Optics Research Group

For a period about four decades, the optics research Laboratory established by **Prof. A. A. Hamza** in 1972 at the physics department, the faculty of science, Mansoura University has a great scientific impact in the field of optics, especially in the characterization of optical, textile and polymer fibres using different interferometeric and non-interferometric techniques. The research studies in Optics Laboratory at Mansoura focus on the optical and physical characterization of fibrous materials, optical fibres, synthetic polymers and natural fibres, using interferometric techniques and colour measurements. The measuring techniques were developed from manual to fully automated measurements and dynamic detection of the phenomena. Analysis of the results was developed using software programmes and image analysis and machine learning techniques for different types of interferograms. These programmes were developed by the optics group members. Many devices were designed to be attached to these interferometric techniques to study the opto-mechanical, opto-thermal and geometric properties of fibres. These devices were also developed from manual to fully automated using stepper motors and software computer programmes. Another techniques, which have been applied in our lab is referred to as Digital Holographic Interferometry and transport intensity equation techniques.

The optics research Laboratory offers to the graduate students and scientists coming for different national and international

Universities, examples include Mansoura, Dameitta and south valley Universities, its facilities to conduct basic and interdisciplinary research in fibre optics. During this period, most kinds of fibres were studied. More than 400 research articles were published in international journals. More than 50 M.Sc. degrees and 40 Ph.D. degrees were awarded at Mansoura, Dimitta and South Valley Universities.

Many modifications in the methods of calculation of the refractive indices and birefringence of fibres are carried out by our group. Moreover, new methods utilized for testing and determining fibre characteristics have been developed. Based on these methods and modifications, new techniques were designed and constructed by the members of Mansoura Optics Group. The most important studies carried out using these methods and their modifications are:

1. Investigation of fibres with irregular transverse sections whether these fibres are homogenous with single layer or heterogeneous, i.e. composed of a multilayer structure.
2. Measuring the refractive indices of the fibres without the necessity to measure the refractive index of the used immersion liquid. This can be done by using two fibres, one of them being a standard fibre with known refractive index and dispersion properties.
3. Using the variable wavelength interferometric (VAWI) technique considering the area under the fringe shift and the cross-sectional area of the fibre to calculate the optical path difference integrated across the fibre.

4. Deriving mathematical expressions to measure the refractive index profile of fibres considering the refraction of the incident light beam inside the fibre.
5. Using the optical Fourier transform technique (OFT) with the variable wavelength interferometric technique to determine accurately the positions of the coincidence and anti-coincidence cases of the variable wavelength interferometric (VAWI) technique.
6. Developing and using a novel video opto-mechanical (VOM) device for studying the effect of stretching speed on the optical and structural properties of fibres.
7. A method using Multiple beam Fizeau fringes for determining the mean refractive index of highly birefringent fibres (highly oriented fibres).
8. Determining the refractive index and the modification depth of a waveguide generated in a planner polymer chip using UV-laser.
9. An automatic determination of refractive index profile, sectional area, and shape of fibres having regular or irregular transverse sections.
10. The reconstruction of the refractive indices distribution in 3D using a single pattern of multiple-beam interference fringes for on-line investigation of necking phenomenon.
11. Studying the effect of recycling on the optical, mechanical and structural properties of polypropylene fibres.
12. Using the digital holographic interferometric technique to investigate the optical and structural properties of optical and polymeric fibres.

13. Using the transport intensity equation technique to investigate the optical and structural properties of highly and partial oriented fibres fibres.

Modifying machine learning techniques for classifying the fibre deformation classes and digital holographic patterns

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