DFA Dirección de Formación Académica

CIO CENTRO DE INVESTIGACIONES EN OPTICA, A.C.

Asesor: Dr. Geminiano Donaciano Martínez Ponce

Sinodales: Dr. Rodolfo Martínez Manuel
(Sinodal Interno, Secretario)

Dr. Gerardo Gutiérrez Juárez
(Sinodal Externo- División de Ciencias e Ingenierías UGTO, Vocal)

Dr. Geminiano Donaciano Martínez Ponce
(Asesor de Tesis, Presidente)

Tesis: **"HYDROPHONES BASED ON INTERFEROMETRIC FIBER-OPTIC SENSORS WITH APPLICATIONS IN PHOTOACOUSTICS"**

Resumen:

Biomedical imaging used for medical diagnosis constantly requires improvement in the characteristics for imaging devices. The sensing devices are one of the most important pieces to improve in order to get images with better quality. In this thesis, it is proposed the use of interferometric fiber-optic sensors (which offer the advantages inherent to optical fibers) as devices to detect pressure/acoustic signals generated by the photoacoustic effect.

Photoacoustics is a technique which combines the advantages of optics and acoustics. The optics field provides with spectral selectivity, while acoustics provides higher spatial resolution and penetration depth. The applications on this field are currently mainly oriented to biomedics, but many other applications can be tested by following this principle.

In this work, it is explored the capability of using fiber-optic interferometric hy-drophones in order to determine the thickness of a material derived from the acoustic signal generated when a sample is illuminated. For this case, rubber and aluminium slabs with different thicknesses were the studied samples.

In addition, the analysis of photoacoustic signals generated by the excitation of nanoparticles of an anisotropic material as absorption centers. The experiments consisted on analyzing the generated signals at different wavelengths, with different polarization states of the excitation beam, and the change in the signal when a tensile strength is applied.

Finally, the cross-section of a metallic sample was photoacoustically imaged by acquiring the pressure signals generated. These signals were processed to form a pressogram. In order to reconstruct the image, a time set of ultrasound signals acquired in a circular scan around the sample were used to solve the time-reversal reconstruction equations. It was observed that image contrast can be enhanced considering the deconvolution of the sensor frequency response from each measured pressure signal.

The results from the experiment, allowed to observe the ability of the hydrophones to be suitable for different photoacoustic applications. The specific goals for this thesis were achieved and throw conclusions on the improvements that can be done and the possible future work with the hydrophones in similar experimental setups, and for different photoacoustic applications.