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# Automatic fringe analysis of two-beam interference patterns for measurement of refractive index and birefringence profiles of fibres

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**Abstract**

Automatic fringe pattern analysis is a powerful and inexpensive digital image-processing technique. Two-beam polarizing interference Pluta microscope [Pluta M. Opt Acta 1971;18:661, Pluta M. J Microsc 1972;96:309] is automated by the computer-aid via CCD camera and digital frame grabber. Software program is prepared to deal with the duplicated (separated and overlapped) Microinterferograms produced by two-beam polarizing microscope. It also gives an accurate and fast automatic measurement of refractive index and birefringence profiles for fibres. In this paper, the refractive index and birefringence profiles of two different types of fibres, basalt and polypropylene (PP) fibres are presented. A new method to determine the birefringence profile of fibres from non-duplicated microinterferogram is suggested. The cold drawing process for PP fibres is studied.


*Keywords:* Interference; Image analysis; Refractive index; Birefringence profiles; Drawing and fibres

## 1. Introduction

Nowadays, the intensive progress in development of laser sources and optical elements has challenged scientists to use the interferometry as an important diagnostic tool for accurate and gross field measurements of various phenomena. These challenges have resulted in an accurate measurement in almost all engineering domains. For example in chemical engineering, materials science and physical fields, refractive index measurement is frequently needed.

All of interferometric techniques are based on the wave characteristics of light, when it reflects from or transmits through an object. Light transmission properties through a fibre depend mainly on its refractive index profile and material dispersion. In other words, the direct result of an interferometric technique is generally fringe pattern or interferogram. This interferogram provides us with rich quantitative information regarding sample material behaviour.

In the past, the interferograms obtained from the conventional interferometric techniques must be photographed and enlarged to a suitable magnification than the required data are obtained from the magnified image [3–11]. The manual quantitative analysis process is time consuming and very tedious, and furthermore it cannot make a full use of the interferogram's data. For this reason, an automatic image processing of these interferograms is an active topic in recent literatures.

The values of birefringence and refractive indices of fibres for plane polarized light vibrating parallel or perpendicular to the fibre axis are important not only in assessing the performance of the fibre in a given system but also it help in fibres fabrication to improve their products. Therefore, there is an increasing need for fast and accurate measurements of refractive index profile of fibres because it provides information for the correlation between their structure and the other properties.

Usually, the synthetic fibres are manufactured with no desirable tensile properties and low birefringence. In order to turn into useful textile fibres, they must be mechanically

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