PAQAP: a quality assessment protocol for MRI

P. Vandemaele[1], R. Achten[1], and Y. De Deene[2]

[1]MR Department, Ghent University Hospital, Ghent, Belgium, [2]Radiotherapy, Ghent University Hospital, Ghent, Belgium

Introduction

Quality assessment (QA) in MR imaging provides clinicians/researchers with objective measures of the performance of their MR scanner and protocol.
There are some very important reasons to set up a QA protocol at an MR site: 1) QA enables early detection of failure in the different components of the MR system. 2) Research applications like quantitative MRI or gel dosimetry require often more stringent specifications then the ones guaranteed by the manufacturer. 3) When new MR components are installed, the user can independently check the specifications of the new MR system configuration and compare them with previous assessed configurations. 4) The source code of new sequences is often not provided. Adequate QA can help in characterizing the performance of new sequences e.g. slice profile, intrinsic resolution and signal-to-noise ratio. 5) Short and long-term stability measurements enable clinicians/researchers to check the overall performance of the MR scanner. 6) QA can also play a valuable role in multi-centre comparison.

The aim of this abstract is to present *PAQAP* (Pieter's Automated Quality Assurance Protocol), a combination of a QA phantom and an elaborate software program for full automatic data analysis and report generation.

Materials and Methods

The Multi-Purpose Gel Phantom (MPGP)

The cylindrical phantom is made from polymethyl-methacrylate (PMMA) (Siemens, Erlangen). The inner diameter is 170mm, the inner length is 125mm. It is filled with a gelatine gel and an anti-fungal agent. The phantom contains eight sections as shown on figure 1. The distance of the centre of two adjacent sections is 15mm. The PMMA-cast produces non-signal structures in the MR images.

The different sections of the phantom (see figure 1) provide quantitative information about: 1) high contrast spatial resolution, 2) signal uniformity and structural and stochastic signal-to-noise ratio, 3) slice profile, 4) quadrature ghosts and spatial linearity, 5) phase encoding ghosts, 6) transmit quadrature ghosts, 7) slice position and slice warp and 8) T1/T2 contrast/relaxation times.

The software

The analyzing software is written in Matlab (The Matworks, Inc) , a high-level vector-based programming language and environment ideally suited for image processing and algorithm development. The acquired QA scan data are stored on a CD and transferred to a PC. The DICOM images are then full automatically analysed and a HTML based report is generated for publication on a network.

Results and discussion

The software contains several Matlab procedures.
The features of the software are:

- ✓ Modular setup for easy customization and expansion
- ✓ Batch script processing for analysis of large datasets
- ✓ Full automatic analysis of data
- ✓ Generation of visual representation of the performance parameters
- ✓ Generation of long term stability data
- ✓ Generation of HTML based reports
- ✓ Additional parameter reports
  (e.g. Helium level, shield temperature, …)
- ✓ Display of the scanner status
- ✓ All data processing within 1 minute

Several sequences can be tested with PAQAP. However, one should be aware that a minimum base resolution of 192x192 pixels is required for adequate image processing. To be able to test low resolution sequences, e.g. echo-planar imaging, a light version of PAQAP called *miniPAQAP* is developed, containing the signal-to-noise ratio, spatial distortion and phase encoding ghosts modules and a graphical user interface.

All acquired and processed data are stored on the processing PC for long term stability data generation. A sudden change in the long term stability data can then easily be tracked to the event which changed the machine configuration. Also the performance of the scanner after a change in the configuration can be compared to the performance before the change.

Conclusion

The PAQAP system provides an easy way to acquire and process QA data on a regular basis with minimal interaction and within a limited time frame. The QA can be performed on a daily basis by an MR technologist. The system will be implemented and systematically used in a QA program at the experimental MR site at our hospital.

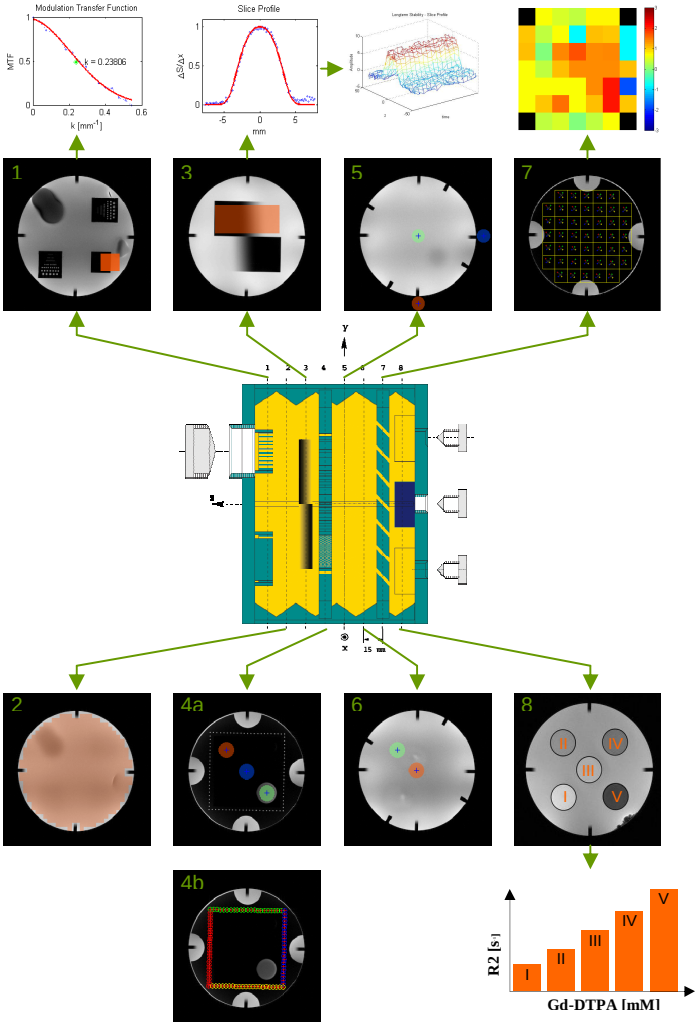

Figure 1: The Multi-Purpose Gel Phantom with the eight different sections and some visual output generated by PAQAP.