

**HOLOGRAPHIC INTERFEROMETRY MEASUREMENT OF REFRACTIVE INDEX  
AND CONCENTRATION OF LIQUIDS**

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## ABSTRACT

The refractive index ( $n$ ) is a basic optical property of materials and its accurate value is often needed in many branches of physics and chemistry. Measurement of liquid concentration is important in fields such as chemical analysis and processing, diagnostics, and semiconductor manufacturing. Refractometers are used routinely to evaluate the refractive index to determine concentration of liquid mixtures. Still other techniques reported for accurately measuring the refractive index of solids and gases include the minimum deviation method, the use of a Littrow prism, Brewster angle techniques and others. All these techniques, however suffer from one or more of the following shortcomings: they must get in contact with the liquid, have poor resolution, require complicated and expensive components, are physically large and difficult to operate, or rely on a visual, subjective measurement of data. Despite the use of infrared ethanol sensors to determine the concentration of alcohol which measure the vibrational frequency of dissolved ethanol, this technique only makes use of light intensity only losing the effect of the phase. Holographic interferometry involves a phase object interfering with a memory of itself at a preceding time, recorded on a hologram. Interference fringes therefore inform on any variation of the phase of the object. A holographic interferometry technique will be used in the measurement of the concentration and refractive index of liquid mixtures and solutions. The essential components in the system include a He-Ne laser (632.8nm) as the light source, a precision glass cuvette as the liquid container and optical cell, a holographic plate and digital camera. The work involves taking three of the common alcohols (Ethanol, Methanol and Propanol) and distilled water each into a cuvette and recording their holograms separately. The distilled water hologram is taken as a reference hologram and the concentration of the alcohol is varied and poured in the cuvette for reconstruction. The interferogram obtained during reconstruction will be captured using a CCD camera. The captured interferogram will be analyzed for the measurement of the concentration and refractive index of liquid. The analysis will be replicated for ethanol, methanol, propanol, distilled water and water mixtures. Further analysis will be conducted using Fourier transform infrared spectroscopy (FTIR) and the results compared with those obtained from the holographic interferometry method.

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**ABBREVIATIONS**

BS	Beam splitter
C	Concentration, volume %
CCD	Charge coupled device camera
FFT	Fast Fourier Transform
HI	Holographic Interferometry
HP	Holographic plate
M	Mirror
n	Refractive index
OB	Object beam
RB	Reference beam
RTHI	Real time Holographic interferometry
$V_A$	Volume of liquid A ( $\text{cm}^3$ )
$V_B$	Volume of liquid B ( $\text{cm}^3$ )
$\lambda$	Laser wavelength (nm)
$\delta$	Optical path length