SIGNALS AND SYSTEMS

OUTLINE

- My Background
- Course Information
- Applications
- Definition & Examples
  - Signals & Systems

MY BACKGROUND

- Assistant Professor @ IIITS: Signal processing and Pattern Recognition
- Associate Professor @ VRSEC: Signal processing and Pattern Recognition
- Post PhD Research @ UMES: Application of Bayesian learning & advanced signal processing for cognitive radar
- Post PhD Research @ MSU: Buried Target Detection and Identification, Building extraction
- PhD @ Mississippi State University : Spatio temporal data analysis.
- Masters @ Chalmers University, Sweden: RAMAS program
- B.Tech from (KLCE) Nagarjuna University. (ECE)

MY BACKGROUND

- My interests include: Statistical signal processing, machine learning, digital image processing, and signals analysis for robotics
- SS is common to all these areas
- Contact info: anish.turlapaty@iiits.in
- More info on my work: https://sites.google.com/site/turlapatyanish/
- Youtube channel: https://www.youtube.com/user/anishchandT

CONTENTS

- **A. Theory**:
  - Module 1: Digital Signals and Systems- Signals and Systems – Introduction, Course Overview- Signal Representation and Types- Signal Conversion, Signal Classification and Representation- Natural and Synthetic signals, Types, Representation, Impulse, Unit sample, Unit step and Ramp signals- Digital Signal – Scaling and Shifting.
  - Module 2: System Classification and Response- Properties of Signal and System- LTI System, Principle of Superposition- System Classification and System Response, Linear Convolution.

CONTENTS CONTD.

- Module 3: Digital Signal Analysis and Transformation- Fourier Series and Fourier Transform- FT Properties, Coefficients and Representations- Analysis and Synthesis, Sine-Cosine Representation, Sampling, Intro to Sampling Theorem, reconstruction and Quantization.
- Module 4: DFT, DTFT, FT Properties, Correlation, Parseval's Theorem, Z-Transform- System Function, Transfer Function.
- **B. Practice Topics**
  - 1. Algorithms derived from the above theoretical content

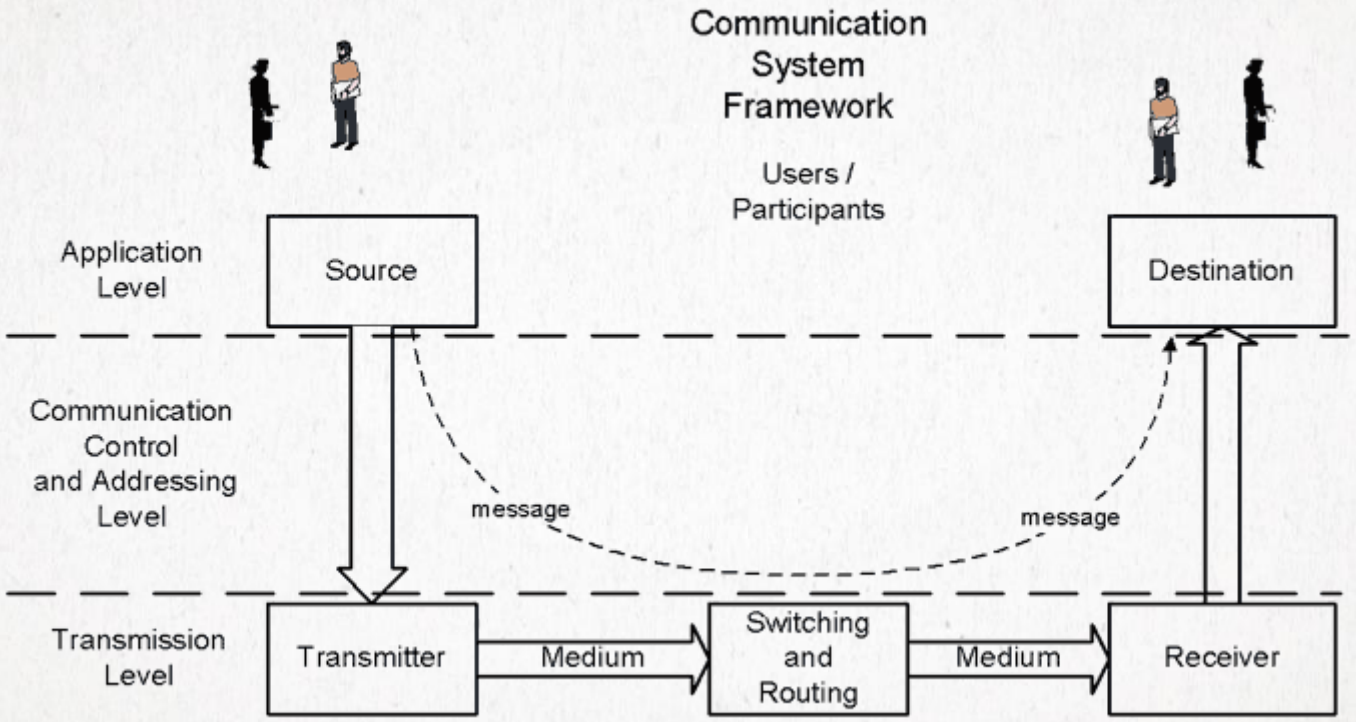
BOOKS

- ***Texts**:*
  - Signals & Systems by Oppenheim, Wilsky and Nawab
  - Digital Signal Processing, Proakis
- *References:*
- Signals and Systems using Matlab (L Chaparro)
- DSP using matlab (V. Ingle and J. Proakis)
- Essential Matlab for Engineers and Scientists (B. Hahn, D. Valentine)

APPLICATIONS

WHY S&S?

COMM. SYSTEM

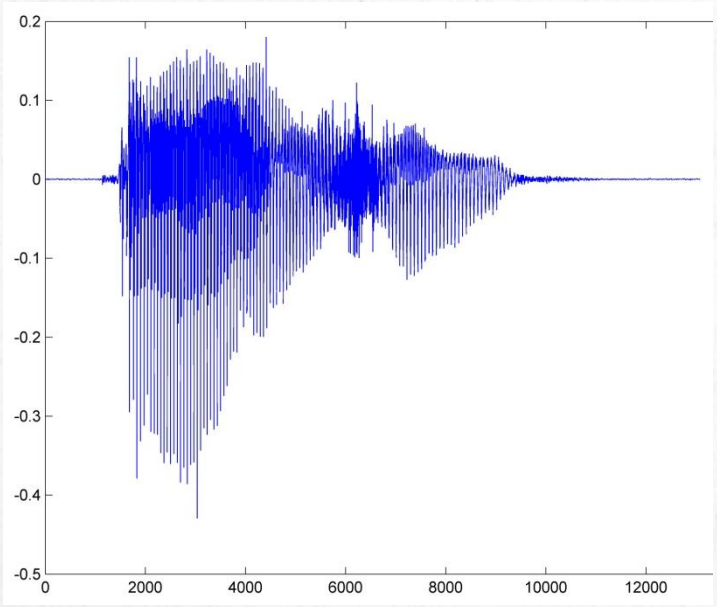

Communication
System
Framework
Users /
Participants
Application
Level
Source
Destination
Communication
Control
and Addressing
Level
message
message
Transmission
Level
Transmitter
Medium
Switching
and
Routing
Medium
Receiver

RADAR

ASTRONOMY

SPEECH SIGNAL

- Independent variable : Time
- Function of variable: Wave file – a function of time
- Information: Vibrations in the air (medium)



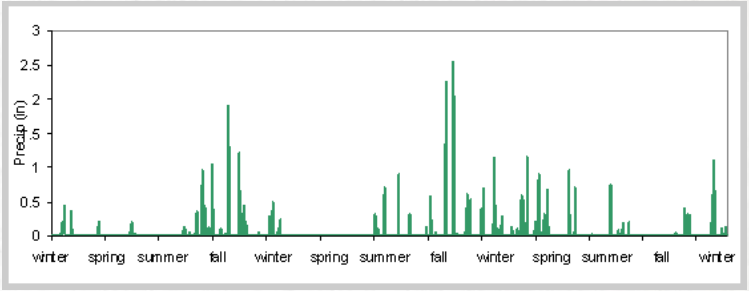
plot of a vowel sound

http://stat.bell-labs.com/dxsun/speech/index.html

GEOPHYSICAL SIGNAL

Image of Precipitation

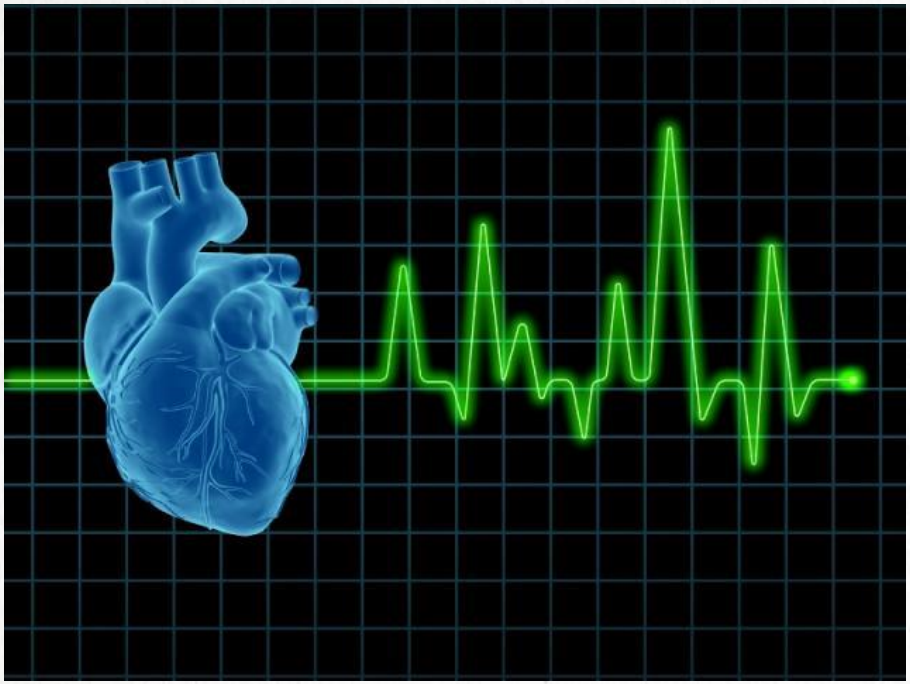
Precipitation Signal



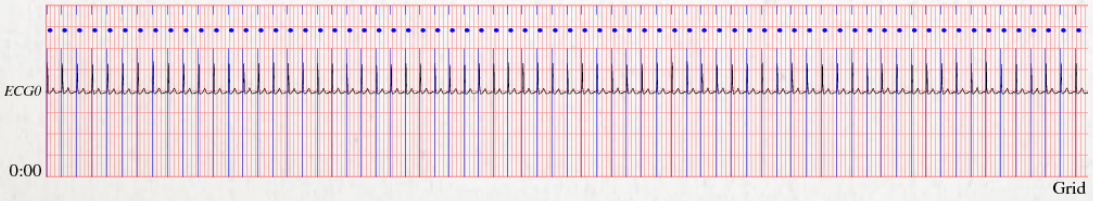
http://www.nws.noaa.gov/om/csd/pds/PCU2/statistics/Stats/part1/CTS_TimeVar.htm

BIOSIGNAL

- Electrocardiogram



Heartbeats:
ECG signals that represent an electric signal that travels through the heart



A real ECG signal from PHYSIOBANK

2 D SIGNAL

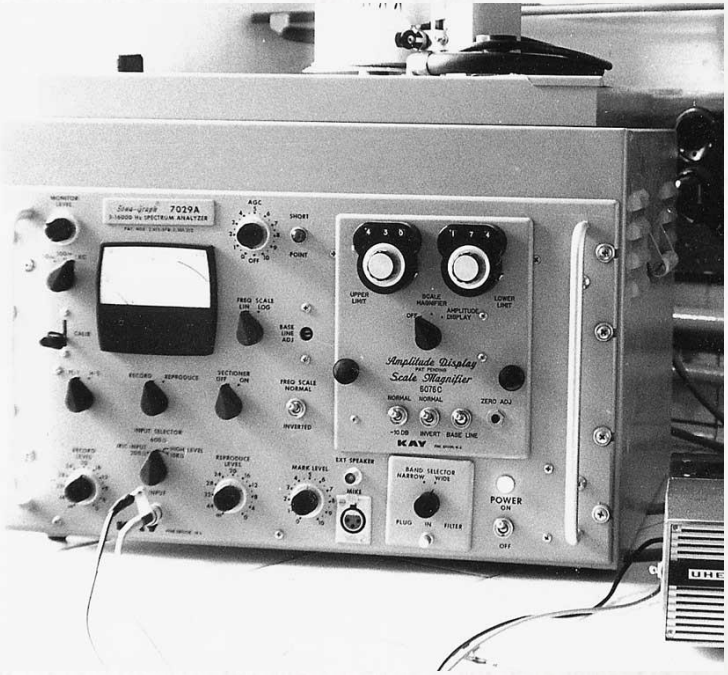
SIGNAL PROCESSING

- Analog signals
- Most of signals in the world are analog
- E.g signals such as speech is a function of time, EM energy function of space and time.
- Processing: Analog devices can process these signals.
- E.g. filters, frequency analyzers and multiplexers.

ANALOG FILTER

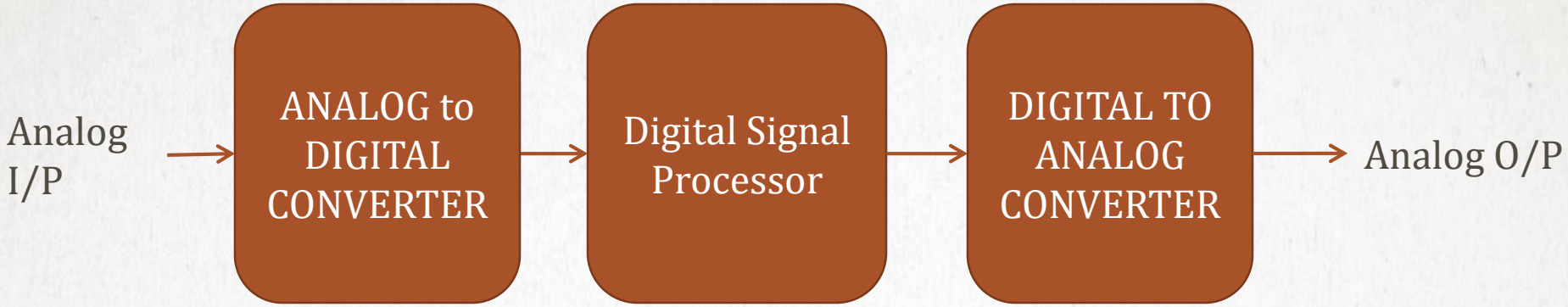
SPECTRUM ANALYZER

ITC INSTRUMENTS SA 1300B



Sonagraph 7029A

DIGITAL SIGNAL PROCESSING



- Large programmable digital computer
- Small programmable microprocessor, flexibility through change of software
- Hardwired digital processor: good for well defined operations and optimized for particular operations and faster.

MAJOR ADVANTAGES

RECONFIGURABILITY

- Reprogramming is easier mainly in software (through algorithms)
- Reprogramming requires system redesign

EASE OF STORAGE AND TRANSFER

- Digital data can be stored in tapes or disks and be easily copied.

ACCURACY CONSIDERATIONS

- Tolerance issues in analog systems.
- Digital systems have word lengths, fixed point vs. floating point arithmetic

LOWER COST

- Digital processors are cheaper either due to advances in hardware or easy programmability