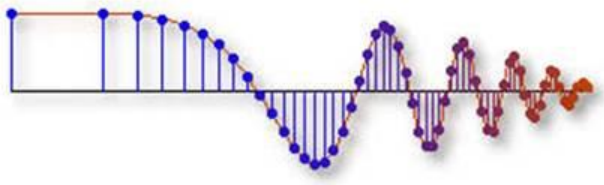
Nonlinear Signal Processing Methods



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Course and Exam Timetable

Exam Date	Location	Day
		Saturday , Monday

Communication

Email: ghaderyan.sahand@gmail.com

Email subject: nonlinear signal processing methods- full name

Course Detail

Course Title	Number of Credits	Academic Year
Nonlinear Signal Processing Methods	3	1399/1400

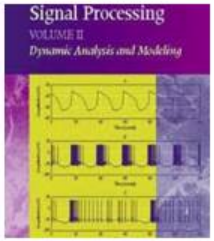
Contents

- Introduction
- Nonlinear dynamics time series analysis
- Entropy and and its application to biosignal analysis
- neural network and its application to biosignal analysis
- Fuzzy system and and its application to biosignal analysis

Grading policy

- Final examination: 13
- Project — Oral presentation : 2-3
- Class activities(home work, quiz, …) : 0-4
- Extra grade point :0-2

References



- 1)M. Akay, Nonlincer Biomedical Signal Processing: Dynamic Analysis and Modelling, Wiley- lEEE press,2000
- G. R. Arce,Nonlinear Signal Processing: A Statistical Approach, John Wiley & Sons, 2005

Introduction

❑ Biomedical signals

- ✓ **Biomedical signals** are observations of physiological activities of organisms
- ✓ The function of the human body is frequently associated with signals of electrical, chemical, or acoustic origin.

- ✓ Electrical signals ⟶ ???
- ✓ Chemical signals ⟶ ???
- ✓ Acoustic signals ⟶ ???

Introduction

- Biomedical signals
- ✓ **Biomedical signals** are observations of physiological activities of organisms
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Such signals convey information which
may not be immediately perceived but which is hidden in the signal's structure. This information has to be "decoded" or extracted in some way before the signals can be given meaningful interpretations. The signals reflect properties of their associated underlying biological systems, and their decoding has been found very helpful in explaining and identifying various pathological conditions.

Introduction

❖ Signal processing

Signal processing is a discipline embodying a large set of methods for the representation, analysis, transmission, and restoration of information-bearing signals from various sources.

signal processing revolves around the mathematical manipulation of signals.

Perhaps the most fundamental form of signal manipulation is that of filtering, which describes a rule **or** procedure for processing a signal with the goal of separating or attenuating a desired component of an observed signal from either noise, interference, or simply from other components of the same signal.

Introduction

❖ Signal processing task

the signal processing task calls for separating a desired component of the observed waveform from any noise, interference, or undesired component. This segregation is often done in frequency, but that is only one possibility.

Introduction

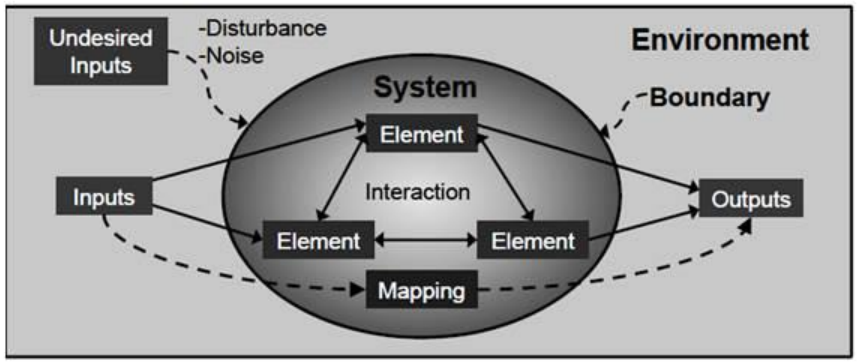
Why Nonlinear Signal Processing?

Introduction

- Nonlinear signal processing offers advantages in applications in which the underlying random processes are nonGaussian. Practice has shown that nonGaussian processes do emerge in a broad array of applications.(exercise #1)
- The common element in these applications, and many others, is that the underlying processes of interest tend to produce more large-magnitude (outlier or impulsive) observations than those that would be predicted by a Gaussian model. That is, the underlying signal density functions have tails that decay at rates lower than the tails of a Gaussian distribution.

- As a result, linear methods which obey the superposition principle suffer from serious degradation upon the arrival of samples corrupted with high-amplitude noise. Nonlinear methods, on the other hand, exploit the statistical characteristics of the noise to overcome many of the limitations of the traditional practices in signal processing.

System


Undesired Inputs
-Disturbance
-Noise
Environment
System
-Boundary
Element
Inputs
Interaction
Outputs
Element
Element
Mapping