(US2-1) Ultra Sound Interference

Aim of experiment

Determination of interference pattern, frequency, and wavelength of ultra sound waves .

Apparatus

Two Similar Sources of Ultrasound Waves, Ultra Sound Detector, A Protractor Scale - Meter Scale.

Theory of experiment

Ultrasonic waves are studied in laboratories because its wavelength is easily measured with an ordinary meter stick. The frequency of ultrasound is above the range of human hearing, so the experiment does not create an audible sound. The experiment also illustrates that the interference of sound waves is a pressure wave in air.

The speed of a sound wave in air is about 340m/s and this speed depends only on the properties of the air (temperature, composition, pressure, etc.) and not on the frequency or wavelength of the wave.

Young’s interference experiments can be carried out using double sound similar sources. Consider two sound waves of equal frequency, *f*, equal wavelength, λ, and nearly equal amplitudes, both approaching an ultra sound detector. If the two waves arrive at the detector in phase, that is with successive maxima arriving at the same time and successive minima arriving at the same time, then the waves interfere constructively, their amplitudes add, and the detector measure high intensity. But if the waves arrive at the detector exactly out of phase, that is, with the maxima of one wave arriving at the same time as the minima of the other wave, then the waves interfere destructively; they cancel and the minimum intensity is detected.

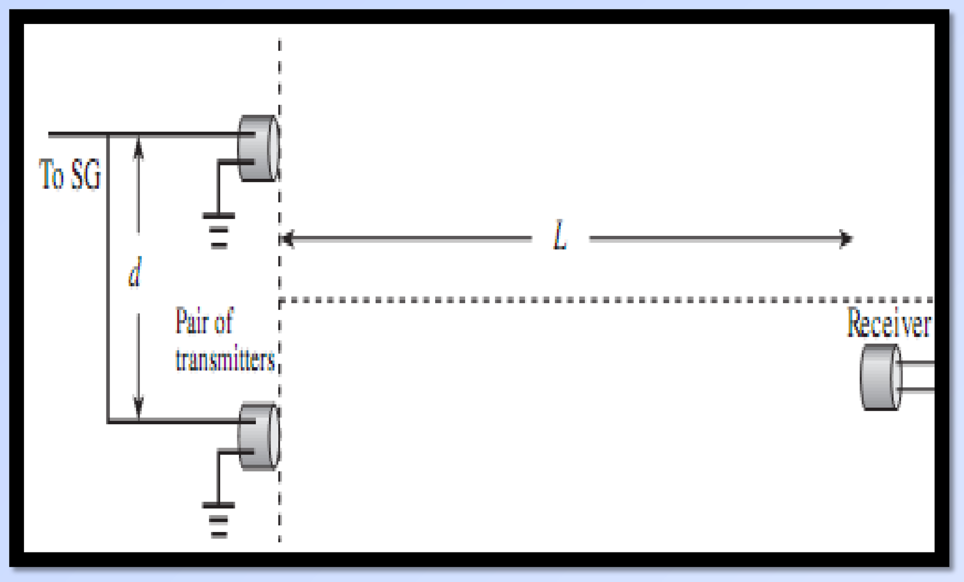

Figure 1. Experimental set up for Ultrsound waves interference.

The path difference for constructive interference is given by

$d \sin\theta_{max} = n\lambda \qquad n=0, +1, +2, +3,........$

Whereas for the destructive interference is given by

$d \sin\theta_{min} = (n+ ½)\lambda, \qquad n=0, +1, +2, +3,........$

where d is the two slits separation distance, n is an integer number determines the order of interference, λ is the wavelength of the wave.

Most wave-detecting instruments measure time-averaged light intensity, therefore, one can write the average light intensity at point P as

$$I \approx I_{\max} \cos^2\left(\frac{\pi d}{\lambda} \sin\theta\right)$$

Intensity maxima, I_{max} and minima, I_{min} are formed as a function of position of the detector *figure 2.* One then can determine the wavelength of the source of ultrasound wave.

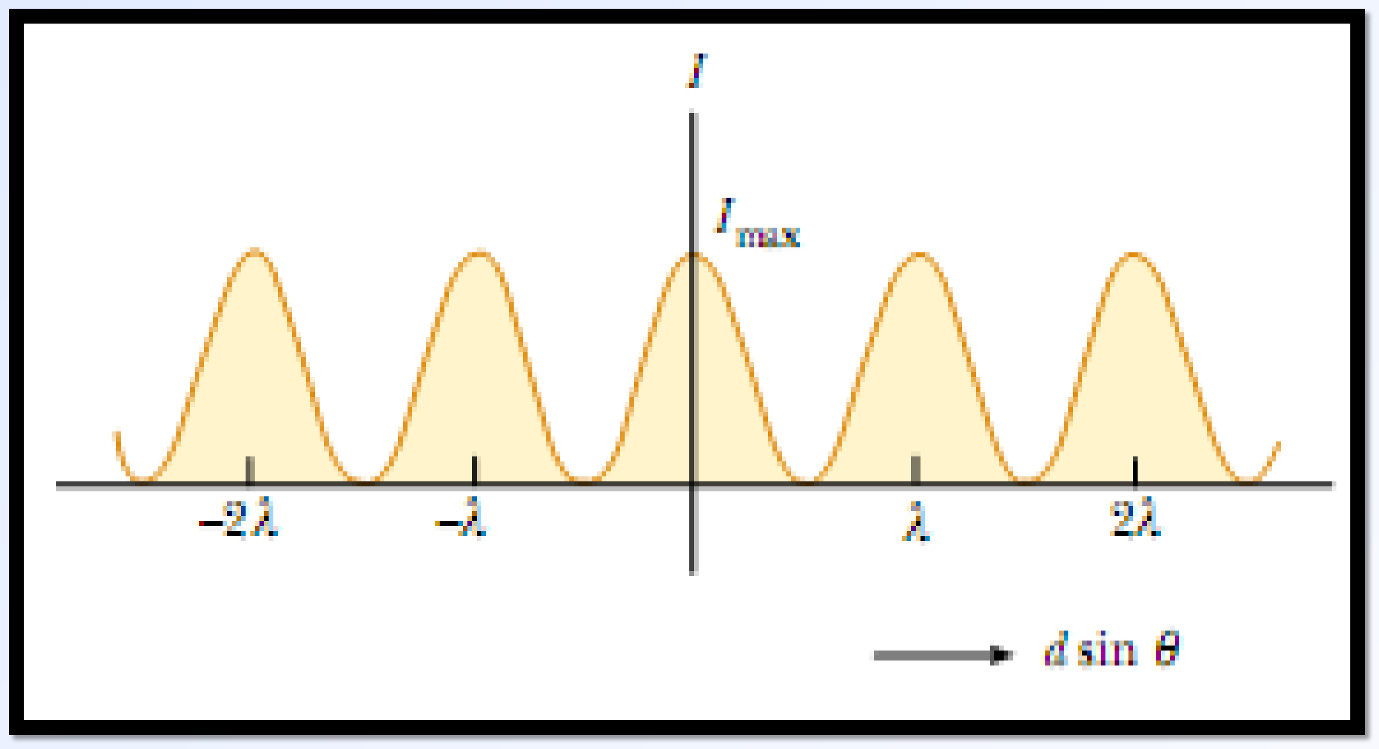

Figure 2. Ultra sound wave intensity as a function of the detector position.

Procedure

1. Arrange the Young’s apparatus as shown in *figure 1.*
2. Set the detector at a distance much greater than *d,* slit separation distance, and adjust it to read maximum intensity at the centerline of the sources - detector .
3. Take the reading of the detector as a function of angle, θ.
4. Draw the readings as a function of the angle.
5. Determine the distance between 2 successive maxima, $\lambda/2$, 3 times at least, from which determine the average value of the wave length λ_{av} .

Results

θ^o	$d \sin(\theta)$	$I_1\ (\mu A)$	$I_2\ (\mu A)$	$I_3\ (\mu A)$	$I_{av}\ (\mu A)$
0					
-2					
-4					
-6					
-8					
-10					
-12					
-14					
-16					
-18					
-20					
-22					
-24					
-26					
-28					
-30					

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