MAE143A Signals & Systems

The course is about (continuous-time and discrete-time) signals, and how they get transformed when passing through (continuous-time and discrete-time) systems

Fundamentals of Signals and Systems (First Edition) 2008
by M.J. Roberts

What do I expect you to know?

Prerequisites and assumed knowledge

- Math 20E Vector Calculus
  - Calculus, limits, continuity, differentiation, integration
- Math 20F Linear Algebra
  - Vectors, matrices, eigenvalues, null spaces
- Math 21D Differential Equations
  - Ordinary differential equations, Laplace transforms
- Complex analysis, Mae 105
  - Basics on Fourier transform

Introduction

"Signal & Systems" view of the world

Signal - represented by functions. They carry information

human voice, Morse code, electricity consumed, gas prices

System – Device that transforms signals

human ear, telegraph, electric grid, economic system

(Two-port representation of a system)

Examples

System	Input signal	Output signal
Car	motor force	displacement
Thermostat	temperature	air cond. Regulation
Optics of eye	visual stimulus	retinal image
Cochlea	sound	cochlea microphonic
Telephone	human voice	audio signal
Digital camera	blurred image	focused image

Systems are natural “filters” on signals

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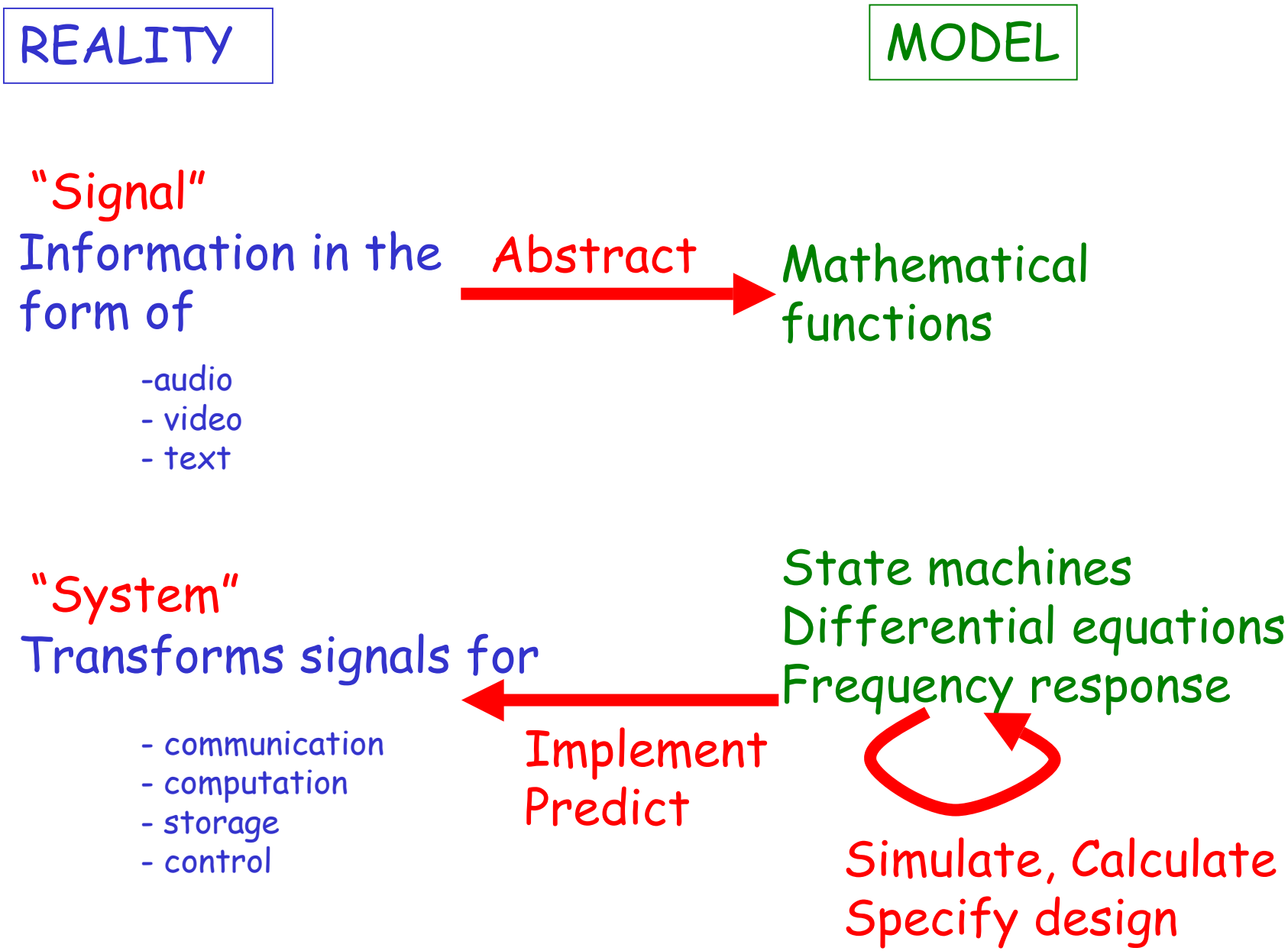
Systems are natural “filters” on signals

Is it possible to determine a system response to any signal?

How to determine a system response to signals?



Why should you be excited about MAE143a&b?

The technology we will learn in MAE143a is everywhere today

The *front and back ends* of your digital cell phone are comprised of analog circuits - This is pretty much true of all *digital* technology

Why does the stagecoach wheel appear to rotate backwards?

Aliasing

A high frequency masquerading as a low frequency

Anti-aliasing filters MUST be used in all sampled data systems

After MAE143a you will be able to start designing such anti-aliasing filters

Why should you be excited about MAE143a?

Anti-aliasing is just one of the things systems can do to signals

Also, amplify them, delay them, distort them, introduce noise…

Introduction

Main Course Objective:

Fundamentals of systems/signals interaction

(we'd like to understand how systems transform or affect signals)

Specific Course Topics:

-Basic test signals and their properties

-System examples and their properties

-Signals and systems interaction (Time Domain: convolution, Frequency Domain: Frequency response)

-Signals & systems applications that make use of these interactions: audio effects, filtering, AM/FM radio

-Signal sampling and signal reconstruction