

Interdisciplinary Workshop on Computational Neurology: Modeling real-life neuropsychiatric diseases

Dates: 4.4 (online) - 11.4 (onsite) – 25.4 (online)- 9.5 (onsite) - 23.5 (online)- 6.6 (onsite) – 27.6 (online)

Time: 14:00-16:00 with 20min break inbetween

Work load: 3 CP

Venue: Building MB (South entrance), Floor 6, Seminar Room, Ruhr University Bochum, Universitätsstraße 150, 44801 Bochum

Why attend?

This is a perfect starter course to understand more about modeling and computational techniques in neurology. The course will be a blend of theoretical concepts and practical application. Through group work you will gain the skills to develop your own modeling projects. We will work with real-life data of patients with neuropsychiatric, creating opportunities for hands-on learning. Furthermore, the models you will develop have the potential to lead to real concrete applications for clinical practice! Projects developed during the course can be further refined beyond the workshop, possibly leading to bachelor and master theses and publishable research. Open to students from diverse disciplines, the course fosters interdisciplinary teamwork and emphasizes the importance of effectively communicating and collaborating with individuals from different academic and professional backgrounds. Besides computational neurology, by working in multidisciplinary teams you will learn to discuss with and understand the point of view of scientists with different backgrounds is a crucial skill in modern day science (in all fields).

Course syllabus:

First day (04/04): Intro to Python (online).

This day is tailored for students with little or no prior experience in programming. We will introduce fundamental concepts related to using Jupyter Notebooks and the basics of some widely used Python libraries (e.g., Numpy and Pandas), as well a small introduction to loading and plotting images. It serves as a gentle entry point for those who are new to programming. If you already use Python on a weekly basis or if you already have completed some projects you most likely will not benefit from this course and you can skip it.

Second day (11/04): Intro to Neuroanatomy, fMRI and neuropsychiatric diseases (onsite).

This day is designed to provide students with a comprehensive introduction to fMRI and neuroanatomy. This session will cover what fMRI is, what it measures, and (some of) its various applications. You will also learn about brain parcellations and how to connect them using diffusion tractography data. Furthermore, we will introduce neuropsychiatry. We will divide you into small groups of 4-5 people and we will assign each group to a specific disease and computational model combination. The overall goal of the group work, which will already start today with some brainstorming, will be to model brain activity changes in each disease using the assigned computational model.

Third day (25/04): Single Node Neural Mass Models (online).

On this day, we will use the Kuramoto model to simulate the activity of a single brain region. We will evaluate its dynamic (e.g., oscillations) and its change according to different model parameters. Through hands-on exercises, you will have the opportunity to work with these models and gain practical experience in their application for your project.

Fourth day (09/05): Whole Brain Neural Mass Modeling of Healthy Subjects (onsite).

On the third day, we will create a real brain simulation. We will connect neural masses into a network, and we will fit this network to real empirical data so that the simulated brain activity resembles the real empirical one. We will also delve deeper into model fitting, and we will learn how to use both static and dynamic functional connectivity to make our brain simulations more realistic.

Fifth day (23/05): Whole Brain Neural Mass Modeling of Neurological Disorders (online).

The last day will be focused on strategies on how to implement disorder-specific aspects into whole-brain modeling.

Sixth day (06/06): Last session with group work and open questions (onsite).

During this session you will have opportunity to meet for group work and to get help with open questions to finalize your projects.

Final day (27/06): Virtual outro session (online).

As an output of the work, we ask you to prepare short presentations of the group work and reflections on interdisciplinary teamwork and modeling of neurological diseases.

Further Information:

As you can see in the syllabus, we will iterate between online (Zoom) and onsite sessions. Additional details regarding software to be installed before the workshop will be provided in due course. Since the project will involve combining expertise from both the biological/neuroscientific and the programming/computational world, there is no formal need for prior programming knowledge and some introduction will be given during a dedicated day. Nonetheless, to allow for a smooth completion of the group work, we will limit the number of participants that have no knowledge of programming to one per group.

Registration Information:

This is a course with limited spaces with strict selection of participants. For registration (and inquiries), please send us an email with your university, full name, field of study + semester, between 3 and 5 sentences about why you want to attend and why you should be accepted to the course (what can you bring to the group work) and one sentence on your previous knowledge in neuroscience and programming and whether you want to attend the programming day. In your statement we ask you to confirm that you will attend all sessions and participate in the group work. Please send all the information to: computationalneurology@ruhr-uni-bochum.de