

# Acoustics and Audio Technology Seminar 2019

## Headphones and Equalizers

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# General Description of the Course

- Course material and lectures in English.
- Seminar will introduce students to a selected area of acoustics and audio technology in depth.
- Goal is that each student will be involved in a specific topic so that he/she will have competence to work independently on the selected problem area.
- Students will acquire skills in scientific writing and presentation!
- WebOodi for Registration & MyCourses for everything else.



# Teachers

- **Prof. Vesa Välimäki**
- **Jussi Rämö, course organizer**
  - Doctor of Science, Aalto University, 2014
  - Industrial Postdoc researcher at Aalborg University and Bang & Olufsen, Denmark, 2015-2017
  - Postdoc researcher at Dept. Signal Processing and Acoustics, 2018 ->
  - Research interests:  
Headphones and Equalizers



# Feedback 2017

Overall assessment of the course: 4.3/5 in 2017

## What was good?

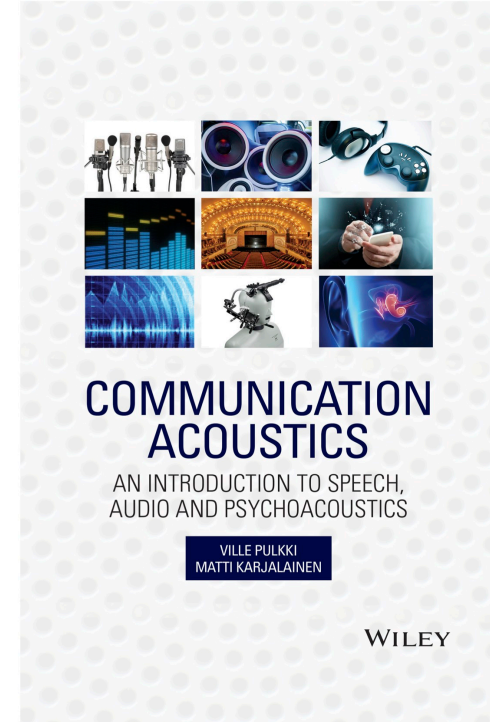
- Seminar work gives freedom to explore topics. Learned how to schedule my work
- Each lecture about different topics, directly related to recent research/industry
- Forced us to practice scientific writing, and also giving talks,
- Clear timetable for the seminar paper.

## What needed improvement?

- This course did not have any guidelines for given topics.
  - freedom in research but in my case I was too ambitious and I ended up doing too long seminar paper
- I would like to have more explanation about what should we do for the paper.
- Some peer reviewing and comments regarding the seminar paper could have been useful.

# Prerequisites

- **ELEC-E5600 Communication Acoustics**  
(or equivalent knowledge)
  - Overall understanding of communication by sound and voice,
  - Deeper knowledge on the human auditory system and auditory perception,
  - Physiology of hearing. Psychology of hearing. Spatial hearing. Auditory modelling. Sound quality. Technical audiology. Sound reproduction.
- **Digital Signal Processing**



# Lectures

## 0. Course Introduction & Topic Selection

1. Equalizers

2. Headphones

3. Headphone and Equalizer Research at Aalto

4. Flexound Augmented Audio introduction - Vibration based nearfield listening approach basics and demonstrations

5. Coupling of Headphones

25.02.2019

04.03.2019

11.03.2019

18.03.2019

25.03.2019

01.04.2019

Vesa Välimäki - Aalto

Jussi Rämö - Aalto

Juho Liski - Aalto

Jukka Linjama - Flexound

Javier Gómez Bolaños - Hefio

## Seminar Presentations

Seminar papers will be presented on **Monday 6 May**.

We might change the date, let's discuss that on Monday 4.3.



# Learning Diaries

**Short essays (1-2 pages) based on your lecture notes, containing for example**

- Highlights of the lecture,
- What did you learn?
- New ideas or insights,
- Study more of the topic online,
- What did you find most interesting?
- **No need** for your own Matlab experiments (like in ASP course)
  - Save that for your seminar paper.



# Learning Diaries

- **Write the learning diaries like essays**
  - Do not copy sentences from the slides or from the Internet
  - Use your own words—Plagiarism is strictly forbidden!
  - Cite references (articles and webpages)
  - Write only in English, please.
- **Deadline: Fridays after each lecture at 15.00**
- **Upload to MyCourses**
- **Grading: Fail/Pass**





# Learning Diaries

- There are 5 introductory lectures, and it is required to return at least 4 learning diaries.
- If you will have to miss more than 1 lecture, you must produce an extended learning diary, 1 per each missed lecture
  - Contact Jussi to negotiate on the contents of the extended learning diary.



# Topics

Let's select the seminar topics.

Topic	Student
Frequency Response & Isolation	
Standards: Safety	
Standards: Equipment	
Perceptual frequency response (in noise)	
Active noise control (ANC) - Feedforward	
Active noise control (ANC) - Feedback	
HRTF: Measurements and modeling	
HRTF: Filtering	
HRTF: Headphone implementation	
HRTF: Head tracking	
Augmented reality: Hear-through	
Augmented reality: Audio Applications	
Bone-conducting headphones	
Assisted listening	
Stereo widening networks	
Psychoacoustic bass enhancement	
Virtual listening tests for headphones	
Occlusion effect	
Modeling of headphones	
Modeling of hearing	
Anatomy of the ear	
Hearing aids (special HP)	
Binaural hearing	
Headphone listener preferences	
Equalizer design: Parametric EQ	
EQ Structures - Comparison	
High-order Equalizers	
Intelligent equalization (in noise)	
Loudness compensation	
Intuitive EQ user interfaces	
Analysis of popular software EQs	
FFT Equalization	
Phase equalization	

# Teams

**Let's form teams (4 – 6 persons) with similar topics**



- Presentation coordination
- Peer review

We will form the teams on Monday 4.3.












# Schedule for the Seminar Paper




- First draft (outline and references) – 18 March
- Second draft (more text and figures) – 1 April
- Full paper (all text and figures) – 17 April
- Slides (presentation) – 29 April

-  Lectures
-  Learning Diary DL

March

M	T	W	T	F	S	S
 25	26	27	28	1	2	3
 4	5	6	7	 8	9	10
 11	12	13	14	 15	16	17
 18	19	20	21	 22	23	24
 25	26	27	28	 29	30	31

April

M	T	W	T	F	S	S
 1	2	3	4	 5	6	7
<i>Exam Week?</i>						
<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	13	14
<i>Easter</i>						
15	16	17	18	<u>19</u>	<u>20</u>	<u>21</u>
<u>22</u>	23	24	25	26	27	28
29	30	1	2	3	4	5
<i>Seminar presentations</i>						
 6	7	8	9	10	11	12

# Seminar Paper

- Use the template provided in MyCourses.
- The expected length of the seminar paper is
  - about 10 pages for Master's students, and
  - about 15 pages for Doctoral students.
- The oral presentation should last for 10 minutes.
- **Short presentation** on how to write a good paper.
- **Example paper** – As requested in the previous feedback.