

# MADRID GLOBAL BRAINHACK

## 3-5 May 2018

**ETSI Telecomunicaciones (UPM). Edificio A**  
**Av. Complutense, 30, 28040 Madrid**



Join us in:

<http://www.brainhack.org/global2018/>

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## WHAT IS A BRAINHACK?

A brainhack is an event that brings together people interested in the brain to work on projects related to neuroscience. Madrid Global Brainhack is part of an International initiative where different spots around the world host the Brainhack simultaneously. Its aims is to promote collaborations within Spain and to create an international community of scientists interested in the brain. We will also offer educational sessions, like hands-on tutorials on basic tools of open collaboration.

Brainhack is great for any level of expertise, this is an occasion to learn new methods, develop new skills, meet new people, and just have fun! During the event there will be unconference sessions, including presentations on ongoing projects of the participants, ideas that could seed future collaborations or panel discussions.

From the organization we will propose you some hacking-challenges, some of them could be published and others could be presented to prizes such as *MATLAB Online Live Editor Challenge* or the National Hackathon of e-Health in June. However, you can also bring your own data from your lab. personal projects, doubts about scripting...and your laptop!.

Finally, in this edition, you can work together with some of the main international references in computational neuroscience (see Lectures).

### Organizers:

**José Pedro Manzano**, Centro Nacional de Investigaciones Cardiovasculares (CNIC)

**Robert Austin Benn**, Centro Nacional de Investigaciones Cardiovasculares (CNIC)

**José L. Ayala**, Universidad Complutense de Madrid (UCM)

**Guillermo Asín Prieto**, Neural Rehabilitation Group (Instituto Cajal, CSIC)

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### FAQS

#### - When and where?

May 3-5, 2018, ETSI Telecomunicaciones (UPM), Madrid.

#### - How to join?

Places are limited, so register now to book yours. There is a registration fee of €15 which will cover coffee, snacks and lunch. Also the social event of the first day will be covered.

<https://madrid-brainhack-global-2018.eventbrite.es/>

#### - Who is it for?

We are inviting anyone from **neuroscience, computer science, engineering, biology, mathematics, philosophy, psychology, statistics, art and many other areas** to work on innovative projects related to the brain

## TUTORIALS



### **"Creating and distributing Neuroimaging Tools in the Cloud with the QMENTA SDK"**

Albert Puente, Software Engineer in QMENTA.  
11.00 - 13.30h. May, 3.

Sala de Grados, Edificio A. ETSI Telecomunicaciones (UPM)

The opening tutorial of the Brainhack is a broad review of the most common tools needed in neuroimaging, from programming skills such as Bash and Python to Open Software such as FSL, ANTS, etc. QMENTA provides for the Brainhack an exclusive Docker environment with all the necessities (data, software, libraries, ...) to automatate full analysis pipelines. Moreover, they allow connection to their cloud and computational resources during the Brainhack. Finally, Albert will present the **QMENTA SDK Challenge**.



### **"Human neural electrophysiological basics and its applications"**

Guillermo Asín-Prieto, Aitor Martínez, Neural Rehabilitation Group from Instituto Cajal (CSIC).

14.30 - 17.00h. May, 3.



Sala de Grados, Edificio A. ETSI Telecomunicaciones (UPM)

A brief introduction for those people who have never or barely worked with human electrophysiological signals. The tutorial will start with basic physiological concepts and a live demo of signals acquisition under several conditions. They will show how to set up and acquire some electrophysiological signals, and will propose some challenges related to brain machines interfaces.



### **"MRI Basics: fMRI and resting-state"**

Robert Austinn Benn, Centro Nacional de Investigaciones Cardiovasculares (CNIC).

17.30 -19.30h. May, 3.

Sala de Grados, Edificio A. ETSI Telecomunicaciones (UPM)

Austin will provide a basic background and introduction to functional Magnetic Resonance Imaging (fMRI). In the process he'll go over all the basic preprocessing steps required, touch on the general linear model in task based fMRI, and dive a little deeper into resting state fMRI, "model free" analysis of data. He'll also briefly touch on best practices in each section.

## LECTURES



### **“Big Data in neuroimaging: Analysis of 100,000 datasets in UK Biobank”**

Fidel Alfaro Almagro, FMRIB (University of Oxford).

11.30 - 12.15h. May, 4

Sala de Grados, Edificio A. ETSI Telecomunicaciones (UPM)

UK Biobank is a prospective epidemiological study of over 500,000 individuals (40-69y when recruited) in the UK. Blood, urine and saliva samples were collected, samples for genetic analysis and physical measurements taken, and each volunteer answered an extensive questionnaire on aspects of health and lifestyle. Additionally, brain, heart and body imaging from 100,000 of the participants is now being acquired (17,000 to date). The brain imaging comprises 6 modalities (T1w, T2 FLAIR, resting fMRI, task fMRI, diffusion MRI and susceptibility weighted imaging) and has been highly optimised to run in 35 minutes.

Brain imaging data is not immediately usable for most research purposes in its raw form. It needs to be processed and analysed in a specific replicable manner for the outcome of an analysis to be valid and meaningful; the way in which such tools are applied is referred to as a “processing pipeline”. UK Biobank needs a pipeline that can process and integrate many modalities; it must be robustly automatable.

Our pipeline also generates 4000 “imaging-derived phenotypes” (IDPs) aiming to identify biomarkers for early diagnosis. These include metrics such as subcortical structure volumes, white matter hyperintensities, microstructural measures in major tracts, and structural/functional connectivity metrics.

Finally, due to the huge number of subjects, manual analysis would be too costly, so we have developed an automated Quality Control tool using machine learning methods to identify images with problems either in their acquisition or in later processing steps.

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### **“Advanced Visualization Tools for Brain Connectivity”**

Vesna Prchkovska, COO and Co-Founder of QMENTA

12.30 - 13.15h. May, 4

Sala de Grados, Edificio A. ETSI Telecomunicaciones (UPM)

Neuroimaging has advanced rapidly in the last two decades. The MRI scanners are getting more powerful offering rich data that can provide detailed insights on the brain structure and function. New computational tools are being developed at a fast pace, and machine learning and big data are the new trends in brain imaging. In this talk I will address some of the most notable advancements in brain imaging and brain connectivity in the recent years.

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### **“The whole-brain dynamics underlying different brain states”**

Gustavo Deco, Computational Neuroscience Group (Univ. Pompeu Fabra).

16.00 - 17.00h. May, 4.

Sala de Grados, Edificio A. ETSI Telecomunicaciones (UPM)

A given brain state could be defined by the broadness of communication, i.e. the dynamical complexity of the underlying network activity sustained by a static structural anatomical connectome. Here, we review whole-brain dynamics and computational modeling aiming to address this important problem. We propose that combining this powerful new data-driven framework with a causal whole-brain computational model can provide novel insights into underlying mechanisms of different brain states. Furthermore, we will discuss how to use the present framework for not only describing healthy brain states but also its breaks down in disease.

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José Luis Pons, Neural Rehabilitation Group (Insituto Cajal, CSIC)

17.30 - 18.30h. May, 4

Sala de Grados, Edificio A. ETSI Telecomunicaciones (UPM)

## **BIG DATA & MACHINE LEARNING CHALLENGES**

Each participant can bring his own proposal or propose it directly to the organization prior to the event. Nevertheless, the organization and invited speakers will propose different projects:

- **CNIC-QMENTA Challenge.** During the Brainhack, the CNIC-QMENTA Challenge will be launched, keeping opened until the National Hackathon of e-Health, where the projects of each team will be presented (<http://laesalud.com/hackathonsalud/>). The requisites are to use the SDK toolkit offered by QMENTA to solve the clinical problem proposed (coming soon).

**The prize is valued in more than 1000€: 750€ + 3 months of QMENTA's cloud availability (to use the SDK) + some guidance by QMENTA experts + co-author of publication (if exists some developing or finding during this time).**

- **Reproduction of a paper results:** The advances and developments in the field of neuroscience have experienced huge advances and findings last 20 years. From the genomics and basic research to neuroimaging and cognitive sciences, the variety of tools, as well as the improvement of techniques and technology, has led to vast amounts of data via the open science community. The requisites imposed by science career, the fast pace of these developments and the increase of programming requisites may produce that many people from life sciences background's get lost.

In this challenge, a paper focused on Machine Learning methods without the "Results" and "Conclusions" is given to the teams in order to compare if the results obtained are similar with the originals, that is, if the results are reproducible.

The results of this challenge could be considered to develop as a publication for the Replication Award of the Organization for Human Brain Mapping (OHBM) (<https://www.humanbrainmapping.org/i4a/pages/index.cfm?pageid=3731>).

- **Matlab Live Editor Challenge:** Develop any of the other challenges in this new format in Matlab and submit the project to the MATLAB Online Live Editor Challenge (<https://www.mathworks.com/academia/student-challenge/matlab-online-live-editor-challenge.html>). IMPORTANT! For this challenge, you must need to have already installed the last version of MATLAB in your laptop or create an account in Mathworks to use the Online version of Matlab.

- **EEG Challenge from the Cajal Insitute Can you decode human neural electrophysiological signals?**

We are going to record electrophysiological signals during motor, sensory, memory, thinking and verbal tasks, and we want you to try and decode these data to tell apart the different recording conditions. Having in mind promising applications in the world of brain machine interfaces.

The agenda could be updated with more challenges. For all the projects, the tools and the SDK provided by QMENTA could be used (highly recomendable).

The Property and Intellectual Rights of the work developed in the Brainhack belongs to his author. The organization supports the publication of any results or work done during the event.

**(Tentative) PROGRAMME - SCHEDULE**

	THURSDAY 3	FRIDAY 4	SATURDAY 5
9:00 - 9:30	Registration	Let's Hack	Let's Hack
9:30 - 10:00	Welcome & Icebreakers		
10:00 - 10:30	Project Pitches		
10:30 - 11:00	Coffe Break		
11:00 - 12:15	Let's Hack/ Tutorial I: Programming Skills + QMENTA SDK Challenge	<b>Fidel Alfaro:</b> “Big Data in neuroimaging. Analysis of 100.000 datasets in UK Biobank”	Let's Hack
12:15 - 13:30		<b>Vesna Prchkovska:</b> “Advanced Visualization Tools for Brain Connectivity”	Project Presentations Brainhack Wrap-up
13:30 - 14:30	Lunch		
14:30 - 16:00	Let's Hack / Tutorial II: EEG Basics	Let's Hack	
16:00 - 17:00		<b>Gustavo Deco:</b> "The whole-brain dynamics underlying different brain states"	
17:00 - 17:30	Coffe Break		
17:30 - 18:30	Let's Hack / Tutorial III: MRI Basics	<b>José L. Pons</b> - tbt	
18:30 - 19:30		Ignite Talks PhD & Poster Presentation	
21:00 - 23:00	Social Dinner	Social Dinner*	