Signal Processing and Communication

An Overview for Prospective Students

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Overview

• What is “Signal Processing and Communication”? How does it differ from other areas of ECE?
• What career options are there?
• What is the curriculum like at OSU?
Areas within ECE:

1. Physics
   - Solid State Electronics
   - Electromagnetics & Optics

2. Circuits
   - Circuits & Electronics
   - Power Systems
   - Computer Systems & Networks

3. Systems
   - Signal Processing & Communication
   - Control Systems

Solid State Devices

- Building blocks for circuits
- Semiconductor lasers
  - fiber optics, CD read/write
- Micro-machines
- IC fabrication

100 micrometers
Electromagnetics & Optics

- Antennas
  - mobile, satellite
- Radar
  - weather, navigation, defense
- Emission regulation
  - compatibility, safety
- Lasers, fiber optics

Circuits and Electronics

- “Chips”
- Building blocks for electronic systems
- Analog, digital, and microwave circuits
- Mixed-signal ICs
Power Systems

- Energy conversion
  - hydro, wind, solar, heat
- Energy distribution
- Energy storage
  - smart batteries

Computer Systems & Networks

- Computer architecture
  - Parallel computers
  - Super-computers
- Processor design
  - Pentium, G5
- Computer networks
  - INTERNET, WWW
Control Systems

- Manufacturing and Process Control
- Spacecraft/Missiles
- Aviation
- Automotive
- Disk Drives
- Robotics

Signal Processing

- Digital audio
  - CD, MP3, AAC, Surround sound
- Digital video
  - DVD, HDTV
- Biomedical
  - MRI, ECG, EEG
- Speech recognition/synth
- Noise Control
- Radar processing
- Sensor Networks
Example: MP3 Audio

• Amazing feat: throw out $>90\%$ of the “bits” and still get CD-quality audio!
• How does it work?

Communication Systems

• Wireless
  – Mobile phones, WiFi
• Wireline
  – dialup, DSL, cable
• Satellite Communication
  – GPS, space exploration
• Digital Television
• Bluetooth
• Sensor Networks
Example: Wireless Digital Comm

- The wireless mobile channel includes complicated time-varying distortion plus noise.
- The system gets more interesting with multiple users and multiple antennas per user.

SP/Comm versus Other Areas:

- **System-level approach**: design block diagrams and algorithms versus circuits and devices.
- **Top of the food chain**: our engineers specify design requirements to digital & analog circuit designers and software engineers.
- Requires/builds an intuitive relationship with math and probability.
- (Control Systems has a similar flavor.)
Careers in SP/Comm

• Focus Areas
  – Algorithm design
  – System engineering
  – DSP software/hardware

• Positions
  – Product development
  – Research & Design
  – Consulting
  – Management
  – Academics

• Example Applications
  – Communication systems
  – Speech, Audio
  – Video
  – Biomedical
  – Radar, Sonar
  – Sensor networks
  – Geophysical

OSU Courses in SP/Comm
My personal story…

- Early fascination with audio (Dolby, MP3).
- Discovered Signal Processing as an undergrad (Univ of Illinois, Urbana-Champaign).
- Stayed for M.S. in SP and Control Systems, jaded by “too much theory/math”.
- Worked at Tektronix in OR as a systems engineer & algorithm designer for digital TV/comm test equipment. Learned to appreciate theory/math!
- Ph.D. at Cornell with SP/Comm focus.
- Stayed in academics for reasons of freedom, intellectual stimulation, and the opportunity to teach/mentor.

Thanks for your time!

- SP/Comm is important.
  - It has revolutionized the world we live in, and will continue to do so for the foreseeable future.
- SP/Comm is a hot area.
  - Lots of good jobs out there.
- SP/Comm is fun.
  - Challenging, exciting work.