Image enhancement of ultra-low dose CBCT images using a deep generative model

Authors: Suvendra Vijayan[1], Jun Luo[2], Shandong Wu[3], Anitha Potluri[1]

[1]University of Pittsburgh School of Dental Medicine

[2]University of Pittsburgh School of Computing and Information

[3]University of Pittsburgh School of Medicine

email: suv16@pitt.edu

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Speaker Disclosures

- I , Suvendra Vijayan, and my immediate family do not have any financial interests to disclose relating to the content of this presentation

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Objective

- Improve the image quality of CBCT images, obtained on an ultra-low dose (ULD) protocol, using a deep generative model called the pix2pix image-to-image translation technique.

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Artificial Intelligence

Artificial Intelligence

Augmented Intelligence

- Augmented intelligence is a subsection of AI machine learning developed to enhance human intelligence rather than operate independently of or outright replace it. It's designed to do so by improving human decision-making and, by extension, actions taken in response to improved decisions

Machine learning and Deep learning

- Machine learning - machine learning describes an AI system's ability to learn and improve from experience without additional programming.
- Deep learning - sometimes referred to as deep neural learning, describes an AI process that mimics the human brain's ability to process data and see patterns, much to the felicity of data scientists staring down massive data sets - convolutional neural network

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Pix 2 pix

- Described by Isola and team
- Use conditional adversarial networks as a general-purpose solution to image-to-image translation problems
- Learn mapping from input image to output image
- Also learn a loss function to train this mapping
- Used for synthesizing photos from label maps, reconstructing objects from edge maps, and colorizing images
- As far we know it has not been used in CBCT images

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Study Design

- CBCT images of dry skull and mandible was obtained using preset standard and ULD imaging protocols.
- We combined the scans into a dataset with 1,412 ULD, and normal dose DICOM image pairs (2,824 scans in total), and randomly selected 10% (140) image pairs as the test set.
- We train a pix2pix deep generative model by first converting the DICOM images to JPG images and then feeding the training set image pairs to the network.
- We tested the performance of the trained model on the previously unseen test set ULD images and compared the synthesized images with the corresponding normal dose image and ULD images.

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Results

- A preliminary blind study on the standard, ULD and synthesized images by an OMF radiologist was done and image identification, image quality and edge definition were assessed

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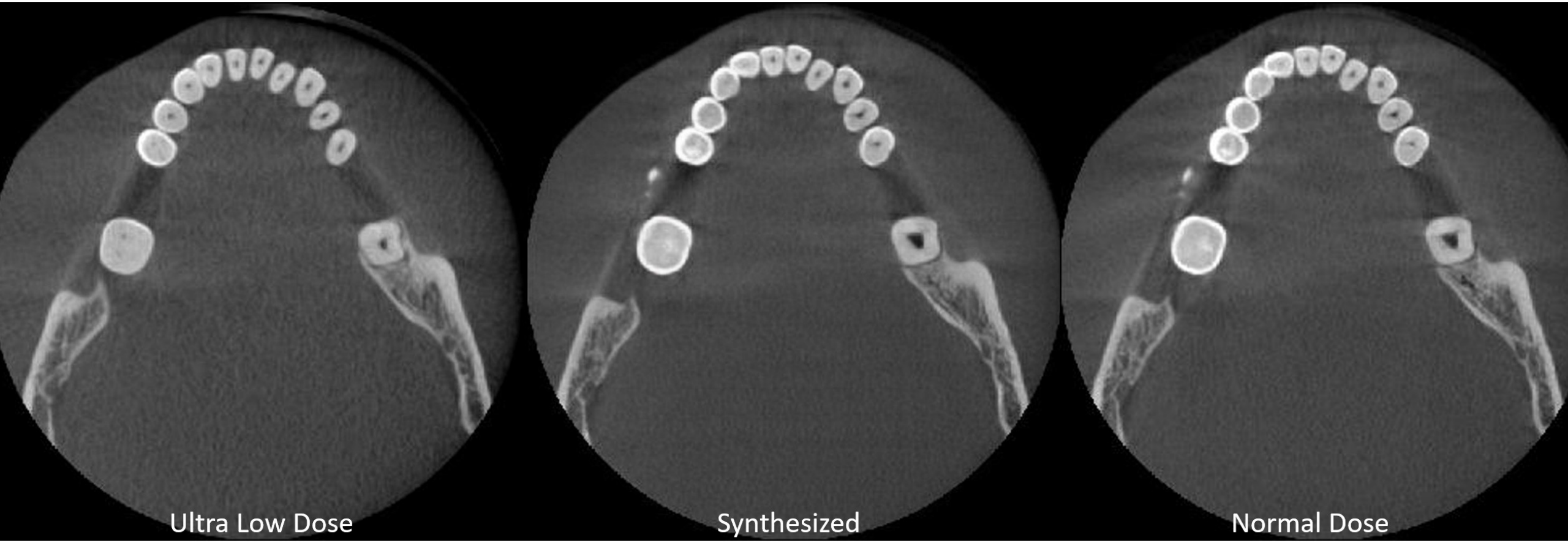
Ultra Low Dose
Synthesized
Normal Dose



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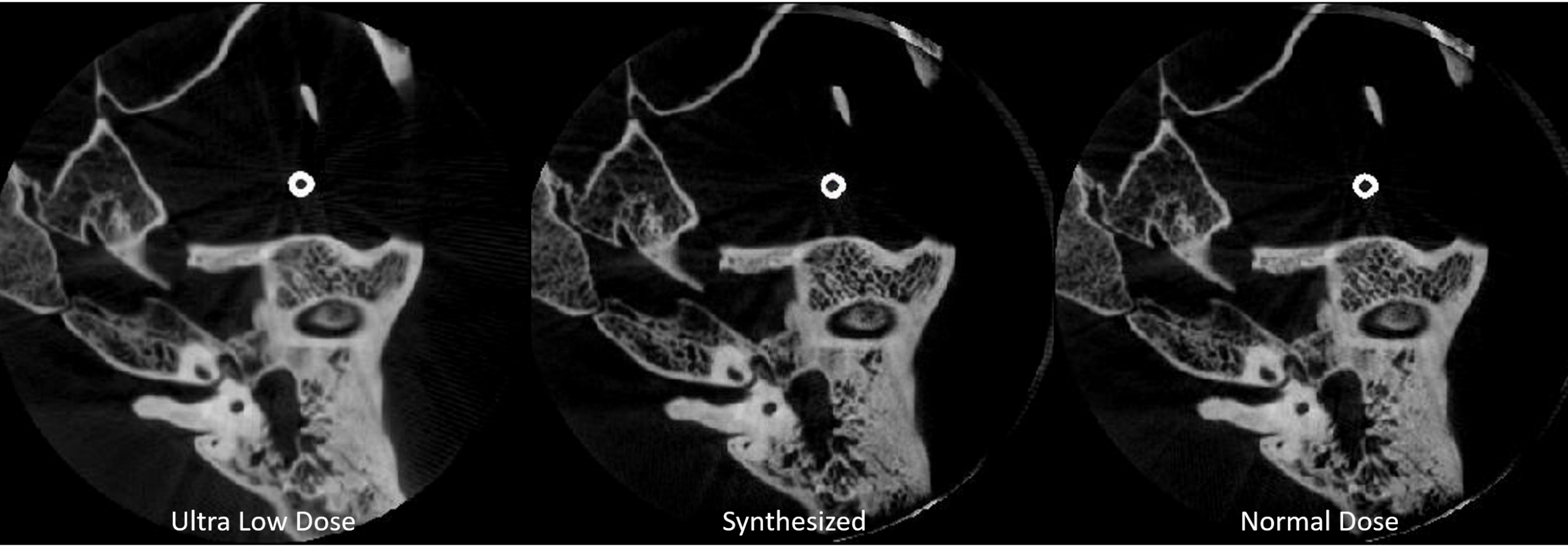
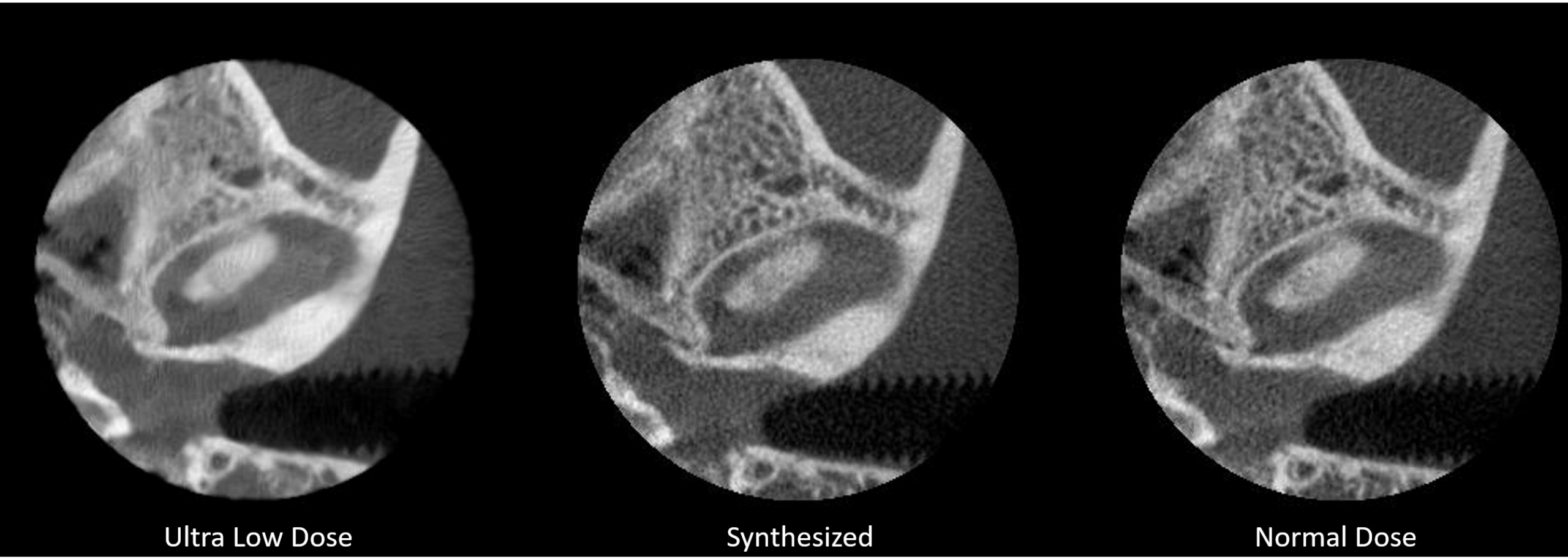

Ultra Low Dose
Synthesized
Normal Dose


Ultra Low Dose
Synthesized
Normal Dose

Conclusion

- CBCT usage market is expected to grow globally by 9.7%.
- Reducing radiation dose and improving image quality is of paramount importance to reduce radiation burden on the population.
- Initial analysis indicates a marked improvement in image quality of the synthesized images when compared to ULD images.
- With further research and successful implementation, we have an opportunity to reduced radiation risks to patients while improving image quality.

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Thank you