Graduate Program in Acoustics

Special Overview Presentation for CAV Workshop Participants

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Penn State Graduate Program in Acoustics
University Park, PA
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Acknowledgements

Students
(this is what its all about)
Acoustics is Highly Interdisciplinary

- Chemical Engineering
- Biomedical Engineering
- Speech and Hearing
- Ocean Engineering
- Architectural Engineering
- Mechanical Engineering
- Physics
- Materials
- Micro- and Nanotechnology
- Electrical and Computer Engineering
- Aerospace Engineering
What is the Graduate Program in Acoustics?

- The Graduate Program in Acoustics is:
  - Intercollege graduate degree program (IGDP), based in the College of Engineering
  - Administratively aligned with Dept. of Aerospace Engineering
  - Associated with the Applied Research Laboratory (ARL)

- History
  1965 Graduate Program established to provide the US Navy with an academic program in acoustics and its applications.
  1987 Distance Education established in partnership with ARL to further extend educational opportunities to students unable to pursue graduate school at University Park.
Philosophy

• Provide a broad education in acoustics fundamentals that will last a lifetime

• Provide this education for
  - residence students
  - working professionals
    o courses *a la carte*
    o pursue M. Eng. degree

• Blend residence and distance students when possible
Penn State Graduate Program in Acoustics

• Over 65 in-residence graduate students in Acoustics
• Over 80 distance education students taking courses each semester
• Over 40 faculty members from across Penn State ARL, College of Engineering, etc.
• Degrees offered in Acoustics:
  - Master of Engineering
  - Master of Science (in-residence only)
  - Doctor of Philosophy (in-residence only)

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Acoustics Program Uniqueness

• Only U.S. institution awarding degrees in Acoustics
• Blending/Simulcasting almost all classes to both local and distance students
• Our distance education classes began (1987) before Penn State World Campus was established (1998). [We also enjoy a healthy relationship with World Campus.]
Employment for Acoustics Students

Apple
APL Johns Hopkins
ARL Penn State
BBN
Boeing
Bose Corporation
Army Corps of Engineer’s Research Lab
Eminance Loudspeakers
ENSCO, Inc.
FDA
IBM
Ingersol Rand
Jet Propulsion Lab
Motorola
NASA Langley Research Center
Naval Surface Warfare Center
Northrup Grumman
Panasonic
Raytheon
US DOT Volpe Center
Verizon
Wyle

Brigham Young University
Central Washington University
Cheju National University (Korea)
Harvard Medical School
Illinois Institute of Technology
James Madison University
Kettering University
Lehigh University
McGill University
Silpakorn University (Thailand)
University of Arizona
University of Cincinnati
University of Hartford
University of Michigan
University of Nebraska
University of Rhode Island
University of Texas at Austin
Virginia Tech

Students also go to architectural acoustics/consulting firms . . .

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Recent Hire: Dr. Michelle Vigeant

- Assistant Professor of Acoustics (75%) and of Architectural Engineering (25%)
- Previously
  - Ph.D., Univ. Nebraska, 2008
  - Asst. Prof. of Mechanical Engineering, Univ. Hartford, 2008-2012
- Areas of Interest
  - Architectural Acoustics (measurement parameters and subjective impression of room acoustics)
  - Relationship between aircraft noise and effects on children’s cognition
  - Neuroscience of hearing
- 2012-2017 NSF Early CAREER Award Winner, “Importance of Late-Sound-Field Properties and Listener Envelopment in Room Acoustics Quality and Design”

Welcome Michelle!

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Acoustics Courses

- Fundamentals of Acoustics (ACS)
- Transducers
- Digital Signal Processing (DSP)
- Structural Acoustics
- Ocean Acoustics
- Data Measurement and Analysis
- Architectural Acoustics
- Outdoor Sound Propagation
- Noise Control Engineering
- Aerodynamically Induced Noise
- Thermoacoustics (refrigeration using sound)
- Nonlinear Acoustics (high amplitude sounds)
Some Recent and Future Offerings

Fall 2012 / Spring 2013:
- Fundamentals of ACS
- DSP
- Transducers
- ACS of Fluids II
- Math Review
- Ocean ACS
- Computational ACS
- Aerodynamically Induced Noise
- ACS of Musical Instruments
- Research and Writing

Fall 2013 / Spring 2014:
- Data Measurement and Analysis
- Sound Structure Interaction
- Architectural ACS and Noise Control
- Animal Bioacoustics
- Flow-induced Noise
- Spatial Hearing and 3-D Audio (+ all the blue courses above)
What a distance education student sees

(Students asking questions in chat area. Also can use microphone.)
Information Contacts

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• Christine Popovich – Operations Manager for Distance Education  
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Backup Slides
Who are the Faculty?

- Approximately 40 Members of the Graduate Faculty
  - Acoustics (4 +1 in Dean’s office)
  - Aerospace Engineering (5)
  - Applied Research Laboratory (20)
  - Bioengineering (0)
  - Communication Disorders (1)
  - Geosciences (2)
  - Engineering Science and Mechanics (3)
  - Mechanical Engineering (3)
  - Physics (1)
Educational Opportunities in Acoustics

Residence Education
- Master of Engineering in Acoustics
- Master of Science in Acoustics
- Ph.D. in Acoustics

Distance Education
- Master of Engineering in Acoustics
- Take individual courses *a la carte*
  - Most popular
  - Many transfer into M. Eng. program after taking a few courses
Delivery via Distance Education

Distance Education Classes leading to M. Eng. Degree

1987 – began acoustics distance education via satellite links with Navy labs and industry

1992 – added PictureTel video conferencing delivery in addition to satellite

1994 – added videotape distribution for many students

1997 – satellite discontinued

2002 – added videostreaming delivery over internet to PictureTel

2003 – ended PictureTel

2006 – blended classes; videostreaming only; no VHS
Current Status of DE Delivery (1)

• Students have opportunity to see lectures live with residence students (blended) or archived (on demand)

• Students participate in live chat room or use microphone to ask questions during lectures

• Web discussion forums for students and media download between classes

• Live office hours / recitation sections

• Dropboxes for homeworks and proctors for tests

Thanks to Miguel Horta and Andrew Orr for providing the following screen shots:
Current Status of DE Delivery (2)

• Use Adobe Connect (Macromedia Breeze) software
  - Need high-speed internet (no dialup)

• Use Smartboards for writing on board/screen

• Use student video producers to ensure quality
Current Status of DE Delivery (3)
Current Status of DE Delivery (4)

(students asking questions in chat area)
ANC Requirements Depend On Sound Field

- Duct is essentially 1-dimensional: sound propagates as plane waves
  - ANC relatively simple to implement
- In Enclosures and rooms, sound field is dominated by normal modes
  - Amplitudes vary throughout the space
  - Excitation Frequencies may be shared by several different modes, especially at high-frequencies
  - ANC requires multiple sensors and sources, effective only at low-frequencies
- In free-field, sound radiates with spherical spreading
  - Amplitude change with distance from source makes near-field cancellation limited
  - In far-field, cancellation can be achieved, but very directionally dependent
  - Many sensors and sources required for extensive sound reduction

(student making live presentation)
Acoustics Curriculum at Penn State

Required courses for Penn State graduate degrees:

501 - fundamentals I (vibrations and acoustics of solids)
502 - fundamentals II (acoustics of fluids)
505 - laboratory [Resident Ed., but not Dist. Ed.]
513 - digital signal processing
514 - transducers
515 - acoustics of fluids II
516 - data measurement and analysis
590 - colloquium
Some of the Research Capabilities

Acoustic Microscopy
Active Control of Sound and Vibration
Aeroacoustics
Computational Acoustics
Data Acquisition Systems
Data Fusion
Design of Quiet Structures
Flow-Induced Noise
Intelligent Sensor Systems
Machinery Diagnostics
Marine Bioacoustics
Materials Characterization
Medical Ultrasonics
Modal Analysis

Noise Control Engineering
Nondestructive Testing/Evaluation
Nonlinear Acoustics
Ocean Acoustics
Resonance Ultrasound Spectroscopy
Seismology
Signal Processing
Smart Materials
Sonar Systems Engineering
Sound Quality/Sound Metrics
Structural Acoustics
Thermoacoustics
Transduction
Ultrasonic Imaging
Proud of Our Graduates

• Acoustics Education Nationwide!

Robert Celmer
Univ. of Hartford

Lily Wang
Univ. of Nebraska

Rendell Torres
Rensselaer Poly.

Tim Leishman, Kent Gee
Scott Sommerfeldt
Brigham Young Univ.

Dan Russell
Kettering Univ.

Penn State Acoustics Program