

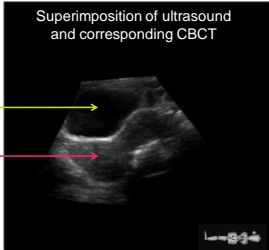
3D spatial compounding with the Clarity® system:

Improving ultrasound image quality in gynaecological image-guided radiotherapy

Sarah Mason, Ingrid White, Helen McNair, Susan Lalondrelle, Matthew Blackledge, Tuathan O'Shea, Jeff Bamber, and Emma Harris
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Making the discoveries that defeat cancer

The uterus can be visualized with ultrasound



Superimposition of ultrasound and corresponding CBCT

Bladder

Uterus

Ultrasound (US) characteristics:

- Non-ionizing
- Non-invasive (transabdominal)
- Excellent soft-tissue contrast

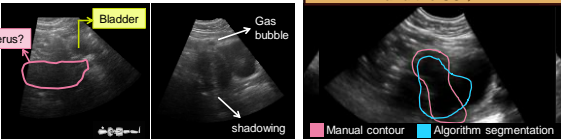
Promising alternative to CBCT for daily **adaptation of radiotherapy** based on soft-tissue information.

Challenges in acquiring high quality transabdominal ultrasound images of the uterus

- Small bladder volume and high BMI → signal attenuation
- Small field of view

Research Question: Does 3D spatial compounding with the Clarity® System improve the quality of transabdominal ultrasound images of the uterus?

(S. Mason et al., *Med. Phys.* (2017))



and the **ANSWER!**

Bladder

Gas bubble

shadowing

Uterus?

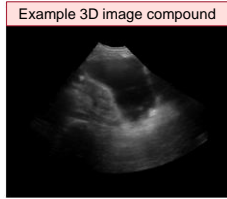
Manual contour

Algorithm segmentation

3D spatial compounding with Elekta Clarity® System

Definition: Average (mean) of at least 2 spatially registered* ultrasound image volumes to form a composite image

Potential benefits: Increase contrast to noise ratio (CNR), extend field of view, and reduce impact of image artifacts on composite image



Study Design

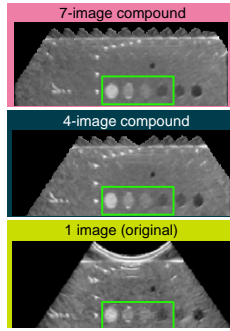
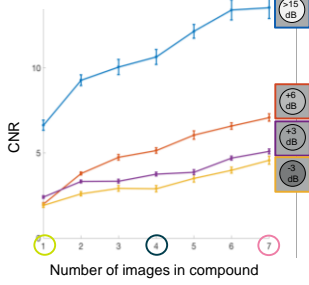
Cohort	# individual US images	# of time points per subject	Total compound 'sets' analyzed	Method for assessing image quality
Phantom (n = 1)	7	1	1	CNR, spatial resolution (FWHM of LSF)
Healthy Volunteers (n = 4)	6	4 – 6 (empty and full bladders)	21	Image ranking by 3 independent observers 1 (worst) – 6 (best)
Patients (n = 4)	4	1 – 6 (during treatment)	15	Image ranking by 3 independent observers 1 (worst) – 4 (best)



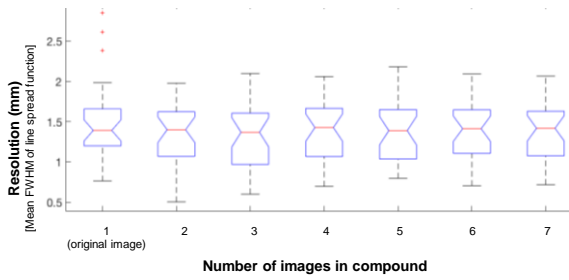
Phantom Study:

Contrast to Noise Ratio (CNR) and spatial resolution results

Phantom Study Results: CNR

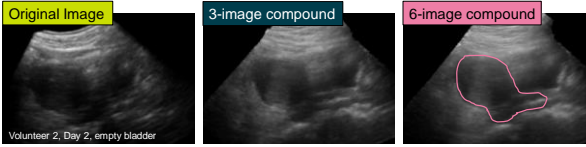
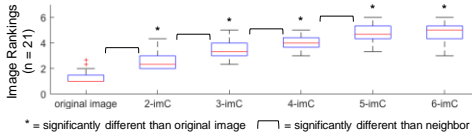


Phantom Study Results: Spatial Resolution



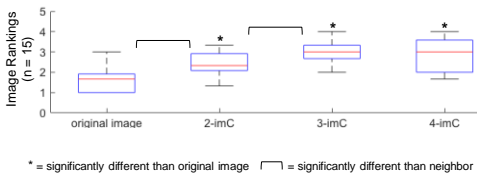
***In vivo* studies:**

Image quality measured by observer rankings



Observer Rankings: Cervical cancer patients

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Summary

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- Image compounding provides significant improvement in CNR (range of improvement from 35% - 104%)
- No significant differences in spatial resolution
- Image quality of uterus had significantly higher ranking in image compounds compared with the original image

Future Work:

- Investigate whether performance of segmentation algorithms is improved on compounded images compared with original images



Thank you for your attention!

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