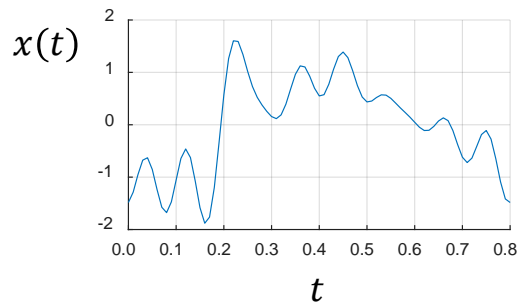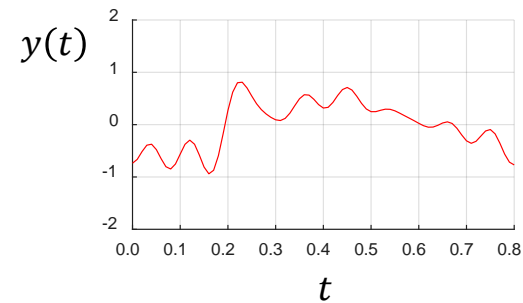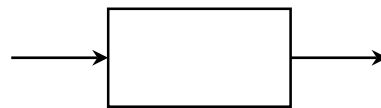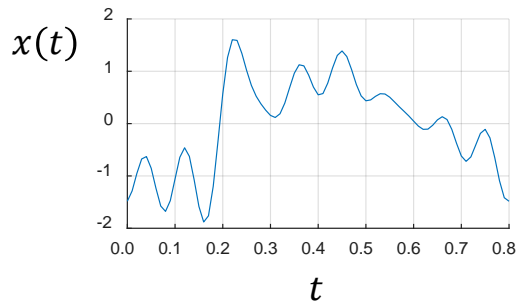# Signals and Systems

Introduction

Definitions

A **signal** is a description of how one parameter varies with respect to another independent parameter.

For example, the voltage changing over time in an electronic circuit:

$x(t)$

A **system** is any process that produces an *output signal* in response to an *input signal*.

$x(t)$

$y(t)$

The Domain and Range of a Signal

The **domain** of a signal is the set of all values of the independent parameter for which the signal is defined.

The **range** of a signal is the set of all possible values of the signal.
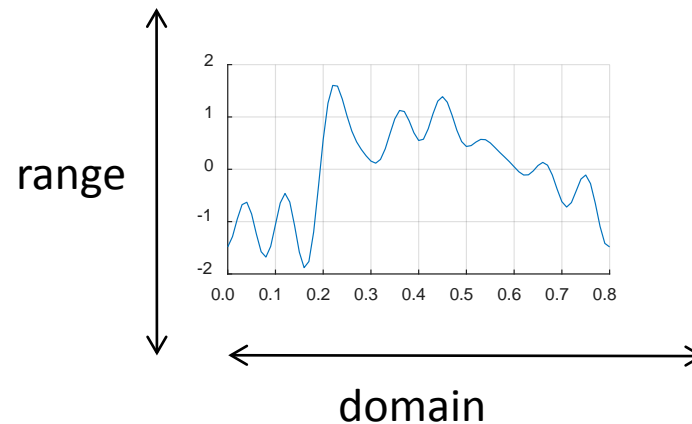
Continuous vs Discrete

The domain and range of a **continuous** signal are the sets of all real values.

The domain and range of a **discrete** signal are limited to sets containing only certain values.

For example, the voltage with respect to time across a resistor is a continuous signal but if this signal is *sampled* and *quantized* it becomes a discrete signal.

The domain of this signal is limited to multiples of the *sampling period* and the range is limited to multiples of the *quantizer step-size*.

continuous

$x(t)$

discrete

$x[n]$
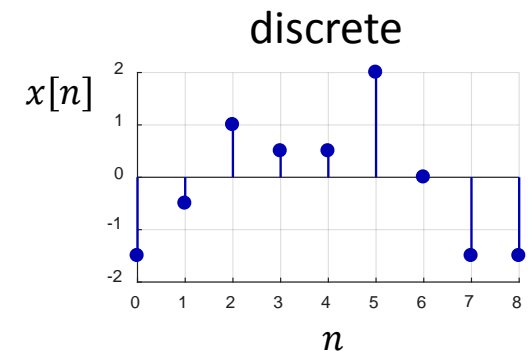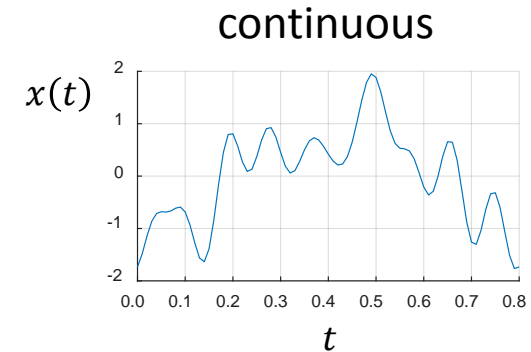
Signals and Systems in Electrical Engineering

The study of signals and systems is applicable to many areas in science and engineering.

Electrical engineers will make most use of this theory in areas such as:

– Telecommunications

– Audio processing

– Image processing

– Echo location

How can we use digital signal processing?

Performing operations on a discrete signal using the theory of signals and systems is normally referred to as **digital signal processing.**
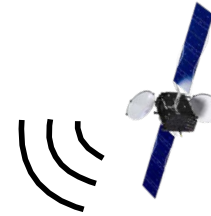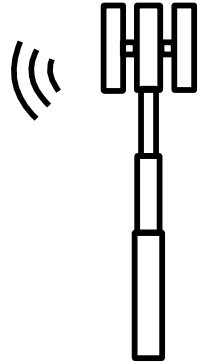
Digital signal processing is used to perform many vital functions such as:

– Removing noise from a signal

– Calculating the frequency content of a signal

– Changing the frequency of a signal

– Separating multiple signals from each other

– Detecting a weak signal in the presence of noise

Telecommunications
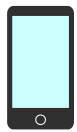
700, 850, 900, 2100
2300, 2600 MHz

1-30 GHz

2.4, 5.8 GHz
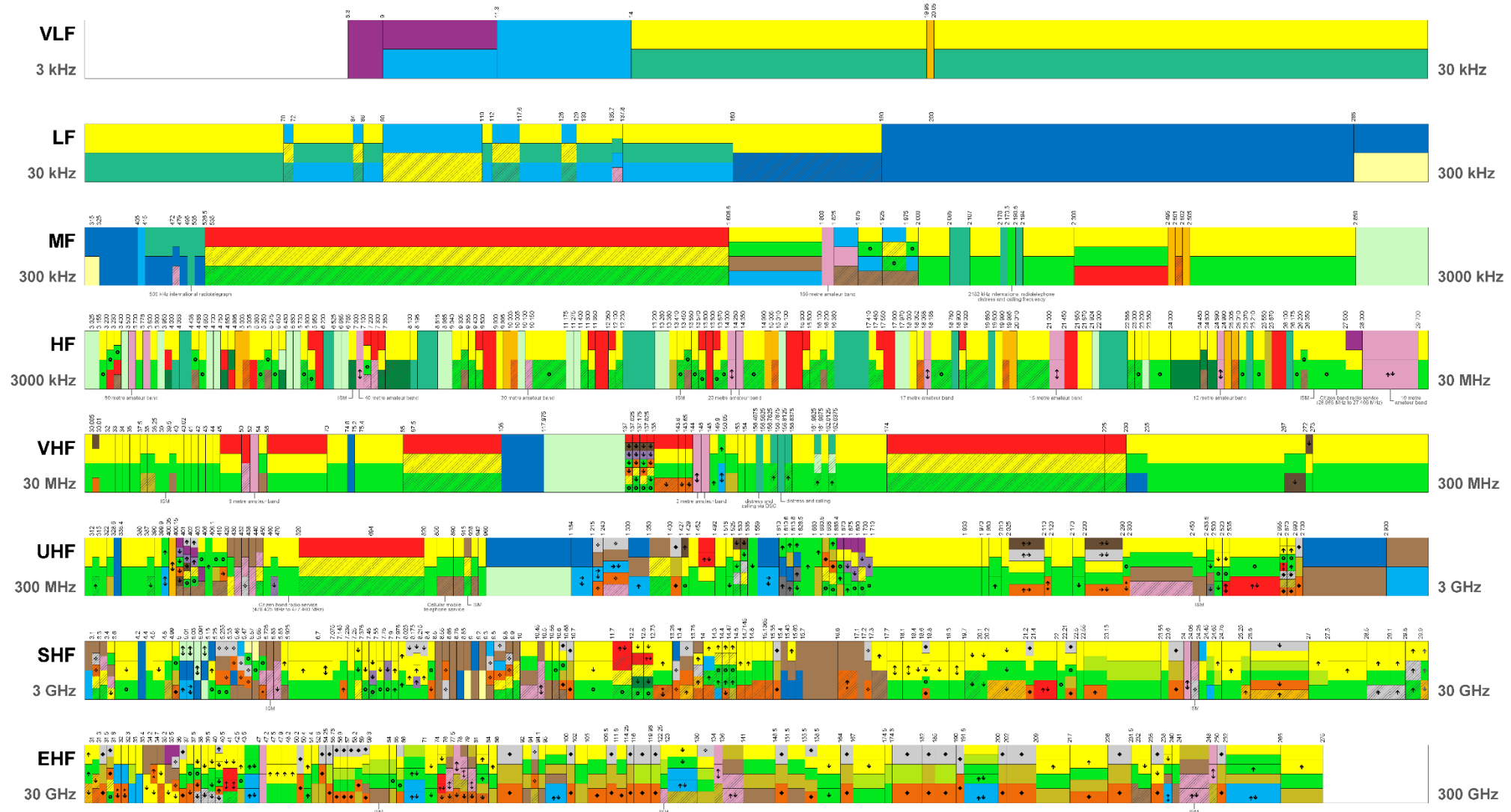
Australian radiofrequency spectrum
allocations chart

Australian Government

acma
Australian
Communications
and Media Authority

VLF 3 kHz — 30 kHz

LF 30 kHz — 300 kHz

MF 300 kHz — 3000 kHz

HF 3000 kHz — 30 MHz

VHF 30 MHz — 300 MHz

UHF 300 MHz — 3 GHz

SHF 3 GHz — 30 GHz

EHF 30 GHz — 300 GHz

Video and Audio Processing

Echo Location

24-26 GHz