WRIGHT STATE UNIVERSITY

Department of Physics

Research Experience for Undergraduates

REU Students

Michelson Interferometer and Fourier Transform Spectroscopy

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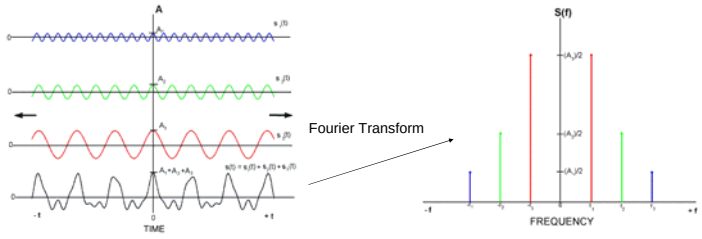
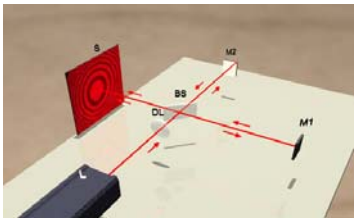
What is Fourier Transform Spectroscopy?

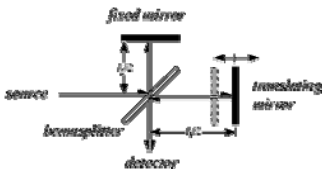
- ✓ Several frequencies can be sounded off at once to create a beat frequency. A graph usually displays amplitude vs. time, making it difficult to identify the different frequencies. A Fourier Transform takes this graph and instead displays it as amplitude vs. frequency. This allows us to clearly see what frequencies are being sounded off together.



Objectives

- ✓ Using a 633 nm wavelength helium-neon laser, calibrate the system and test the software.
- ✓ Create a program that will contain the Fourier Transform.
- ✓ Determine the rate at which the translating mirror moves.
- ✓ Search for the zero path difference, and locate interference patterns of broad banded light sources.

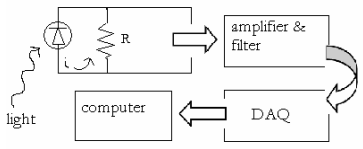




Michelson Interferometer

Lab Setup

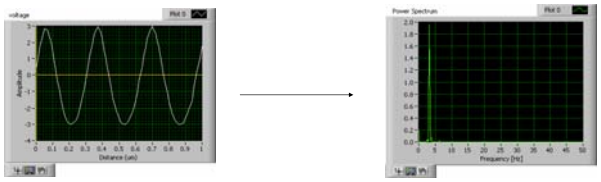
- ✓ Michelson Interferometer with translating mirror
- ✓ Interference pattern is created
- ✓ Vernier Labpro DAQ is used to read the voltage at a rate of 100 samples per second.
- ✓ A Labview program was created to control the Labpro readings and the Fourier Transform
- ✓ Photo diode is used as the detector.
- ✓ Filtered amplifier (×200) with high and low pass frequencies of 0.3 Hz and 10 Hz, respectively.



- ✓ According to the helium-neon sine wave, the path difference (Δ) is equal to 3λ in 1 second.
- ✓ Since the path difference is twice the length between the mirror and the beam splitter (x), then:

$$x = \frac{3}{2}\lambda = \frac{3}{2}(633nm) = 0.950\mu m$$

- ✓ Using the equation v = (x/t), the velocity of the translating mirror is ~1μm per second.
- ✓ Sine wave is produced, then FFT is applied



- ✓ Fourier Transform power spectrum displays peak at around 3.1 Hertz for the helium-neon laser.