**Introduction**

MR simulation for Radiation Therapy (RT) is desirable due to its superior soft tissue contrast when compared to CT [1,2,3]. However, inherent spatial distortions in MRI have been found to exceed 5 mm in regions away from isocenter, which is not ideal for RT planning. Thus, measuring and tracking this distortion is necessary for treatment planning with MRI. Availability of open source algorithms may allow centres to independently test and compare results from vendor provided software during the commissioning of an MRI QA program.

**Objectives**

To develop and validate an open source software solution for calculating, visualizing, and tracking MRI distortion on anthropomorphic grid phantoms.

**Methods and Materials**

The phantoms used in this study are the CIRS MRI distortion phantom for SRS (Model 603A) and the CIRS Large Field MRI distortion phantom (Model 604), as seen in Figure 1. Both phantoms contain 3D orthogonal grids of rods whose intersections are used as principle points for CT and MR image comparison. The SRS model also contains anthropomorphic skull features.

![603A Phantom](Image)

**Figure 1:** For the 603A the grid spacing is 15mm, For the 604 the spacing is 20mm.

High resolution CT images of the phantoms were taken on our GE LightSpeed CT system. MRI images were obtained using our 3T Siemens Skyra MRI system using a three dimensional image sequence. These images are processed using modules developed in 3D Slicer, as shown in Figure 2.

![604 Phantom](Image)

**Results**

Siemens’ built-in distortion correction significantly reduced the maximum distortion from 3 mm to under 1 mm. For the 604 phantom, our software in this example calculated 79.5% of the gridpoints accurately and found a maximum and average distortion of 2.57 mm and 0.91±0.47 mm. The calculation time for the open source algorithm over the 604 phantom was < 2 minutes, and < 1 minute for the 603A phantom. Initial comparisons between our open source calculated results to CIRS Inc. beta online software yielded similar results (we observed a relative difference of ~10% in the number of points identified).

**Conclusions and Future Work**

The 3D Slicer module is an open source tool to calculate and track distortions map over a variety of phantom sizes. In comparison to CIRS online Distortion Check tool, we have demonstrated there is a good agreement between the two calculation methods. We are currently working towards, eliminating the need for users to find a suitable image threshold, an and automatic registration of reference grid-points and MRI grid-points.

**References**


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