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Integration direktional farbkodierter Tensorschichtdaten in die Neuronavigation

Integration of stacked directional colour-coded tensor data into a neuro-navigation system

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Introduction

Tensor data such like diffusion tensor imaging (DTI) provide information about shape and orientation of brain white matter structures and should be integrated into neurosurgical planning. If applied to neurosurgical resection of brain tumours infiltrating white matter fibre structures, it may allow the sparing of eloquent fibre tracts resulting in a reduction of postoperative morbidity. A great demand exists, therefore, concerning the transfer of DTI images into neuronavigation systems. So far, systems customary in commerce do not support this integration.

Methods

To visualize tensor data, the direction and value can be coded by colour hue and intensity respectively. Some software packages (e.g. DTI Taskcard, MGH, Boston, USA) support the export and transfer of true colour coded directional DICOM data.
Our software dic2openmind allows to convert the DICOM data into the OpenMind format which can be read by the planning software of the BrainLab neuronavigation system. This format currently supports only grey value volume data. Therefore the original true colour data need to be approximated by a smaller indexed colour table which has to be available on the navigation system. This is achieved by a nearest colour recoding algorithm.
To reduce visualization related artefacts, a prior linear interpolation was included in the pre-processing. For visual inspection of possible colour differences both the original and the converted data as well as numerical difference images are displayed to the user by the software. Finally the information provided by the transformed DICOM data is used to create an OpenMind compliant header and data file.

Import of the converted data, registration with other imaging modalities, and export for the navigation system can then be performed by the BrainLab software PatXfer(OpenMind) and VVPlanning according to the standard procedures. In a final step the corresponding colour table has to be selected for the grey value coded tensor data to display it in colours.

Results

The presented algorithm allows to integrate colour coded data (such as DTI) into neuronavigation routine procedures and use it for planning and intraoperative navigation. Experiments revealed that colour reduction artefacts due to indexing in the navigation systems colour map could be further reduced by a customized colour map.

Discussion

As can be seen in figure 1, there are still artefacts present in the displayed data (small borders of different colours around otherwise homogeneous structures). These artefacts can be reduced either by a higher resolution of the original data or by additional interpolation in the preprocessing step on the cost of increased memory.
Due to the limited number of colours in the colour maps currently available on the BrainLab navigation system, only high intensity voxels are represented in the converted data. For surgical application, this seems not to be a disadvantage since, bright voxels are considered to represent locations with high anisotropic diffusion and are thus the most important data points.

Acknowlegdements

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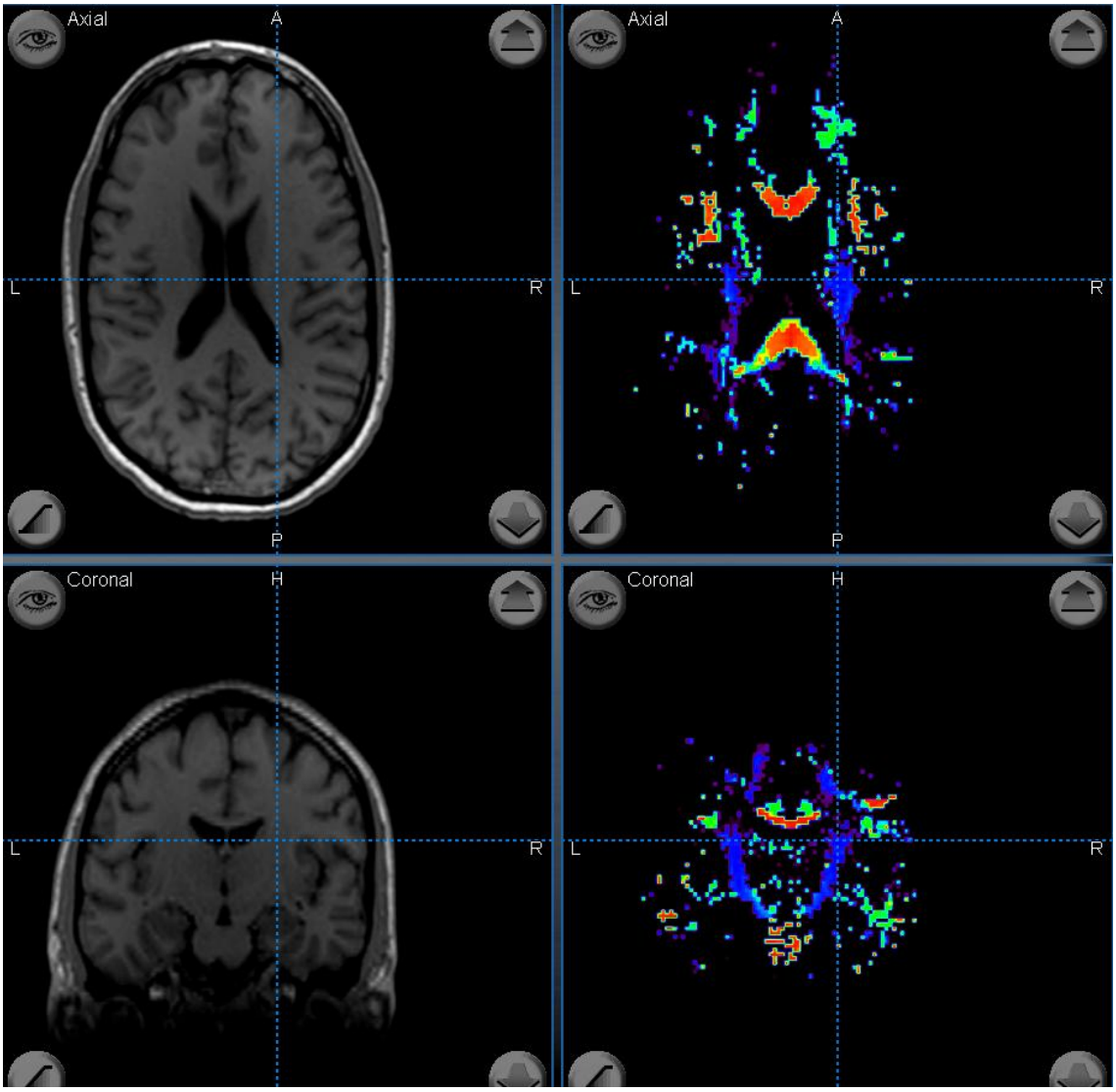
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