Chapter 1

The name of the game

> Signum est quod et se ipsum sensui et praeter se aliquid animo ostendit.
>
> Saint Augustine of Hippo (354 — †430), *De dialectica*, V

System

System is the part of the Universe we want to study.

Mechatronic system

A **mechatronic system** is a system combining both mechanical and electronic components.

Signal

A **signal** is a function of time or space that conveys information about a system.

Example 1.1. A Wave Energy Converter (WEC) is a mechatronic system that extracts the energy of sea waves, usually to produce electricity. The power injected to the electric grid is a signal that depends on time. The elevation of the sea waves is a signal that depends on both time and space. Figure 1.1 illustrates these signals. □

In this course on Signals and Mechatronic Systems, we will study the following subjects:

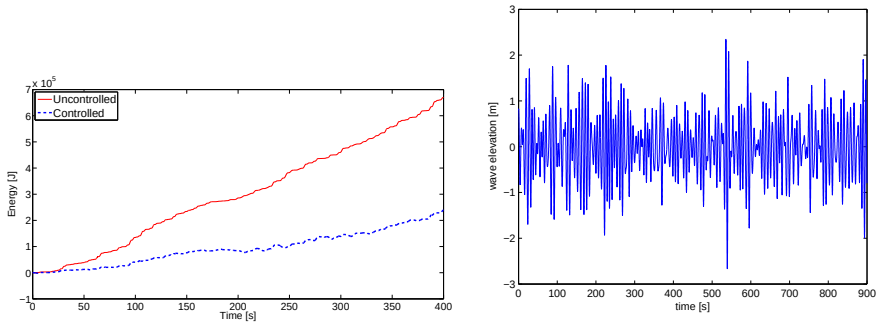

Figure 1.1: Left: electrical energy produced by a WEC as a function of time. Right: wave elevation as a function of time at a given point; at a different location, the wave elevation will be different.

Chapter 2 presents very handy mathematical tools for the resolution of differential equations, which we will need repeatedly in subsequent chapters.

Chapter 3 gives examples of mechatronic systems and signals, and the basic notions related thereto.

Chapter 4 addresses the modelling of mechanical systems.

Chapter 5 addresses the modelling of electrical systems.

Chapter 6 addresses the modelling of fluidic systems, a particular type of mechanical systems.

Chapter 7 addresses the modelling of thermal systems.

Chapter 8 addresses the modelling of systems combining several of the components studied in chapters 4 to 7, as well as of systems with nonlinear models.

Chapter 9 develops the very important notion of transfer function of a system, already alluded to in the chapters about modelling, in particular through the representation of interconnected systems as blocks, in so-called block diagrams.

Chapter 10 is dedicated to the study of time and frequency responses.

Chapter 11 introduces the basic concepts of measuring chains and control loops.

Chapter 12 presents the technology of the most common types of sensors, and the criteria to choose them.

Chapter 13 presents the technology of the most common types of actuators, and the criteria to choose them.

Chapter 14 concludes these lecture notes with an introduction to related subjects that will be addressed in other courses.

MATLAB
SIMULINK

Along the course we will often use a software called MATLAB, as well as MATLAB's graphical environment for working with block diagrams SIMULINK. MATLAB is not a free software. On the other hand, some of the functionalities of MATLAB can be supplied by free software such as Octave (which you can install from `https://www.gnu.org/software/octave` or run online from `https://octave-online.net/`). Notice that several functionalities of MATLAB we will need are missing from Octave, which also lacks anything parallel to SIMULINK.

Octave as a succedaneum of MATLAB

In what follows it is presumed that you are acquainted with the most basic features of MATLAB (or Octave), which you can learn with the "Getting started with MATLAB" tutorials in the program's "Documentation Center".