ABSTRACT SUBMISSION FORM

Please email to: info@mriinrt2018.com with 'abstract' as the subject

6th MR in RT Symposium 2018

Name (First, last)	Emily Johnstone
Mailing address (including province/state, country, postal/zip code)	Leeds Institute of Cancer and Pathology, St James's University Hospital, Beckett Street, Leeds, LS9 7TF, United Kingdom
Institution/organization	University of Leeds
Position	PhD student
Telephone (including country prefix)	01132667921
Email	umerj@leeds.ac.uk

The submission is to be considered in the following category	Trainee status
☒ Oral presentation preferred	☒ I am a trainee (student or postdoctoral fellow)
☐ Poster presentation only	☒ I wish to be a candidate for best student paper/poster

PRESENTATION TITLE

Characterising the temporal stability of full field of view MRI geometric distortions on multiple scanners

AUTHOR(S)

Emily Johnstone[1*], Jonathan Wyatt[2], David Broadbent[3], Hazel McCallum[2], David Sebag-Montefiore[1,4], Susan Short[1,4], Charles Kelly[2], Louise Murray[1,4], Bashar Al-Qaisieh[4], Ann Henry[1,4], Richard Speight[4]

1. *University of Leeds, Leeds, United Kingdom*
2. *Northern Centre for Cancer Care, Newcastle-upon-Tyne, United Kingdom*
3. *Department of Medical Physics and Engineering, Leeds Teaching Hospitals NHS Trust, Leeds, United Kingdom*
4. *Leeds Cancer Centre, Leeds, United Kingdom*

ABSTRACT

Purpose: MRI provides excellent tissue contrast, however the modality suffers from geometric distortions which may impact on clinical applications in radiotherapy, such as the registration of MRI and CT images and in MRI-only planning. The work presented here characterises the temporal stability of these distortions over the full field of view (FOV) on multiple MRI scanners.

Materials & Methods: Using the large FOV 3D GRADE phantom (Spectronic Medical AB, Helsingborg, Sweden) the geometric distortions of 4 MRI scanners were assessed (3 T Siemens Prisma, 3 T GE Signa, 1.5 T Siemens Espree and 1.5 T Siemens Aera) using both a 2D multi-slice fast spin echo and a 3D fast gradient echo sequence, both with 3D distortion correction applied. Each MRI scan was compared to a phantom CT scan to calculate a geometric distortion field using spherical markers within the phantom. Repeated measurements were taken once a month over a period of approximately one year and 5 test-retest measurements were also acquired.

The range and standard deviation of the distortion of each marker over the 5 test-retest measurements ($R_{Tr,M}$ and $SD_{Tr,M}$ respectively) were calculated. The same was calculated for 5 consecutive monthly measurements. The two results were compared for each scanner and sequence. It was determined whether there was a statistically significant ($p<0.05$) difference using paired samples tests. For each month, it was determined whether any marker distortions were greater than both $3SD_{Tr,M}$ and 1 mm from their respective test-retest mean distortion.

Name (First, last)	Emily Johnstone
Mailing address (including province/state, country, postal/zip code)	Leeds Institute of Cancer and Pathology, St James's University Hospital, Beckett Street, Leeds, LS9 7TF, United Kingdom
Institution/organization	University of Leeds
Position	PhD student

Distortion histograms were calculated each month and the skew and kurtosis values of these tracked over time. The maximum deviation of each marker from its median distortion over the measurement period was determined.

Results: The 2D and 3D sequences on the Espree and the 3D sequences on the Prisma and Signa, showed distortion variation over 5 monthly measurements that was not significantly greater than the variation over the 5 test-retest measurements. This temporal stability was also observed across the other tests.

The 2D sequences on the Prisma and Signa and the 2D and 3D sequences on the Aera showed significantly greater distortion variation when comparing the monthly to the test-retest measurements. A large number of markers were greater than $3SD_{Tr,M}$ and 1 mm from their mean test-retest distortion values, up to a maximum of 13.0%. The 2D scans showed larger than expected variation when analysing the distortion histograms. Variations >2 mm in monthly distortion measurements compared to the respective median marker distortion values, were also observed (Figure 1).

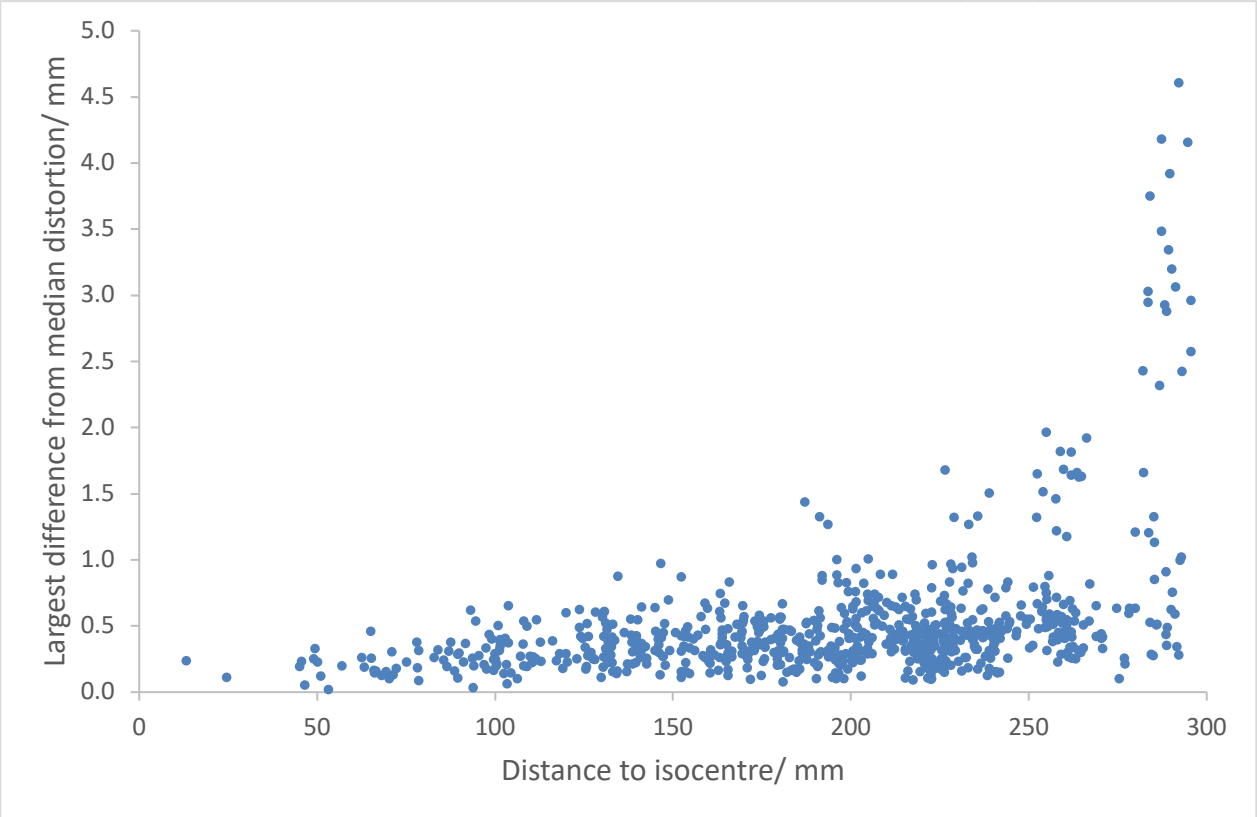

Figure 1. Showing the maximum deviation of marker distortions from their respective median distortion values over the measurement period for the Siemens Aera 3D sequence, as an example. The results are shown as a function of the radial distance to isocentre.

Conclusions: Some scanners and sequences displayed a greater distortion variation over time compared to test-retest measurements. For scanners such as these, more regular quality assurance, for example on a monthly basis, would be appropriate when using the images for applications where geometric integrity is critical, such as MRI-only radiotherapy.