

Popular science summary of the PhD thesis

PhD student	Anders Stevnhoved Olsen
Title of the PhD thesis	Uncovering brain dynamics using directional statistics and functional neuroimaging data
PhD school/Department	DTU Compute

Science summary

* Please give a short popular summary in English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology.

What happens in your brain when you're doing nothing at all? And is this "resting state" different, e.g., when you're conducting a task, sleeping, or experiencing mental health conditions like depression? Understanding this could unlock important insights into brain function in both health and disease.

Brain areas don't work in isolation—different regions communicate in complex networks, which can be observed using brain imaging techniques like functional magnetic resonance imaging (fMRI), which measures brain activity over time. Traditional methods for analyzing *connectivity*, i.e., the similarity between brain regions, rely on averaging signals over long periods, potentially missing the brain's rapid, ever-changing dynamics.

This thesis develops new mathematical and statistical tools to capture brain connectivity at every moment, rather than smoothing over time. The key idea is to model the brain as a collection of synchronized oscillators. By refining the way we detect patterns in these oscillations, we can better understand how the brain's networks shift from moment to moment. Additionally, this work introduces methods to analyze data from multiple imaging techniques, such as EEG and MEG, which measure electrical and magnetic brain activity. By integrating data from different individuals and different scanning technologies, the research strives to provide a more complete and reliable picture of brain function.

These new approaches pave the way for more precise studies of the brain in action—helping us understand the dynamics of brain networks.

Please submit the summary to the department PhD coordinator together with your thesis