Agenda

• Department Update
• Faculty Spotlight
• Current State of Online ECE Education
• Breakout Session
• Lunch
• Breakout Review
• Industry Tour of Wolf Robotics
• Social at Otto PINT
Welcome New Members

- **Patrick Strausbaugh**
  Chief Engineer – New Moon Program
  Northrop Grumman
Department Update

Prof. Tony Maciejewski
Department Head
Electrical and Computer Engineering
Colorado State University
View Presentation Online

URL:
www.engr.colostate.edu/ece/industry/industrial_advisory_board.php
-or-
www.engr.colostate.edu/ece → Industry → Industrial Advisory Board
-then-

Presentation Location:

• Related Links → Meeting Presentations → Fall 2019
Service Recognition

- Orhan Norman – 10 years
What I’ll Cover Today

• What’s New
• Educational Landscape
• Research Highlights
• Outreach and Retention Activities
• Career Outlook
• Status of SP19 Action Items
• Background for Breakout Discussions
What's New
New CSU President

Joyce McConnell became 15th president on July 1
150th Festivities Underway

Then and Now

1910s

2019

csu150.colostate.edu
Professor Budak Passes Away at 90

ECE is establishing the Aram and Helga Budak Professorship to honor his teaching legacy
Recent Awards
ECE Honored by National Society of Professional Engineers Colorado Chapter

Project of the Year Award
for the public sector
Amanda Merkley was one of 52 students across the nation selected for the scholarship.
Notaros Recognized for Excellence in Electromagnetics

2019 ACES Technical Achievement Award
Applied Computational Electromagnetics Society
Pasricha Honored by World’s Largest Computing Society

Distinguished Service Award
Association for Computing Machinery
Special Interest Group on Design Automation
Chandra Lauded for Lifetime Achievements in Geoscience and Remote Sensing

IEEE GRSS Distinguished Achievement Award

Ceremony was attended by the emperor and empress of Japan
Notable Publicity
TEMPEST-D Revealed New View of Hurricane Dorian

Peering inside Hurricane Dorian on Sept. 3, showing the layers of the storm

CubeSat developed at CSU is providing precise images of global weather
CSU is Host Institution for LaserNetUS

- Program established by $6.8M grant from DOE
- Experiments underway
  - Users selected by peer-reviewed panel

“There is no other laser in the world with the capabilities of this system.”

--Dr. Matthew Hill, Atomic Weapons Establishment, U.K.
Tackling Post-Hurricane Grid Resiliency

Prof. Sid is leading NSF grant to design a self-reliant, resilient electric system that can withstand the next Category 5 hurricane.
Advanced Energy Announced New Research Partnership with ECE

Young’s team aims to develop enhanced control algorithms that can deliver increased performance and reliability in next-generation power supplies.
Strange interfacial molecular dynamics
Motion underlying contact interactions that are vital for biology has farther-reaching implications than previously thought
Educational Landscape
World-Class Faculty

• 24 full-time faculty

• More than 40% hold IEEE Fellow distinction

• ECE is a Top Ten Technology Producing Department at CSU
  – 35 new technologies disclosed to CSU Ventures from 2015 to 2019
  – ECE inventors are on approximately 35% of CSU’s issued patents since 2015
ECE Boasts Four University Distinguished Faculty

Dr. Carmen Menoni
Dr. Jorge Rocca
Dr. V. Chandrasekar “Chandra”
Dr. Branislav Notaros

University Distinguished Professors

University Distinguished Teaching Scholar
Faculty Search Underway

- Seeking assistant or associate professor
- Accepting applications through January 2020
Teaching Mission
We Passed ABET Accreditation Review with Flying Colors
Update on RED: Revolutionizing Engineering Departments

• $2M, 5-year National Science Foundation grant redefines what it means to teach and learn in the ECE department
RED Pedagogical Approach is New Normal in ECE

Faculty work in multifaceted teams to provide integrated learning experience
What’s Next

• Simulated internship program underway

• Focusing on broader dissemination and continuation grant from NSF
  – Diversity may be component of follow-on grant
  – Professional formation advisory committee will play a role
Teaching Productivity
ECE Student Credit Hours

<table>
<thead>
<tr>
<th>Year</th>
<th>Undergrad</th>
<th>Grad</th>
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<tbody>
<tr>
<td>2015-2016</td>
<td>6,000</td>
<td>1,000</td>
</tr>
<tr>
<td>2016-2017</td>
<td>7,000</td>
<td>2,000</td>
</tr>
<tr>
<td>2017-2018</td>
<td>8,000</td>
<td>3,000</td>
</tr>
<tr>
<td>2018-2019</td>
<td>9,000</td>
<td>4,000</td>
</tr>
</tbody>
</table>
Engineering Student Credit Hours (‘18-’19)

- ME: 36%
- CEE: 28%
- CBE: 11%
- ECE: 18%
- ATS: 5%
- Intra-College: 2%
CSU Enrollments Mirror National Picture

Includes BME dual degrees
Undergraduate Enrollment Trends

Number of students

- FA11
- FA12
- FA13
- FA14
- FA15
- FA16
- FA17
- FA18
- FA19

Undergraduate Primary Majors (includes BME)
Undergraduate Enrollments by Major

Number of Students

<table>
<thead>
<tr>
<th>Year</th>
<th>Electrical Engineering</th>
<th>Computer Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2015</td>
<td>250</td>
<td>100</td>
</tr>
<tr>
<td>Fall 2016</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>Fall 2017</td>
<td>350</td>
<td>200</td>
</tr>
<tr>
<td>Fall 2018</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td>Fall 2019</td>
<td>450</td>
<td>350</td>
</tr>
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</table>
ECE Graduate Enrollment

Number of students

<table>
<thead>
<tr>
<th>Year</th>
<th>PhD</th>
<th>Masters</th>
<th>ME</th>
</tr>
</thead>
<tbody>
<tr>
<td>FA11</td>
<td></td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>FA12</td>
<td></td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>FA13</td>
<td></td>
<td>225</td>
<td></td>
</tr>
<tr>
<td>FA14</td>
<td></td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>FA15</td>
<td></td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>FA16</td>
<td></td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>FA17</td>
<td></td>
<td>180</td>
<td>50</td>
</tr>
<tr>
<td>FA18</td>
<td></td>
<td>190</td>
<td>50</td>
</tr>
<tr>
<td>FA19</td>
<td></td>
<td>180</td>
<td>50</td>
</tr>
</tbody>
</table>

PhD  Masters  ME
Ph.D. Enrollment

- Fall 2015: 80
- Fall 2016: 80
- Fall 2017: 80
- Fall 2018: 60
- Fall 2019: 60

Electrical Engineering
Computer Engineering
Freshman Enrollment

Total number of students

FA13 | FA14 | FA15 | FA16 | FA17 | FA18 | FA19

- Biom/EELO
- Biom/EE
- CpE
- EE

Colorado State University
Department of Electrical and Computer Engineering
<table>
<thead>
<tr>
<th>Year</th>
<th>Nontraditional</th>
<th>Traditional</th>
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<tr>
<td>FA14</td>
<td>60</td>
<td>240</td>
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<tr>
<td>FA15</td>
<td>60</td>
<td>240</td>
</tr>
<tr>
<td>FA16</td>
<td>60</td>
<td>240</td>
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<tr>
<td>FA17</td>
<td>60</td>
<td>240</td>
</tr>
<tr>
<td>FA18</td>
<td>60</td>
<td>240</td>
</tr>
<tr>
<td>FA19</td>
<td>60</td>
<td>240</td>
</tr>
</tbody>
</table>

*Does not include Biomed dual majors*
First-Generation Undergrads in ECE

*Does not include Biomed dual majors
H-1B Back on Table for US-India Talks

- India has put the H-1B temporary visa program back on table with U.S.
- U.S. grants a total of 85,000 three-year visas to foreign professionals required by companies to meet a shortfall in local talent
  - An estimated 70% of these visas go to Indians

Source: Hindustan Times, 10/24/19
ECE Freshman Enrollment: Colorado Institutions

EE only (CS no longer included)

Data does not include biomed dual degrees
National Engineering Undergraduate Retention

Persistence and graduation to the second year has increased over the last survey cycle

Source: ASEE Databytes, July 2018
ECE Freshman Retention to 2\textsuperscript{nd} Fall

Cohort Size of First-Year ECE Students

Persistence Rates of First-Year ECE Students Through 2\textsuperscript{nd} Fall

Dot com bubble

“The World is Flat”

The Great Recession

Persistence Rates Within Department by Cohort Department and Cohort Term
ECE Freshman Retention to 6th Fall

Cohort Size of First-Year ECE Students

Persistence Rates of First-Year ECE Students through the 6th Fall

Persistence Rates Within Department by Cohort Department and Cohort Term
Women in Engineering
Bachelor’s Degrees to Women (2018)

- Up from 19.9% in 2015

Source: ASEE by the Numbers, 2018
Bachelor’s Degrees to Women (2018)

- Bio and environmental disciplines have the largest share of women

Source: ASEE by the Numbers, 2018
Bachelor’s Degrees to Women (2018)

- Mechanical, electrical, and computer still unacceptably low

Source: ASEE by the Numbers, 2018
Skilled Tech Force by Gender

The Skilled Technical Workforce
By Sex: 2017

- Male:
  - Overall Workforce: 47%
  - Skilled Technical Workforce: 72%

- Female:
  - Overall Workforce: 53%
  - Skilled Technical Workforce: 28%

citation
Women’s Share of S&E Bachelor’s Degrees (2000-2015)

Source: NSF S&E Indicators, 2018
Women in Engineering (FA19)

**Undergrad**
- Biomed Dual Degrees: 31%
- Intra-College: 4%
- ECE: 6%
- CBE: 15%
- CEE: 30%
- ME: 14%

**Graduate**
- Biomed Dual Degrees: 31%
- Intra-College: 5%
- ECE: 23%
- AS: 21%
- CEE: 36%
- CBE: 3%
- BME: 7%
- ME: 5%
Women in ECE Program

• Olivera leading initiative to build community among women in ECE

• Diversity efforts ramping up in ECE
  ➢ Focus of tomorrow’s faculty retreat
Degrees Awarded
Undergraduate Degrees Awarded

<table>
<thead>
<tr>
<th>Year</th>
<th>Computer Engineering</th>
<th>Electrical Engineering</th>
<th>EE/BME</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>40</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>2014-15</td>
<td>17</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>2015-16</td>
<td>20</td>
<td>54</td>
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<td>2016-17</td>
<td>18</td>
<td>52</td>
<td>0</td>
</tr>
<tr>
<td>2017-18</td>
<td>0</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>2018-19</td>
<td>10</td>
<td>62</td>
<td>0</td>
</tr>
</tbody>
</table>
Percent of International Degrees Awarded

<table>
<thead>
<tr>
<th>Year</th>
<th>Ph.D.</th>
<th>ME</th>
<th>MSEE</th>
<th>MSCpE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>77%</td>
<td>11%</td>
<td>12%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>2014-15</td>
<td>77%</td>
<td>11%</td>
<td>12%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>2015-16</td>
<td>78%</td>
<td>10%</td>
<td>12%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>2016-17</td>
<td>80%</td>
<td>10%</td>
<td>13%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>2017-18</td>
<td>80%</td>
<td>10%</td>
<td>13%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>2018-19</td>
<td>83%</td>
<td>11%</td>
<td>12%</td>
<td>0%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Full Year
University research on front lines of conflict with China
Research Highlights
ECE Contributes to Soaring CSU Research

CSU’s record-breaking research enterprise is at $398.5 million for FY2019, up 6.3% from last year
Walter Scott, Jr. College of Engineering

- Atmospheric Science
- Chemical & Biological Engineering
- Civil & Environmental Engineering
- Electrical & Computer Engineering
- Mechanical Engineering
- Systems Engineering
- Biomedical Engineering
- Cooperative Institute for Research in the Atmosphere
COE Total Research Expenditures FY19

College of Engineering 49%

CIRA 32%
ATS 19%
ECE 13%
CEE 20%
ME 13%
CBE 3%
ECE Total Research Expenditures

Actual was $12,985,706
Actual was $7,782,847
## Proposal Activity FY19

### 23 ECE Faculty Submitted Proposals

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposals submitted*</td>
<td>94 (up from 69 last year)</td>
</tr>
<tr>
<td>Total amount of proposals</td>
<td>$66.24M</td>
</tr>
<tr>
<td>Highest proposal amount w/ECE as lead</td>
<td>$4.98M to NASA</td>
</tr>
<tr>
<td>Highest proposal amount w/ECE as collaborator</td>
<td>$7.89M to HHS-NIH</td>
</tr>
<tr>
<td>Primary funding agencies</td>
<td>DHS, DOC, DOD, DOE, DOJ, NASA, NIH, NSF, USDA</td>
</tr>
<tr>
<td>Collaborators</td>
<td>Ag Experiment Station Atmospheric Science, Biomedical Sciences, CIRA, Chemical &amp; Biological Engineering, Civil &amp; Environmental Engineering, Mechanical Engineering, Microbiology, Immunology &amp; Pathology, Statistics</td>
</tr>
</tbody>
</table>

*ECE faculty are PI or co-PI*
ECE Research Disciplines

- Biomedical Engineering
- Communications and Signal Processing
- Computer Engineering
- Controls and Robotics
- Electric Power and Energy Systems
- Electromagnetics and Remote Sensing
- Lasers and Photonics
Engineering Research Centers

• Extreme Ultraviolet Science and Technology Research Center

• Center for Collaborative Adaptive Sensing of the Atmosphere
Demonstrating Micro-Scale Nuclear Fusion with Record Efficiency

- Inspired visit from Senator Bennet
- Overwhelming popularity on Reddit
- 47,177 unique views
  - Most popular story ever on College news site
  - Most articles get less than 2K unique views
- Contributes to role as host institution for LaserNetUS

Research was published in *Nature Communications*
TEMPEST-D Surpasses a Year in Space

Led by Prof. Reising, the project is supported by an $8.2 M grant from NASA
Using Virtual Biopsies to Improve Melanoma Detection

Partnership with Vet Med to test new imaging applications on canine patients
Improving Commutes in Fort Collins

Using autonomous vehicle technologies and big data to save people time and money and realize environmental benefits
Data Science and Social Science Intersect to Prevent a Terrorist Attack

Creating a powerful, data-driven tool that can help identify individuals headed toward violent extremism
Fault-Tolerant Robotics

Robotic systems for remote/hazardous environments
Keeping Miners Safe Underground

Providing miners a low-cost, high-fidelity communication system that bypasses GPS, wireless, cellular, and other signals we take for granted above ground.
Tackling Post-Hurricane Grid Resiliency

Designing a self-reliant, local, resilient electric system that can withstand the next Category 5 hurricane
Mapping the Sound of Silence

Using novel sensing technologies to study the impact of noise pollution in our National Parks
Retention and Outreach Activities
ECE Outreach Team

• New team dedicated to K-12 outreach

• Goal is to foster interest in the field through targeted events, hands-on activities, and school visits
Filling Engineering Pathway through Online Education

• Exploring options for high school students to earn college credit and gain exposure to ECE through online learning

• Pilot with Colorado Early Colleges
Community College Outreach

• Increase emphasis on community college population
  – Community colleges enroll more than 8M students each year, and 43% of all U.S. undergraduates*

• Leverage online education to make ECE education more accessible and help students successfully transfer

*American Society for Engineering Education
Engineering Grads Who Attended 2-Year Colleges

NSF’s National Survey of College Graduates

- Aerospace, Aeronautical, and Astronautical Engineering
- Chemical Engineering
- Civil and Architectural Engineering
- Electrical and Computer Engineering
- Industrial Engineering
- Mechanical Engineering
- Other Engineering Fields
- All Engineering

Bachelor’s, Master’s, Doctorate
Engineering Grads Who Also Completed an Associate’s Degree

NSF’s National Survey of College Graduates
New Graduate Student Association

Newly formed student group aims to bolster recruitment and build community among graduate students in ECE
Career Outlook for ECE Majors

National statistics:
• EE and CpE among the top 10 majors in demand for B.S., M.S., and Ph.D.
  Trend has persisted more than a decade

CSU grads:
• EE: 93% employed in major
• CpE: 100% employed in major

*2019 National Association of Colleges and Employers Annual Job Outlook Report
**CSU First Destination Study, 2017-18
# Median Earnings: CSU vs. CU

<table>
<thead>
<tr>
<th>Institution</th>
<th>Group</th>
<th>Program</th>
<th>Degree</th>
<th>Year1 Wage</th>
<th>Year5 Wage</th>
<th>Year10 Wage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU</td>
<td>Science, Technology, Engineering and Math</td>
<td>Computer Engineering</td>
<td>Bachelor's Degree</td>
<td>$70,089</td>
<td>84,902</td>
<td>87,744</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electrical, Electronics and Communications Engineering</td>
<td>Bachelor's Degree</td>
<td>$67,101</td>
<td>78,475</td>
<td>81,068</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Master's Degree</td>
<td>$87,455</td>
<td>108,267</td>
<td>108,506</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Doctoral Degree</td>
<td>$85,188</td>
<td>111,518</td>
<td>129,511</td>
</tr>
</tbody>
</table>

*Overall, CSU grads had highest median salaries across the state in ECE*

*College Measures EdPay Report, 2002-2017*  
https://highered.colorado.gov/Data/Workforce/EdPays.html
Engineer in Residence Key to Career Readiness

• Partnership with IEEE launched in 2015 – central to professional formation thread

• Industry volunteers hold lab hours to advise and mentor students
Spring Action Items
Action Item from SP19 Meeting

• **Action item:** Report back on simulated internship program

• **Status:** Program immerses students in real engineering and exposes them to technical breadth and potential of the discipline
  – 16 students enrolled, one HS student
  – Held community forum with industry reps and Fort Collins Mayor to review students’ wind farm designs
  – Common theme in teams’ final reports: students cited appreciation for seeing how engineering works in the real world
Background for Online Discussion

• Launched in 2012, ECE online enrollments remain low

• Struggle not limited to CSU
  – Purdue launching three under-$25,000 online master’s degrees in engineering to address low enrollments
  – Georgia Tech, Indiana University, Arizona State, and Boston University also offer master’s degrees priced well below comparable in-person programs