Communications and Signal Processing

Prof. Daniel Bliss
What is Signal Processing?

- Active Noise Cancellation
- Video Compression
- Audio Coding
- MP3
- iPod
- iPhone DSP apps
- Biometric ID Verification
- Array Signal Processing

Communications and Signal Processing
Biomedical Signal Processing?

DSP for Speech And Hearing

Hyper-spectral Imaging

DNA Sequence Analysis using DSP Methods

DSP for Health Monitoring

Communications and Signal Processing
What is Communication?

Data Networking

Cellular Telephony

Satellite Communications

Communications and Signal Processing
Military Applications ...

Automatic Target Recognition

Sensor Networks

Target Imaging

Communications and Signal Processing
Smart Grid Network Applications…
... to Applications in the Arts

Ambiguous Icons

Interactive Performance

Body Sensing Technologies

AME Concentration

Communications and Signal Processing
COURSES
Junior Level “Lead-in” Courses

• EEE 203 – Signals and Systems I
  – Introduction to linear systems and Fourier transform analysis

• EEE 304 – Signals and Systems II
  – Theory and Applications of linear systems in Communications, Controls, and Signal Processing

• EEE 350 – Random Signal Theory
  – Introduction to probability and stochastic processes

• EEE 203 and 350 are representative of the things you need to know
• They are prerequisites to some senior level courses
COURSES
Senior Electives

• **EEE 407 – Digital Signal Processing**
  – *Fundamentals* of digital signal processing-time and frequency domain analysis, FFT, filter design

• **EEE 455 – Communications Systems**
  – *Fundamentals* of communication systems-digital and analog modulation, receiver design, noise

• **EEE 459 – Communications Networks**
  – Communications network architectures, transmission protocols, seven-layer OSI stack

• **EEE 404 – Real Time DSP**
  – *Usually students will take after EEE 304 or 407*
  – Course covers programming of DSP algorithms
### Sample MSE Plan of Study

**Signal Processing**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Semester Hours</th>
<th>Semester/Year</th>
<th>Grade</th>
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<tbody>
<tr>
<td>1 EEE 591</td>
<td>DIGITAL SIGNAL PROCESSING</td>
<td>3</td>
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<td>3</td>
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<td>5 EEE 552</td>
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<td>3</td>
<td>SPRING</td>
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<td>6 EEE 508</td>
<td>IMAGE/VIDEO CODING</td>
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<td>7 EEE 507</td>
<td>MULTI-D SIGNAL PROC</td>
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<td>TIME FREQUENCY SP</td>
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<td>9 EEE 606</td>
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<td>10 EEE 607</td>
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### Sample MSE Plan of Study
Communications/Networks

#### Proposed Graduate Program

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<td>1</td>
<td>EEE 591 Communication Networks</td>
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<td>2</td>
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<tr>
<td>3</td>
<td>EEE 554 Random Signal Theory</td>
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<td>4</td>
<td>EEE 551 Information Theory</td>
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<td>EEE 552 Digital Communications</td>
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<td>6</td>
<td>EEE 553 Coding and Cryptography</td>
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<td>7</td>
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<td>EEE 598 Wireless Networks</td>
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Direct Ph.D. POS

Direct Includes

- 30 hours of MS level courses
- +18 hours for PhD level courses
- +Research Credits
- +Dissertation Credits
What do signal processing and communications engineers do?

- **Signal Enhancement**: noise reduction, music and image restoration, high resolution imaging
- **Signal Compression**: speech, image, video, biomedical data
- **Pattern Recognition**: speech recognition, biometric identification, target recognition, machine learning
- **Cellular Systems**: system design, performance analysis, equipment design and manufacturing
- **Satellite and Terrestrial Microwave Systems**: modem design and implementation, system design, performance analysis
- **Networking**: network design and implementation, Network security, equipment design and manufacturing.
- **Algorithm Design**: software and hardware implementations, data mining
- **Hardware Design**: architectures, DSP chips, application specific IC’s
## Career Opportunities

### Some Potential Employers

<table>
<thead>
<tr>
<th>Motorola</th>
<th>AT&amp;T</th>
<th>Qualcomm</th>
<th>Intel</th>
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<tr>
<td>Medtronics</td>
<td>Raytheon</td>
<td>Cisco</td>
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<td>Freescale</td>
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<td>EF Data</td>
<td>LG Electronics</td>
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<tr>
<td>Government</td>
<td>Universities</td>
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Graduate School

- Communication and signal processing fields are advancing rapidly

- Companies are looking increasingly towards MS and PhD holders to lead their development teams
  - BS just doesn’t provide enough expertise
Demand has increased considerably for Ph.D.

- Careers in academia
- Careers in Industry Research Labs
- Careers in Government Labs  
  (graduates in big demand)
- Entrepreneurs
Graduate Classes

- Digital Communications
- Wireless Networks / Wireless Communications
- Broadband Networks
- Network Security
- Motion Capture
- Spectral Estimation and Array Processing
- Coding and Cryptography / Information Theory
- Multidimensional Signal Processing
- Image and Video Processing
- Speech and Audio Processing
- Time-Frequency Analysis
- Filtering of Stochastic Processes
- Detection and Estimation
- Adaptive Filters for Equalization and Echo Cancellation
- Multimedia Signal Processing
- Signal Processing for the Arts
- Array Processing
- Big Data
Faculty

Anna Scaglione, Signal Processing for Communications Networks
Chaitali Chakrabarti, Low Power Architectures
Lalitha Sankar, Networks, Optical Networks
Dan Bliss, Communications, Radar, Biomedical, Sensor Arrays
Andreas Spanias, DSP, Speech/Audio Processing, Sensor Arrays
Douglas Cochran, Signal Analysis, Sensor Networks
Lina Karam, Image/Video Processing and Coding
Oliver Kosut, Information Theory, Sensor Networks
Lei Ying, Wireless Networks, Big Data
Yanchao Zhang, Network Security
Visar Berisha, Speech Processing, Machine Learning
Tolga Duman, Wireless Communications, Turbo Codes
Pavan Turaga, Motion Estimation
Martin Reisslein, Networks for streaming data and media
Antonia Papandreou-Suppappola, Sensors, Time-Frequency Representations
Cihan Tepedelenlioglu, Signal Processing for Communications, Multicarrier
Junshan Zhang, Information Theory, Ad-Hoc Networks
David Frakes, Bioengineering, Imaging
Programmatic Collaborations

• Co-advisement for M-disciplinary dissertations
• Sensor Signal and Information Processing (NSF Industry-University Center)
• Arts Media and Engineering (Concentration)
• Certificate in Sensors and Signal Processing
• Global Security Initiative (GSI)
• Biodesign Institute
• School of Sustainability
Communications and Signal Processing

Questions?