Model-based autosegmentation of brain structures in the honeybee using statistical shape models

K. Neubert[1], H. Lamecker[2], H.-C. Hege[2], R. Menzel[1], J. Rybak[1]

[1] Institute of Neurobiology, Free University of Berlin, [2] Zuse Institute, Berlin

Surface-based brain atlases like the Honeybee Brain Atlas (www.neurobiologie.fu-berlin.de /beebrain/),(Brandt et al.,2005)[1] compare neuronal morphologies in a 3D context, and serve as databases and communicative platforms. Transforming neurons into the atlas requires manually segmenting neuropils in confocal images, a time-consuming task requiring expertise in identifying biological structures which can result in different outcomes from various segmenters.

Statistical shape models are promising approaches for automatic segmentation of 3D medical data (CT)[2]. A deformable linear 3D neuropil model is generated by principle component analysis (PCA) of a set of training shapes; it consists of an average shape and the most important variations of the training shapes. We use a statistical 3D-model of the bee calyx, derived from synapsin-stained brains[1]. We aim for robust automatic segmentation of neuropils in confocal data based on the shape of already-segmented calycal structures and image properties. To initialize the shape model, an affine registration of a grey value dataset is applied to a reference dataset (contained in the shape model statistics). Then the shape model is deformed via a segmentation strategy to match the image. This surface displacement is computed by analyzing grey value profiles along surface normals.

Our results reveal a good fit at the high-contrast calycal neuropil areas and greatly reduced work time. We currently focus on optimizing the displacement algorithm at low-contrast brain regions, which in the future will also help in developing automated segmentation strategies adapted to time-saving, low-contrast neuropil stainings.

[1]Brandt et.al. (2004) Three-Dimensional Average-Shape atlas of the honeybee brain and its applications. JCN **492**(1):1-19. [2]Lamecker et.al. (2004). A 3D statistical shape model of the pelvic bone for segmentation. Proc.of SPIE-Medical Imaging: Image Processing (JM Fitzpatrick, M Sonka,eds.) v.5370, pp.1341-51.

Keywords (according to Abstract submission guideline): New Technologies