

Purpose: We propose to characterize the spatial distribution of PET-derived voxel statistics within anatomically-defined Regions Of Interest (ROIs) as a means to characterize disease-related changes.

Methods: We used 3D moment invariants (3DMIs) to characterize the spatial distribution of PET data ([¹¹C]Raclopride, [¹¹C]Tetrabenazine and [¹⁸F]Fluorodopa) recorded from subjects with Parkinson's Disease (PD) and healthy controls. 3DMIs are mathematical spatial descriptors designed to be invariant to scaling, translation and rotation. In fMRI studies, assessing the spatial characteristics of voxel-based statistics has recently been shown to be a powerful and sensitive method to characterize brain activation. Crucially, this allows characterization of the spatial characteristics of activation without the need to warp brain images to a common brain template. Analogously, we propose characterizing the spatial distribution of PET-derived voxel statistics within anatomically-defined ROIs using 3DMIs. The 3DMIs used here were a combination of terms describing spatial variance, skewness and kurtosis. Subjects also underwent MRI scans so that the T1-weighted MRI data could be used to anatomically delineate basal ganglia ROIs to act as binary masks on the PET data.

Results: 3DMIs were found to accurately describe the “3D texture” of PET images despite changes in the size and orientation of these regions across subjects. In addition, we were able to find differences in the 3DMIs of PD patients distinct from those of healthy volunteers. These changes suggest that disease-related variations in the spatial distribution measured using PET can be quantitatively described with the proposed method.

Conclusions: This method shows great promise to extract additional information from PET data with a wealth of potential applications to disease diagnosis, staging, treatment assessment and more. The quantification of the observed disease-related changes for PD subjects is currently under way.