Image segmentation methods integrating texture analysis and deformable models

The proposed project is focused on image segmentation algorithms based on deformable models and texture analysis. The project will result in creation and implementation of novel and efficient segmentation algorithms that will be suited for practical application in medical image analysis. Image segmentation can be defined as partitioning of the image into a set of separated regions that differ by some specific characteristic, such as intensity or texture. It is one of the most necessary but difficult tasks in computer vision, especially in the analysis of medical images. One of the most successful groups of segmentation algorithms are deformable models – a class of methods based on a deforming shape that tries to adapt to a specific image region under the influence of internal and external forces. The external forces attract the model toward desired image features, while the internal forces control its smoothness and continuity. Simple image features can be based on edge and intensity of the region. Texture features can provide a more advance way of describing the segmented region according to its uniformity, repeatability and directionality of its pattern or contrast.

The research will be conducted on two- and three-dimensional synthetic data sets, as well as computed tomography and magnetic resonance imaging studies. The work will be focused on addressing the current problems in integration of texture analysis with defor;mable models, like feature selections, parameter estimation, 3D feature usage and computational performance. The research will consist of design and implementation of two- and three-dimensional deformable model-based methods and their adaptation and validation in medical applications. To overcome the common performance problems, the implementation of the developed methods will make a heavy use of general-purpose computing on graphics processor units (GPGPU).

Image segmentation is one of the fundamental tasks in computer vision. The manual segmentation process can often be difficult and labor-intensive, especially in the case of large data sets, therefore it is necessary to create new and more efficient segmentation techniques. Effective and reliable segmentation is one of the most important tasks in the medical image analysis. The extraction of specific organs, tissues or pathological changes is often necessary in diagnostics, preoperative planning, surgical implant design and visualization in augmented or virtual reality-based methods. Further work on segmentation methods is necessary to keep up with the ongoing improvements of the imaging techniques.