AUTOMATED ANALYSIS OF MRI QUALITY ASSURANCE IMAGES

T. Mäkelä1,2, T. Ihalainen1 and O. Sipilä1

1Helsinki Medical Imaging Center, FI-00029, Hospital District of Helsinki and Uusimaa
2Department of Physics, P.O.B. 64, FI-00014 University of Helsinki
email: teemu.makela@hus.fi

Phantom-based image quality estimation is an essential part of any modern MRI scanner quality control (QC) programme. A standardized test object mimics the magnetic properties of soft-tissue and has a well-known geometry and good temporal stability. This makes long-term monitoring, as well as comparison between instruments, convenient. Ideally the specific structures included inside the phantom would allow individual estimation of each parameter of interest. The accreditation phantoms designed by the American College of Radiology (ACR) [1,2] are widely used in MR equipment acceptance and quality assurance testing [3]. The suggested analysis can be carried out manually on any radiology workstation. The primary purpose of this project was to automate this somewhat tedious procedure and furthermore decrease the subjectivity of the results.

A MATLAB [4] program was written to automatically analyse images acquired of ACR head and knee multi-purpose phantoms. Graphical user interface allows the operator to either view and confirm the results or modify parameters and re-analyse the images. Implemented subroutines estimate signal-to-noise ratio, geometric accuracy, slice location and thickness, resolution, image intensity uniformity and ghosting artefact. The reliability of the software was verified by using simulated test images imitating degraded MR acquisitions. Finally a comparison was made between manual and automated analyses of 35 sets of images. Data were available from thirteen scanners of three major manufacturers with field strengths of 1, 1.5 and 3 teslas.

The advantages of computer aided analysis were evident. Tailor-made tools for each step reduced time consumption considerably and improved objectivity. Increased sensitivity of certain methods (e.g. ghosting) resulted in findings that were previously missed in visual investigation. Future work will include thorough evaluation and improvement of current routines and development of additional image quality tests.

[1] Phantom Test Guidance for the ACR MRI Accreditation Program, American College of Radiology, Reston, VA, 2005