Fourier Methods:

A summary table of contents

Chapter 0: Fourier Methods

This section introduces the concept of the Fourier spectrum, the frequency-domain view of a signal.

Introductory Methods

Chapter 1: Learning to use the SR770

This section presents the first-time use of a powerful Fourier-analysis tool, the SR770.

Chapter 2: Learning to use the SR770's internal waveform source

This section teaches you some more capabilities of the SR770.

Chapter 3: Modulated Waveforms – Amplitude Modulation

This section will show you how to create an 'amplitude-modulated' wave, and how such a wave looks in the time domain and in the frequency domain.

Chapter 4: Modulated Waveforms – Heterodyning and Mixing

This is an optional section, which changes amplitude modulation (as in Ch. 3) to another, subtly different, modulation scheme. It introduces you to the general topic of heterodyning, using the electronic tool, the mixer.

Chapter 5: Modulated Waveforms – Frequency Modulation

You've seen the Fourier view of AM spectra in Chapter 3, and now you'll see how FM, frequency modulation, looks in the frequency domain.

Chapter 6: Noise Waveforms

Signals that are periodic in time have Fourier *line* spectra; now you'll see non-periodic *noise* signals whose Fourier spectra are *continua*.

Chapter 7: The LCR system, introducing transfer functions

Working on an inductor-capacitor-resistor (LCR) system, you will see time-domain and frequency-domain views of the *transfer function*, which is an attribute of a host of physical systems.

Chapter 8: Transfer functions of acoustic systems

This section uses the resonances of sound waves in air to show how Fourier methods can markedly increase the speed and completeness of a survey over frequencies.

Chapter 9: Fourier transforms of transient waveforms

In this section you'll see that Fourier methods can be extended from steadily continuing to *transient* waveforms. You'll also see that *phase* information can be extracted from spectra in these cases.

Additional Projects

Chapter 10: Modulated waveforms – modulation by a pulse
Modulation of a steady carrier wave by pulse-like signals gives Fourier spectra showing a new kind of sideband structure.

Chapter 11: Down-conversion and demodulation of AM radio
This section is an application of many concepts gathered from previous sections, with the goal of configuring your Electronic Modules into a working AM-band receiver.

Chapter 12: Deterministic chaos, in time- and frequency-domains
In this section you will apply Fourier methods to look at the signals emerging from a deterministic but *chaotic* system, the Lorenz attractor realized as an analog-electronic circuit.

Chapter 13: Harnessing harmonic distortion – the fluxgate magnetometer
A fluxgate magnetometer is a device which exploits deliberate harmonic distortion to measure weak magnetic fields in an all-electronic way; here you'll see exactly how one works.

Chapter 14: Frequency-domain views of audio waveforms
This section takes up methods for subjecting ordinary audio waveforms, from sounds and electronic sources, to Fourier analysis.

Chapter 15: Signal Recovery for signals-under-noise
This section addresses the question of detecting a sinusoidal signal when it is affected by, immersed in, or even buried under, broad-band noise.

Chapter 16: Coupled Oscillators
Here you can use the Fourier techniques you've previously learned to study an example of a very general phenomenon: coupled oscillators.

Chapter 17: Fourier methods for detecting nonlinearity
Ideal systems might have the mathematical property of linearity, but Fourier methods allow a very sensitive *test* of this assumption, via the phenomenon of 'intermodulation'.

Chapter 18: Demodulation of FM signals
The detection of an FM waveform requires different methods of demodulation than an AM waveform, and this section introduces you to one of them.

Appendices

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The process of data-capture and data-sampling in the SR770's full-span mode

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Why the canonical form of a sinusoidal waveform is written as it is

Appendix A3. The decibel (dB) and dBV scales
The relative, and absolute, decibel scales for voltages and powers

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