Diffusion MRI is an MRI technique sensitive to the motion of water molecules at the microscopic scale. A relevant application of this diffusion MRI is fiber tractography, a technique which attempts to reconstructs the organization of brain connections. The whole set of brain connections reconstructed with diffusion MRI is often referred to as connectome.

The connectome has been shown to provide valuable information about the brain's structure and organization, with relevant applications to major neurological diseases. In particular, whole-brain tractography has shown promising results in characterizing structural differences in patients with Alzheimer's disease as compared to healthy individuals. A current challenge in fiber tractography is the large number of user parameters it involves and the lack of guidelines on their setting, which can lead to great differences in outcome. Accordingly, the aim of this study is to evaluate the effect of user parameters in fiber tractography when investigating differences between healthy controls and patients with dementia patients and provide guidelines for their choices in future studies.

The data employed during this research consisted of 3T MRI scans and cognitive assessment of 59 dementia patients and 47 control subjects. We evaluated the impact of specific fiber tractography parameters (angle threshold, termination criteria), ways of constructing the connectome, and considered connectome measures.

Our results show that the relatively simple DTI-based fiber tractography approach outperforms more advanced approaches based on spherical deconvolution. Furthermore, user parameter choices have a relevant effect on connectomics and network analysis and subsequent analysis steps. In particular, we observe that leanant parameters (e.g., high tolerance in angle threshold or termination fractional anisotropy) result in good discriminative power between patients and controls, whereas conservative parameters aimed at minimizing false positives (e.g., low tolerance) can have detrimental results on the discriminative power. Besides these general guidelines, we identify a subset of parameters that provide the best discriminating performance between healthy controls and dementia patients, which can serve as useful basis for future studies.