Local and Global Features in 3D Biomedical Image Classification

Supervisor: Jaromir Kukal, PhD.

Medical diagnosis of neurodegenerative diseases is based on 3D imaging of the human brain using CT, MRI, PET, and SPECT techniques, which are focused on both anatomical and physiological properties of the brain structures. The research will concentrate on the development of novel computer-based 3D image analysis and classification techniques based on advanced mathematical and statistical principles.

There are numerous methods of local image analysis that differ in efficiency and time complexity. The first goal will be to create new local features of 3D images that can be used to diagnose brain diseases. It is also the goal that the calculations of these features be time-efficient due to the embedded fast Fourier transform, which will form a part of the utilized nonlinear algorithms. These features will be tested on spatially normalized 3D scans, and the resulting local brain changes will be used as characteristics for disease diagnosis.

A similar situation arises in the case of global image analysis, where the standard techniques are well known. The second aim will be to design new global features of 3D images that will not require spatial normalization of the scans.

The theoretical background of the feature design includes orthogonal functions and the Fourier transform. Classifier design and analysis will incorporate the theory of Hilbert spaces. The novel features and classifiers will be directly applicable to 3D PET and SPECT brain scans used for Alzheimer's disease diagnostics.

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