Design, programming and testing of automatic quality assessment tools for brain magnetic resonance images

Artefacts in medical magnetic resonance imaging (MRI) can be caused by both technical and human factors. Early artefact detection may have a positive impact on the duration of an examination and the accuracy of a treatment, or may be used to ensure high image quality standards in clinical trials. The main objective of this work was to design, implement and test automatic MR artefact detection software. The focus of this project was put on two artefacts, the radiofrequency (RF) artefact and the motion artefact. In the case of the RF artefacts, two procedures were implemented using information from the spatial and frequency domain, respectively. The first tool located bright intensity lines in the phase encoding direction of the images by calculating the projection of the pixels in the background and detecting the abrupt changes of intensity. The proposed algorithm has a computing time of approximately one minute per 3D brain MRI, and a sensitivity of 100 % as well as a specificity of 93 % and will be embedded in a real time quality assessment framework. The second procedure detected RF lines by looking for high intensity points in the Fourier space using mean intensity and variance projections. However, due to its dependency on the imaged object, this procedure still could be improved by several pre-processing steps. The features of motion artefacts in Fourier transformed images were analysed qualitatively and further steps for the detection of these errors in the frequency domain were proposed. In conclusion, a substantial basis for the automatic detection of RF artefacts and motion artefacts in brain MR images was established.