Telecommunications/DSP Track

Prof. Kapil R. Dandekar
Prof. Stan Kesler
Track Advisors

Department of Electrical and Computer Engineering
Drexel University
August 11th, 2004
Presentation Outline

- Importance of interdisciplinary knowledge
- Why Telecommunications?
- Telecommunications Industry
- Telecomm Research at Drexel
- Track Overview
- Course Descriptions
- Useful Links
- Questions
Importance of Interdisciplinary Knowledge

Unrealistic to expect when you seek and find a job that your profession can be neatly “pigeon-holed” into one of tracks.

Benefit of Drexel’s curriculum is that you not only have track-specific courses which allow you to focus on a particular area, but you also have technical electives that allow you to expand your horizons in other areas.
Why Telecomm/DSP?

- Develop next-generation communications technology
- Convey information from one place to another given limited resources
- Modulation – Conversion of information signal to a form that can be sent over physical medium
- Applications
  - Broadband Access
  - Cellular Communications
  - Wireless/Optical Networks
  - Satellite Communications
  - Image/Speech Processing
  - Biomedical Signal Processing
Why Telecom/DSP?

- Activities undertaken by workers in telecommunications field:
  - Designing and testing next generation cellular telephones
  - Providing home broadband access via cable, DSL, or optical fiber
  - Designing communications links to a constellation of satellites in orbit
Why Telecomm/DSP?

- Activities undertaken by workers in telecommunications field:
  - Wireless/optical local area networking and next-generation Internet
  - Developing radio frequency (RF) and baseband hardware for microwave data links
  - Image or speech signal processing for radar, biomedical, radio astronomy, etc.
Why Telecomm/DSP?

- Activities undertaken by workers in telecommunications field:
  - Measuring and simulating the propagation of signal energy to determine the coverage region of a cellular basestation
Telecomm Networks

- Activities undertaken by workers in telecommunications field:
  - “Ad-hoc networks” - Communications in which there is no centralized infrastructure or existing infrastructure has been damaged or destroyed
Telecommunications Industry Statistics


- While there has been a downturn in the Telecommunications area over the past two years, the industry is now in recovery
  - Industry expenditures in the U.S. in 2003 - $143 billion
  - In 2003, 14.3% increase in wireless services ($89 billion) surpassing long-distance services ($78 billion) for the first time
  - Spending in “specialized services” (e.g. high speed internet access, video/web conferencing, etc.) reached $18 billion in 2003, up 34.2% from 2002
  - U.S. telecommunications market will grow at projected 9.2% annual rate in 2004-07, and is projected to reach $1 trillion in 2007

- Just as telecomm industry problems began with unrealistically high expectations, the current situation is often viewed with unnecessary pessimism

  “People can come up with statistics to prove anything… 14% of all people know that…” – H. Simpson
Telecommunications Industry

- Telecomm Companies
  - Motorola, Inc.
  - Westell Technologies
  - Lucent Technologies
  - Nokia Communications
  - Spirent Communications
  - Ericsson Communications
  - Bechtel Communications
  - Radisys Corporation
  - Texas Instruments
  - Lightwave Corporation
  - Cisco Systems,
  - Comcast Communications
  - Verizon Communications
  - Hewlett-Packard
  - Hughes Network Systems
  - InterDigital Communications Corporation
  - Navini Networks
  - Nortel Networks
  - Sprint
  - Lockheed Martin
  - … and others
Telecomm and Networking at Drexel: Core Group Members

- Kapil Dandekar
- Afshin Daryoush
- Jaudelice Cavalcante de Oliveira
- Bruce Eisenstein
- Stanislav Kesler
- Mohana Shankar
- Steven Weber
- Ruifeng Zhang
Affiliated Group Members

- Nihat Bilgutay
- Allon Guez
- Peter Herczfeld
- Timothy Kurzweg
- Ryszard Lec
- Bahram Nabet
- Prawat Nagvajara
- Athina Petropulu
- Harish Sethu
<table>
<thead>
<tr>
<th>Track Overview</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Telecommunications/DSP Track by Term</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>TSEC 110, 112, 114</td>
<td>TSEC 111, 112, 115</td>
<td>TSEC 120, 121, 152</td>
<td>TSEC 150, 151, 152</td>
<td>TSEC 120, 121, 152</td>
<td>TSEC 200, 201, 202</td>
<td>TSEC 200, 201, 202</td>
</tr>
<tr>
<td>2</td>
<td>Mathematical Foundations of Engineering</td>
<td>Probability and Estimation</td>
<td>Chemical and Biological Foundations of Engineering</td>
<td>Engineering Design and Laboratory</td>
<td>Engineering Design and Laboratory</td>
<td>Engineering Design and Laboratory</td>
<td>Engineering Design and Laboratory</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>TSEC 221 Systems I</td>
<td>TSEC 221 Energy</td>
<td>TSEC 211 Materials</td>
<td>ECE 200 Logic</td>
<td>ECE 201 Digital</td>
<td>ECE 200 Logic</td>
<td>ECE 201 Digital</td>
</tr>
<tr>
<td>5</td>
<td>TSEC 222 Systems II</td>
<td>TSEC 222 Energy</td>
<td>TSEC 240 Materials</td>
<td>ECE 201 Digital</td>
<td>ECE 200 Logic</td>
<td>ECE 201 Digital</td>
<td>ECE 200 Logic</td>
</tr>
<tr>
<td>6</td>
<td>NATH 290 Linear Modeling</td>
<td>ECE 301</td>
<td>ECE 302</td>
<td>ECE 304 ECE</td>
<td>ECE 304 ECE</td>
<td>ECE 304 ECE</td>
<td>ECE 304 ECE</td>
</tr>
<tr>
<td>7</td>
<td>NATH 270 Vector &amp; Complex Analysis</td>
<td>ECE 301 Digital</td>
<td>ECE 302 Digital</td>
<td>ECE 304 ECE</td>
<td>ECE 304 ECE</td>
<td>ECE 304 ECE</td>
<td>ECE 304 ECE</td>
</tr>
<tr>
<td>8</td>
<td>ECE 305 EM Fields &amp; Waves</td>
<td>ECE 306 Modules and Design</td>
<td>ECE 306 Modules and Design</td>
<td>ECE 306 Modules and Design</td>
<td>ECE 306 Modules and Design</td>
<td>ECE 306 Modules and Design</td>
<td>ECE 306 Modules and Design</td>
</tr>
<tr>
<td>9</td>
<td>10 Elective</td>
<td>10 Elective</td>
<td>10 Elective</td>
<td>10 Elective</td>
<td>10 Elective</td>
<td>10 Elective</td>
<td>10 Elective</td>
</tr>
<tr>
<td>10</td>
<td>ECE 461 Senior Energy</td>
<td>ECE 462 Senior Design I</td>
<td>ECE 462 Senior Design II</td>
<td>ECE 463 Senior Design III</td>
<td>ECE 463 Senior Design III</td>
<td>ECE 463 Senior Design III</td>
<td>ECE 463 Senior Design III</td>
</tr>
<tr>
<td>11</td>
<td>Communications</td>
<td>Communications</td>
<td>Communications</td>
<td>Communications</td>
<td>Communications</td>
<td>Communications</td>
<td>Communications</td>
</tr>
<tr>
<td>12</td>
<td>ECE 463 Senior Design III</td>
<td>ECE 463 Senior Design III</td>
<td>ECE 463 Senior Design III</td>
<td>ECE 463 Senior Design III</td>
<td>ECE 463 Senior Design III</td>
<td>ECE 463 Senior Design III</td>
<td>ECE 463 Senior Design III</td>
</tr>
</tbody>
</table>

13
Course Description Highlights (Term 6-7)

- S302 – Transform Methods
  - Characterization of signals and systems
  - Time / frequency domain
  - Fourier, Laplace, and Z-transforms

- S352 – Digital Signal Processing
  - Characterization of discrete-time signals
  - Analog-digital conversion
  - Time and frequency domain analysis of discrete-time systems
Course Description Highlights (Term 8-9)

- S490 – Errors, Uncertainty, Reliability
  - Concepts of probability and randomness
  - Probability distributions
  - Behavior of signals in noise

- S304 – EM Fields and Waves
  - Coulomb's Law, Gauss' Law, Ampere's Law
  - Maxwell's equations
  - Electromagnetic (EM) field propagation

- S306 – Modulation and Coding
  - Analog modulation (AM & FM)
  - Digital modulation (Binary & M-Ary)
  - Behavior of communications systems in noise

- S354 – Wireless Communications
  - Modern cellular communications
  - Multiple access techniques
  - Wireless circuits and components
Course Description Highlights (Term 10-12): Communications

- **S421 – Communications I**
  - Analog communications
  - Linear(Amplitude) modulation
  - Angle (Frequency) modulation

- **S422 – Communications II**
  - Analog pulse modulation
  - Digital pulse modulation
  - Information theory

- **S423 – Communications III**
  - Baseband digital modulation
  - Passband digital modulation
  - Spread-spectrum communications
Course Description Highlights
(Term 10-12): DSP

- S434 – Deterministic Signal Processing
  - Application of DSP to speech and image analysis
  - Speech synthesis and recognition

- S435 – Statistical Signal Processing
  - Power spectral analysis in signal processing
  - Data modeling, forecasting, system identification
  - Signal detection

- S436 – Speech & Image Signal Processing
  - Speech production modeling material
  - Anatomy of speech production
  - Image modeling and recognition
Useful Links

- Telecomm Track Advisors
  - K.R. Dandekar – (A-K Students)
    - Curtis 253
    - dandekar@ece.drexel.edu
  - S. Kesler – (L-Z Students)
    - Randall 152
    - keslersb@ece.drexel.edu

- Track outline
  - http://www.ece.drexel.edu/undergrad/telecommunications_table.html

- Course descriptions