Advanced techniques for functional and structural neuroimaging of the cerebellum

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Recent years have seen a resurgent interest in the human cerebellum, a brain structure challenging to image but essential to human cognition. Improved data quality and advanced analysis techniques now allow neuroscientists to better understand the many functions of this highly folded brain structure. This is an important development, as the cerebellum contributes to mental function across a wide range of domains, including motor control, cognition, language, and emotion. Disruption of cerebellar function has been implicated as a risk factor for many neuropsychiatric disorders. In this course, we will cover the current state of the art of cerebellar imaging, starting from the choice of structural and functional acquisition protocols, analysis pipelines, atlas normalization, and visualization techniques. We will do so in a short series of six different lectures, 2 of which will include hands-on interactive demonstrations of the software packages Nighres and SUIT.

Objective

Learning objectives will be to (1) know what can be achieved in terms of cerebellar image contrasts, both functionally and structurally and (2) how to go about analysing this data. To help achieve these goals, an application-oriented lecture is also included.

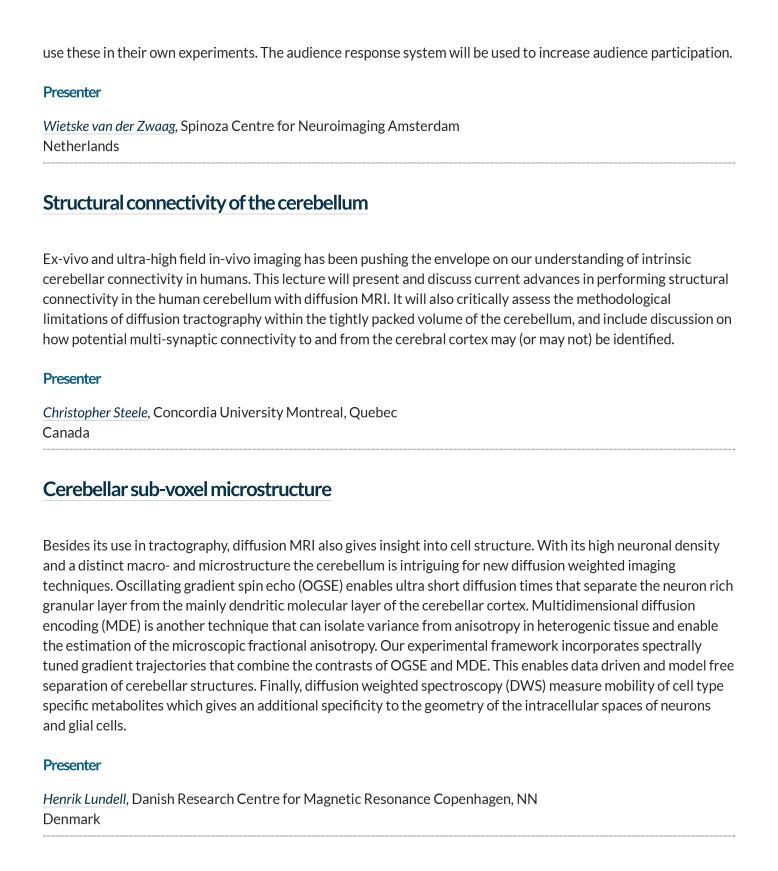
Target Audience

We welcome all neuroscientists interested in whole-brain studies, as well as those interested specifically in the cerebellum.

Presentations

High resolution and high SNR in the little brain

The fine structure of the cerebellum necessitates high spatial resolution, which in turn limits the available signal to noise ratio in cerebellar MRI. This lecture will discuss the possibilities of improving on that SNR and spatial resolution, specifically in the cerebellum. The use of ultra-high field, dielectric pads, multi-channel transmit and local coils will be discussed in such a way that the audience should be able to make an informed choice on how to



Functional segmentation and atlases for the human cerebellum

This lecture will cover recent developments in the SUIT toolbox for analysis of cerebellar imaging data, including isolation, group normalisation, and surface-based visualization. Traditionally, neuroimaging results have been summarized in terms of the 10 cerebellar lobules. However, new task-based functional atlases of the cerebellum now show that these anatomical boundaries do not corresponding to functional subdivisions – and instead suggest alternative ways to subdivide the cerebellar functionally. The presentation will include hands-on demonstration of analysis tools and online atlasses.

Presenter

<u>Joern Diedrichsen</u>, the University of Western Ontario London, Western Ontario Canada

Cerebellar segmentation and cortical mapping

The cerebellar cortex is a tightly folded structure tucked under the cerebrum. While obtaining a complete cortical map is still beyond the capabilities of modern MRI, the geometry of the lobules can already be captured. This lecture will present a processing pipeline for estimating the cortical surface of the cerebellum from high resolution MRI with the open source Nighres toolbox. Cortical surface inflation, mapping, and partial volume correction via depth modeling will also be covered. The methods will be demonstrated on open data during the presentation.

Presenter

<u>Pierre Louis Bazin</u>, University of Amsterdam Amsterdam, NH Netherlands

The role of the cerebellum in language and neurodevelopmental disorders

In humans, the cerebellum constitutes 10% of the total volume of the brain. Though historically considered a motor structure, the vast majority of the cerebellum is functionally and anatomically connected to associated cortices. Neuroimaging research shows that the cerebellum is consistently active during cognitive tasks. This lecture will present research on cerebellar contributions to complex cognition including language processing and discuss how cerebellar dysfunction may be associated with neurodevelopmental disorders.

Presenter

Anila D'Mello, MIT Boston, MA	
United States	