Fourier Research

Acknowledgements: Developed by Ui Luu, Faculty of Glendale Community College, Glendale, Arizona

Time Required: 3 hours

Equipment & Tools

- Internet connection
- Technical magazines
- Technical textbooks

Team or Individual: This is an individual activity.

Learning Objectives

1. Locate, gather, and organize information about an application of the Fourier theory.
2. Describe how the Fourier theory contributed to the development of the application you researched.
3. Prepare a written or oral report describing the application.

Introduction

The Fourier theory was discovered in 1826 by Jean Baptiste Fourier, a French physicist and mathematician. It is an infinite mathematical series that Fourier used in his analysis and design of heat and thermodynamic systems. It was later discovered that it could be used in almost any engineering analysis including mechanical and electrical/electronic systems.

The Fourier theory shows the relationship between the time and frequency domains. It provides a way to represent complex non-sinusoidal signals as the sum of harmonically related sine and/or cosine waves.

The Fourier theory states:

> Any complex repetitive, non-sinusoidal waveform may be expressed mathematically as a fundamental sine wave at the signal frequency plus an infinite number of harmonic signals of varying amplitudes and phases.

> Any repetitive waveform can be broken down into a series of sine waves at appropriate amplitudes and phases.

The Fourier theory is used to analyze complex periodic signals. By using a process based upon integral calculus, waveforms are reduced to a mathematical expression that is nothing more than the mathematical summation of sine and/or cosine waves. The use the Fourier transform has many applications, in engineering, physics, applied mathematics, and chemistry.

This exercise involves visiting various web sites to collect detailed information on an application such as voice recognition, communication, sonar, radar, or scientific instrumentation.

Performance and Task Procedures

1. Use technical publications, books, or the Internet and a search engine such as Yahoo.com or Google.com to find at least one article on the use of the Fourier theory and calculations in applications such as communications, radar, sonar, scientific instrumentation, or voice identification.

2. Analyze and arrange your accumulated data.

3. Prepare an oral or written report that describes the application and how the Fourier theory makes it possible.

Deliverables: Students will prepare either a written report or oral presentation on one use of the Fourier theory. The length of the report or presentation is up to the instructor

Scoring or Grading Criteria

Instructors may use the following criteria to grade this exercise:

Written Report:

- Clarity of descriptions of search strategies, conclusions, and summary of findings
- Degree that the information is well organized
- Grammar and general quality of writing

Oral Report:

- Clarity of descriptions of search strategies, conclusions, and summary of findings
- Degree that the information is well organized
- Presentation of material in a logical, interesting matter to include graphics as needed