning technique caused the vibration to the system.

This project proposes to develop a new lens' thickness measurement technique which eliminate the scanning technique. The varying wavelength technique is designed in this project. The author has used the simple idea that different wavelength of light can be caused the different focusing on the lens. Therefore, in this project is to study the concepts of confocal microscopy technique, all the required equipment. Next, find the relationship of focal length of objective lens of different wavelengths. Finally, use computer to control the wavelength scanning and demonstrate how the lens thickness will be achieved by using software.

TECHNICAL BACKGROUND:

The basic optical principle is to scan specimen with an illuminating spot, and at the same time have a small photodetector aperture follow that illuminating spot. This is usually achieved by having a laser as illumination source and a small aperture in front of the photodetector.
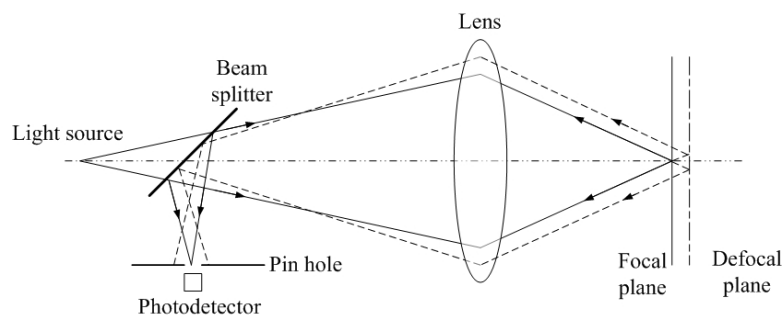

Figure 1 The Arrangement of Equipments of Confocal Microscopy.

From Figure 1, the laser beam is first focused to a spot by the microscope objective by passing through the beam splitter. An illuminating spot is formed in the focal plane of the objective. The laser beam is traveling back through the objective. Most of the laser beam is reflected by the beam splitter. The light from defocal plane will be focused at a plane behind the pinhole such is blocked away by the pinhole plate. The light from defocal plane will be focused before the pinhole and is blocked away by the pinhole too. Only the light from focal plane is just focused at the pinhole thus can reach the image photodetector. The ray-path indicated with dashed lines shows how light from out-of-focus objects are propagated through the optical system. The illuminating spot is defocused, thus illumination a larger area with a weaker intensity. This is indicated to the left with the dotted focal position within the specimen.

METHODOLOGY:

In "Wavelength-scanning fiber optics confocal microscopy for lens' thickness measurement", has the ideal concept as shown below.
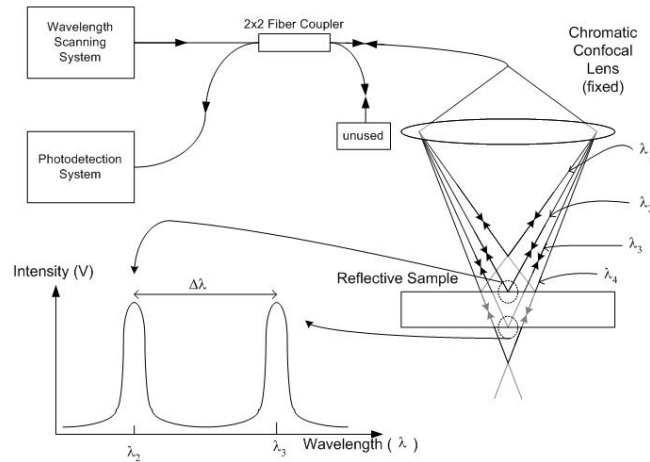

Figure 2 Diagram of Wavelength-scanning Fiber Optics Confocal Microscopy for Lens' Thickness Measurement.

From Figure 2, the wavelength scanning system generates the light in different wavelength (for example; λ_1 to λ_4) passing through fiber optics to the 50/50 fiber coupler, fiber coupler (acts as beam splitter) divides the input light power (50/50 coupling ratio). One of light transmits to objective lens which focused the light beam on to the lens. If the light is focused onto the surface, it will reflect and enter the fiber tip which acts as pinhole, the light transmits back to fiber coupler and divides the light power again, one go to the photodetector system and then the result is maximum intensity. Otherwise, if the light is out-of-focus on the surface, its light intensity will be less. In the Figure 2, the light at wavelength λ_2 to λ_3 are focused to the reflective sample surface and these two wavelength will result the confocal peaks. The sample thickness is proportional different between two wavelength (sample thickness $\alpha \, \Delta\lambda$).

PROGRAMMING:

The program developed by LabVIEW is used to perform the wavelength scanning by controlling the Monochromator which used for selecting the desired wavelength. The graphic user interface (GUI) is shown if Figure 3 below.
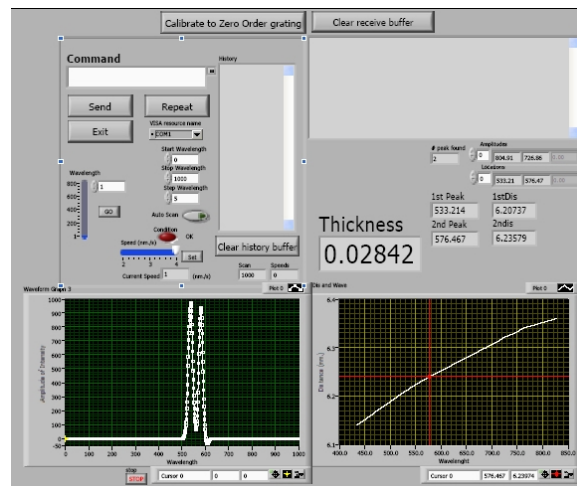

Figure 3 The GUI of Program.