NBE-E4000 Principles of Biomedical Imaging

Autumn 2020

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Where we are & who this is for?

LIFE MSc program, Biomedical Engineering Major

E40xx: Imaging, signal analysis and modeling

NBE-E4000	Principles of Biomedical Imaging
NBE-E4010	Medical Image Analysis
NBE-E4020	Medical Imaging
NBE-E4045	Functional Brain Imaging
NBE-E4050	Signal Processing in Biomedical Engineering

- **Compulsory course in LIFE/Biomedical Engineering major**
- **Compulsory course in LIFE/Human Neuroscience and Neurotechnology**
- **Prerequisite for NBE-E4020 & NBE-E4045**
- Good choice for PhD studies of BME/NEURO
- Educating & useful for Physics and Math MSc & PhD students

Background studies: BSc in

- Physics / Mathematics*
- Biomedical engineering / Bioinformation technology
- Electrical engineering / Signal processing*
- Computer science* / Complex systems*

+ Matlab skills (functions, programming), study skills…

* = + some physics…

Who are you?

MSc students	
BME	7
NEURO	4
LIFE other	11
CCIS	4
BIZ	3
Other Aalto	6
Exchange+JOO	3

BSc students	
BioIT	3
EST	3
Other	3
PhD students	5

From course description (Oodi):

- The course is planned for students of BME and NEURO majors. It is also suitable for MSc students of applied physics.
- *If you do not belong to these groups, please contact the teacher-in-charge before enrolling.*

For other students, it ~~might~~ should work out, assuming

- prerequisites: phys, maths, some Matlab
- skills for computer-based problem solving
- ability to **meet deadlines**
- active participation in learning sessions
- study skills (e.g. BSc thesis project)
- 130 hours of joyful study work!

What do we learn?

… well…, "Principles of Biomedical Imaging".

- Principles
  - Physical mechanisms, applied math,
  - System/estimation theory, signal analysis
  - Something common to all imaging modalities?
- Imaging
  - What is "imaging"?
  - What causes the measured signals?
  - How to interpret measured signals as an "image"?
  - How to stimulate a biological system to obtain an "image"?
  - Approached from the perspective of different imaging modalities
- Skills: computer-based problem solving
- To know other BME/NEURO students & to work with them.

How do we learn?

Introduction +

Five parts with…

- two “lectures” (concepts, techniques)
- a large exercise set that focuses on “principles”
- four mainly student-driven ”exercise sessions”
- an exercise report (-> MyCourses), feedback
- a short text on key concepts (-> MyCourses), feedback
- different teacher teams, same head coach
- varying learning/study/teaching practices

~~End exam~~

Study practices

- Basic mode: **work together** in small groups so that everyone…
  - writes his **own** answers in own words
  - writes his **own** Matlab/Python codes
  - Assembles and writes his **own** concept texts
  - returns his **own** report/codes **by the deadline**

- Prepare for lectures and exercise sessions
- Ask for help 1) from your peers, 2) from teachers at exercise sessions, in Teams, or in MyCo discussion
- **Follow the deadlines!**
  - If you get sick, let us know ***before*** **the DL**
- Follow MyCourses news & discussion in MyCo and Teams
- Search for more information yourself!

When do we meet?

- "Lectures": Thu 10–12 @Zoom
  - Live, contains some interaction
  - Authenticated users only, use your real name
  - Every week until 26 Nov (except 22 Oct)

- "Exercises": Fri 12–14, Wed 14–16 at Teams
  - The "exercise cycle" starts on Friday
  - Student-driven
  - Not much pre-planned content
  - Workspace dynamically divided to smaller rooms
  - The Teams space is available all the time

Topics & teacher teams

Intro: Basic concepts of imaging & pinhole camera
Matti Stenroos & Pauliina Hirvi, teaching 10.9.–16.9., **DL 17.9. at 10h15**

Part I: Linear imaging system: Ill-posed problem & bioelectric source imaging,
Matti & Jaakko Vallinoja, teaching 17.9.–30.9., **DLs 1.10. & 5.10.**

Part II: Linear elecrophysiological neuroimaging: time-series estimation
Matti & Jaakko, teaching 1.10.–14.10., **DLs 15.10. & 19.11.**

Part III: Xray and computed tomography
Ilkka Nissilä & Tuomas Mutanen, teaching 15.10.–4.11., **DLs 5.11. &** 9.11.

Part IV: Ultrasonic imaging
Heikki Nieminen, teaching 5.11.–18.11., **DLs 19.11. & 23.11.**

Part V: Magnetic resonance imaging
Baran Aydogan, Heikki Sinisalo, teaching 19.11.–2.12., **DLs 3.12. & 7.12.**

+ concept & coaching: Matti
+ peer learning: we all!