Simultaneous Optical Scanners Obtained by the Mechanical Wave Propagation in Water

Amir Guessoum

Applied Optics Laboratory, Institute of Optics and Precision Mechanics, Ferhat Abbas University Setif 1, 19000, Algeria

ABSTRACT

As it is well known, the light interaction with a perturbed medium by a mechanical wave provokes the diffraction phenomenon. This diffraction has been explained by Raman-Nath's theory for sinusoidal ultrasonic wave and Mertens-Hereman's theory for amplitude modulated (AM) ultrasonic wave. In this paper, a theoretical development has been performed of the diffraction phenomenon of a laser beam by a frequency modulated (FM) ultrasonic wave. The obtained results show that each diffracted order position oscillates periodically around a central position, in the rhythm of the modulating wave signal.

Moreover, the scanning frequency of the diffraction order increases linearly according to the frequency of the modulating signal, in addition the increase in the frequency excursion leads to the increase of the angular excursion. All the theoretical results are experimentally confirmed. Furthermore, the frequency modulation index has been easily obtained with good precision using experimental measurements of a diffracted order angular excursion.

Keywords: acousto-optic Interaction, optical scanner, angular excursion, scanning frequency.

The experimental setup consists of;

1- He-Ne laser source (output power 30mW at □0 =632.8nm)
2- Parallelepiped AO cell,
3- A circular piezoelectric transducer (diameter 20 mm with resonance frequency fr=10MHz),
4- A transducer holder.
5- A frequency generator (FI 5500GA) with maximal frequency fa max=25MHz, Umax=20 V and a modulation frequency fm max=20kHz,
6- An oscilloscope with a maximal detected frequency fmax =80MHz,
7- An ultrafast photodiode with a detection specter varying from □=170 to 1100 nm and Us=20 V,
8- A photodiode holder,
9- An acquisition card connected to the photodiode and to the computer,
10- A Computer.