BME1473: Acquisition and processing of bioelectric signals

Course Syllabus, Fall 2025

Course Instructor: Ryan Koh

Introduction and course objectives

This course will provide you with a collection of methods to interpret the electrical activity of the nervous system. We will first examine the biophysical basis of bioelectric recordings, and then discuss data collection and signal processing methods for a range of modalities, including: electroencephalography, intracranial recordings, electromyography, electroneurography, and evoked potentials. Applications and examples will be provided for each of the techniques studied, drawn from fields including neuroscience, neurorehabilitation, kinesiology, and neurosurgery. You will have the opportunity to apply selected methods of the course to a problem in your own areas of research (knowledge of MATLAB is expected). By the end of this course, you should:

- Understand the physiological origins of the different bioelectric signals studied.
- Be able to select the most appropriate way to record and process a signal of interest.
- Appreciate the clinical and research applications of each modality discussed.
- Be familiar with a range of common advanced signal processing techniques and be able to apply them to new problems.

Course time and location

Lectures will be held on Wednesdays, 10am-12pm, in KP 113 (Koffler House).

Contact info, office hours, and contact policies

- Office hours are by appointment. I can be reached at ryan.koh@mail.utoronto.ca and will provide a timely response with a meeting time.

- Although you are welcome to send me questions via email, I cannot guarantee a response time, particularly just before deliverables. For that reason, I encourage you to make good use of the lectures and office hours for any questions about the course material.

- For email messages, please include “BME1473” in the subject line.

- The teaching assistant for the course (responsible for assignment marking) is David Koivisto, who can be reached at david.koivisto@mail.utoronto.ca.

Recommended Textbooks

- *Practical biomedical signal analysis using Matlab 2nd Ed.*, KJ Blinowska and J Zygierewicz, Boca Raton: CRC Press, 2022
- *Biosignal and Medical Image Processing 3rd Ed.*, J.L. Semmlow, Boca Raton: CRC Press, 2014

Marking scheme

Assignment 1:	15%
Assignment 2:	15%
Assignment 3:	15%
Project report:	40%
Project presentation:	15%

Course outline and important dates

Sept 3	Origins of bioelectric activity and key DSP concepts	
Sept 10	Evoked potentials	
Sept 17	EEG, part 1	
Sept 24	EEG, part 2	Assignment 1 due
Oct 1	Single-unit recordings, part 1	
Oct 8 and 15	Project proposal presentations	Project proposals due Oct 7
Oct 22	Single-unit recordings, part 2	Assignment 2 due
Oct 29	**Fall Break – No Lecture**	
Nov 5	EMG	
Nov 12	De-noising methods	
Nov 19	ENG	Assignment 3 due
Nov 26	Heart rate variability	
Dec 3	**No lecture**	**Projects due**
Week of Dec 8-12	Project presentations (to be scheduled)	

Policies

I reserve the right not to accept late deliverables, or to impose a penalty. In most cases late deliverables will simply not be accepted. If your deliverables are late because of circumstances outside of your control, supporting documentation will be required (e.g. doctor's note in case of illness), and it is expected that the deliverables will be submitted at the earliest possible time after the deadline.

This course, including your participation, may be recorded on video. Recordings will be available to students in the course for viewing after each session. Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor. For questions about the recording and use of videos in which you appear, please contact your instructor.

University of Toronto Resources

University Land Acknowledgement

I wish to acknowledge this land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

Learn more about Canada's relationship with Indigenous Peoples here.

Indigenous Students' Supports

If you are an Indigenous engineering student, you are invited to join a private Discord channel to meet other Indigenous students, professors, and staff, chat about scholarships, awards, work opportunities, Indigenous-related events, and receive mentorship. Email Professor Bazylak or Darlee Gerrard if you are interested.

Indigenous students at U of T are also invited to visit First Nations House's (FNH) Indigenous Student Services for culturally relevant programs and services. If you want more information on how to apply for Indigenous specific funding opportunities, cultural programs, traditional medicines, academic support, monthly social events or receive the weekly newsletter, go to the FNH website, email or follow FNH on social media: Facebook, Instagram, or TikTok. A full event calendar is on the CLNX platform. Check CLNX often to see what new events are added!

Wellness and Mental Health Support

As a university student, you may experience a range of health and/or mental health challenges that could result in significant barriers to achieving your personal and academic goals. The University of Toronto and the Faculty of Applied Science & Engineering offer a wide range of free and confidential services that could assist you during these times.

As a U of T Engineering student, you have a Departmental Graduate Administrator who can support you by advising on personal matters that impact your academics. Other resources that you may find helpful are listed on the U of T Engineering Mental Health & Wellness webpage, and a small selection are also included here:

- U of T Engineering's Mental Health Programs Officer
- Accessibility Services & the On-Location Advisor
- Health & Wellness and the On-Location Health & Wellness Engineering Counsellor
- Graduate Engineering Council of Students' Mental Wellness Commission
- SKULE Mental Wellness
- U of T Engineering's Learning Strategist and Academic Success
- Registrar's Office and Scholarships & Financial Aid Office & Advisor

We encourage you to access these resources as soon as you feel you need support; no issue is too small. If you find yourself feeling distressed and in need of more immediate support, consider reaching out to the counsellors at U of T Telus Health Student Support or visiting U of T Engineering's Urgent Support – Talk to Someone Right Now.

Accommodations

The University of Toronto supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, visual impairments, chronic health conditions, addictions, D/deaf, deafened or hard of hearing, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.

If you have a learning need requiring an accommodation the University of Toronto recommends that students register with Accessibility Services as soon as possible.

We know that many students may be hesitant to reach out to Accessibility Services for accommodations. The purpose of academic accommodations is to support students in accessing their academics by helping to remove unfair disadvantages. We can assess your situation, develop an accommodation plan with you, and support you in requesting accommodation for your course work. The process of accommodation is private; we will not share details of your needs or condition with any instructor.

If you feel hesitant to register with us, we encourage you to reach out for further information and resources on how we can support. It may feel difficult to ask for help, but it can make all the difference during your time here.

Phone: 416-978-8060
Email: accessibility.services@utoronto.ca

Equity, Diversity and Inclusion
Looking for community? Feeling isolated? Not being understood or heard?

You are not alone. You can talk to anyone in the Faculty that you feel comfortable approaching, anytime – professors, instructors, teaching assistants, academic advisors, student leaders or the Assistant Dean of Diversity, Inclusion and Professionalism.

You belong here. In this class, the participation and perspectives of everyone is invited and encouraged. The broad range of identities and the intersections of those identities are valued and create an inclusive team environment that will help you achieve academic success. You can read the evidence for this approach here.

You have rights. The University Code of Student Conduct and the Ontario Human Rights Code protect you against all forms of harassment or discrimination, including but not limited to acts of racism, sexism, Islamophobia, antisemitism, homophobia, transphobia, ableism, classism and ageism. Engineering denounces unprofessionalism or intolerance in language, actions or interactions, in person or online, on- or off-campus. Engineering takes these concerns extremely seriously and you can confidentially disclose directly to the Assistant Dean for help here.

Resource List:

- Engineering Equity, Diversity & Inclusion Groups, Initiatives & Student Resources
- Engineering Positive Space Resources
- Request a religious-based accommodation here
- Email Marisa Sterling, P.Eng, the Assistant Dean, Diversity, Inclusion & Professionalism here
- Make a confidential disclosure of harassment, discrimination or unprofessionalism here or email engineering@utoronto.ca or call 416.946.3986
- Email the Engineering Society Equity & Inclusivity Director here
- U of T Equity Offices & First Nations House Resources