COGS 280 | Neural Oscillations (mostly)

Meeting: Spring 2022, Th 9:00a-11:50a (all times Pacific)
Instructor: Professor Bradley Voytek
Location: CSB 272

Course GitHub: https://github.com/voytekresearch/ephys-class/

COURSE OBJECTIVES

Learn how to:

- Think critically about the field of neural oscillations.
- Perform basic neural time series data pre-processing, such as filtering, and learn how those basic choices influence results.
- Perform a Fourier Transform (and its inverse) and learn about its limitations in neural data analysis.
- Simulate neural time series data with similar statistical properties as real data.
- Perform non-linear time series analyses on neural data in order to parameterize data with a rich set of features.
- Do much more!

COURSE MATERIALS

There are quite a few readings for this course, that can be found on the course GitHub here: https://github.com/voytekresearch/ephys-class/tree/main/Readings

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GRADING & ATTENDANCE

Lecture Attendance

This a small, discussion- and coding-based graduate course. While I do not require attendance, you will benefit significantly from attending.

Grades

There are 7-8 critical readings, and for each you will submit your critical assessment and questions. These Reading Assignments are the entire basis for your grade for this course. You have until *Wednesday at 11:59 PM* (so the night before class) to complete each Reading Assignment. Assignments will be released and submitted on Canvas. Assignments are submitted individually.

This is a graduate-level course, so the goal of these readings is to learn and to foster discussion. This is not a big ask of you, but you *must do the readings*, or you will not get much out of this course.

It is your responsibility to ensure your assignments are submitted on time and to check your grades and get in touch if any are missing or if you think there is a problem.

There are no late assignments unless you make prior arrangements with me.

Course logistics

Neural Oscillations will be a lecture, discussion, and analysis-based course. Each Thursday we will begin with a lecture on the week's topic. We will then follow with a group discussion about the lecture topic and the Readings you did that week, including the questions and assessments you submitted previously. We will then spend the last hour or more of each class working through coding and analysis exercises to implement what you have learned.

I strongly encourage you to bring your own research data if you have any, or to find publicly-available datasets: you will get much more out of this class if you're working specifically on something you find interesting!

There is no Final Exam or Final Project for this class.

OTHER GOOD STUFF

Class Conduct

In all interactions in this class, you are expected to be respectful. This includes following the UC San Diego principles of community: https://ucsd.edu/about/principles.html

This class will be a welcoming, inclusive, and harassment-free experience for everyone, regardless of gender, gender identity and expression, age, sexual orientation, disability, physical appearance, body size, race, ethnicity, religion (or lack thereof), political beliefs/leanings, or technology choices.

At all times, you should be considerate and respectful. Always refrain from demeaning, discriminatory, or harassing behavior and speech. Last of all, take care of each other.

If you have a concern, please speak with Dr. Voytek, your TAs, or IAs. If you are uncomfortable doing so, that's ok! The OPHD (Office for the Prevention of Sexual Harassment and

Discrimination) and CARE (confidential advocacy and education office for sexual violence and gender-based violence) are wonderful resources on campus.

OPHD: https://blink.ucsd.edu/HR/policies/sexual/OPHD.html
CARE: https://care.ucsd.edu/

Academic Integrity

Don't cheat.

You are encouraged to (and at times will have to) work together and help one another. However, you are personally responsible for the work you submit. It's your responsibility to ensure that the correct file has been uploaded, that the uploaded file is uncorrupted, and that it renders correctly. Please review academic integrity policies here: https://academicintegrity.ucsd.edu/

We anticipate you all doing well in this course; however, if you are feeling lost or overwhelmed please let me know! It's totally okay and I genuinely want you to enjoy this class.

Cheating and plagiarism have been and will be strongly penalized. If, for whatever reason, something else prohibits you from being able to turn in an assignment on time, immediately contact me by emailing your assignment (bvoytek@ucsd.edu), or else you will receive a zero.

Disability Access

Students requesting accommodations due to a disability must provide a current Authorization for Accommodation (AFA) letter. These letters are issued by the Office for Students with Disabilities (OSD), which is located in *University Center 202* behind Center Hall. Please make arrangements to contact Dr. Voytek privately to arrange accommodations.

Contacting the OSD can help you further:
858.534.4382 (phone)
osd@ucsd.edu (email)
http://disabilities.ucsd.edu

Finally…

If you have…

- **Questions about course content**: These are awesome! We want everyone to see them and have their questions answered too… so post these to Slack!
- **Questions about course logistics**: First, check the syllabus. If you can't find the answer, ask a classmate. If still unsure, post on Slack.
- **Questions about a grade**: If for an assignment, submit a regrade request or question as an email or a private message on Slack to your TAs.

- **Something super cool to share related to class**: Feel free to email Dr. Voytek (bvoytek@ucsd.edu), share it on Slack, or come to office hours.
- **Something you want to talk about in-depth**: Come to office hours or schedule a time to meet by email (bvoytek@ucsd.edu).

Schedule **(subject to change!)**

Week 1 | Introduction to Neural Oscillations
To set the foundation for this course, we'll introduce neural oscillations by reviewing their historical origins, as well as touching on their biophysical origins.

Week 2 | Filtering and Digital Signal Processing (DSP)

Week 3 | FFT and power spectra

Week 4 | Identifying oscillations

Week 5 | Non-oscillatory, "aperiodic" data

Week 6 | Parameterizing neural power spectra

Week 7 | Gamma oscillations, high gamma, broadband activity

Week 8 | Non-sinusoidal oscillations

Week 9 | Time-domain analyses of oscillations

Week 10 | Coherence, synchrony, and phase/amplitude coupling