

# Reliable Medical Image Reconstruction in the Age of AI



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m4DI

# Bath Imaging Group

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Patrick Fahy (PhD student)



## Methods:

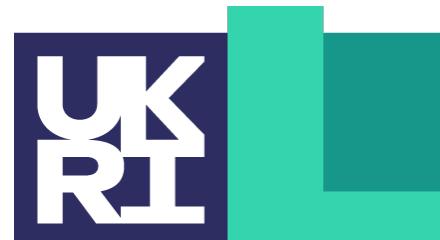
Inverse Problems  
Machine Learning  
Optimization

## Applications:

Medicine  
Biology  
Material Sciences

## Industry:

NHS (RUH, Addenbrooke's)  
GE HealthCare  
Diamond Light Source



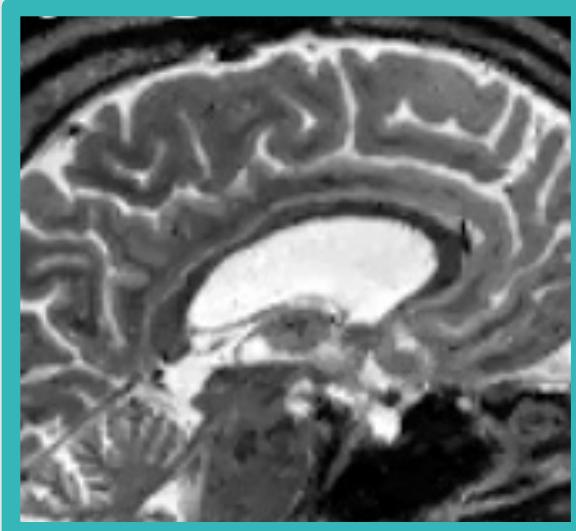
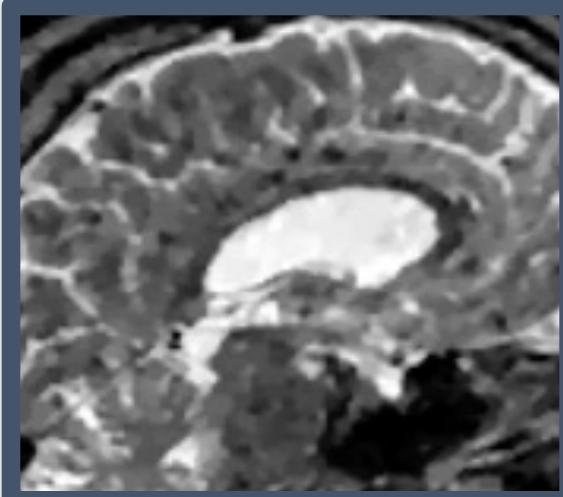
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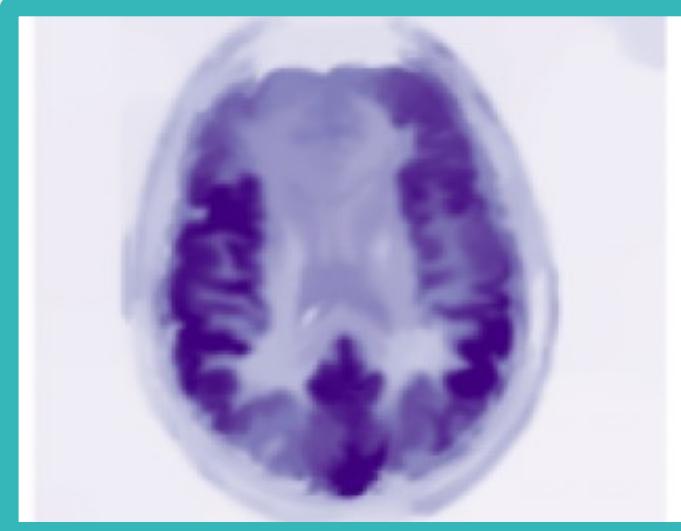
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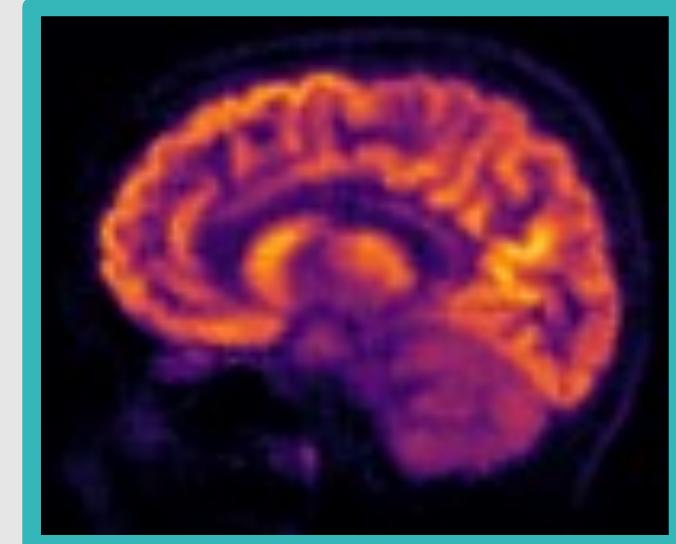
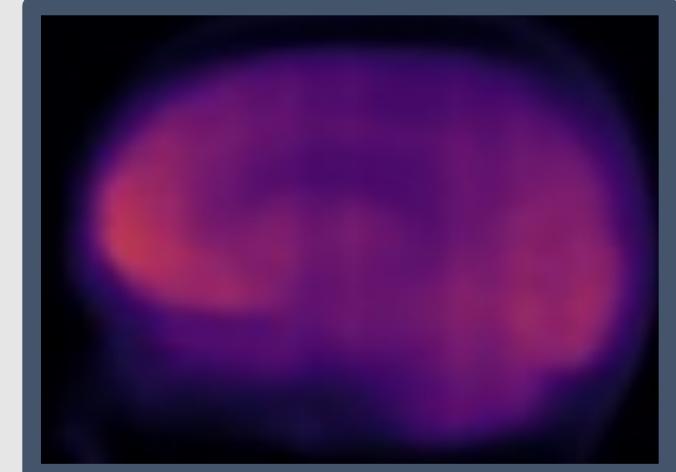
## MRI Faster Scans



## C13-MRI Localization

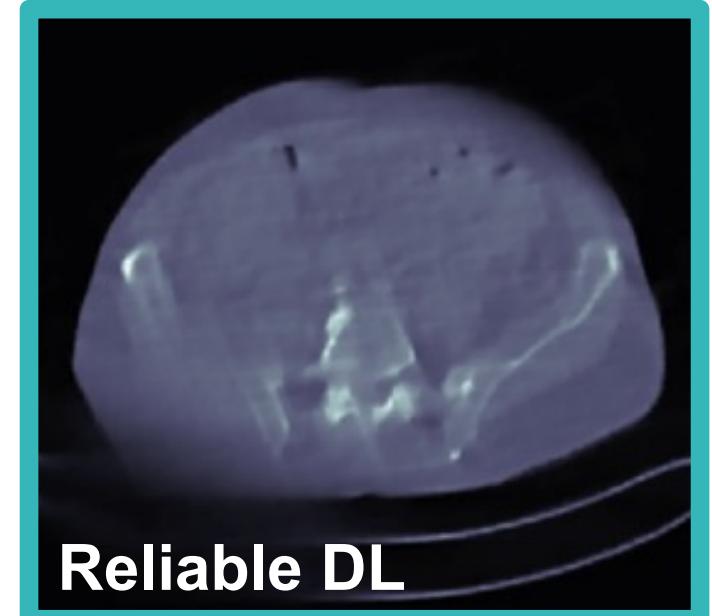
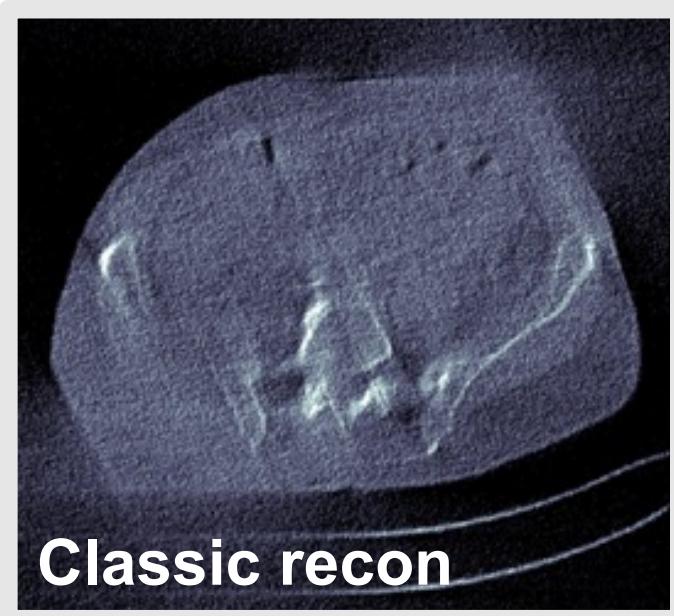
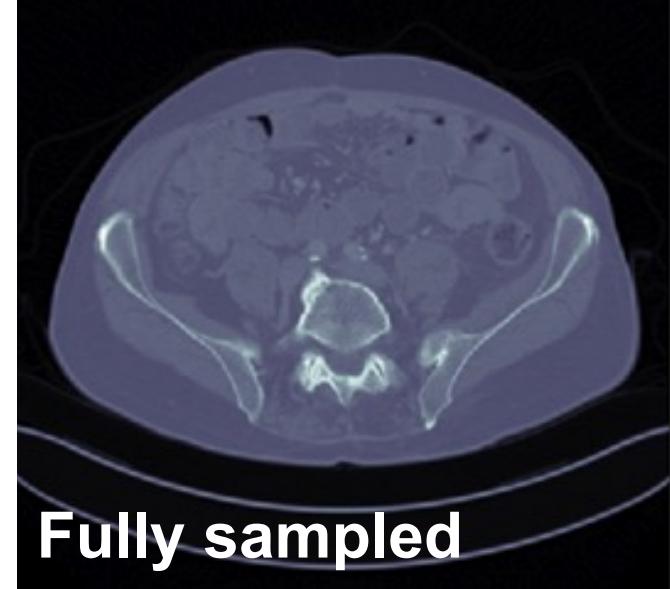


## PET Faster Recon



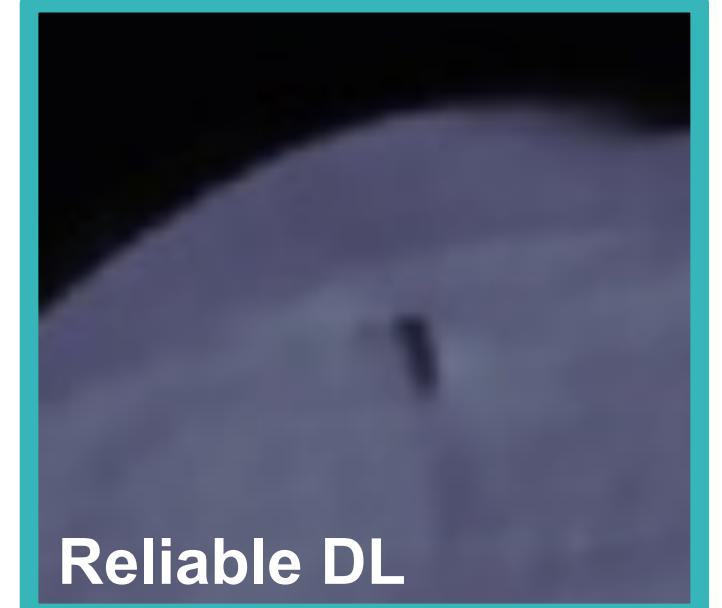
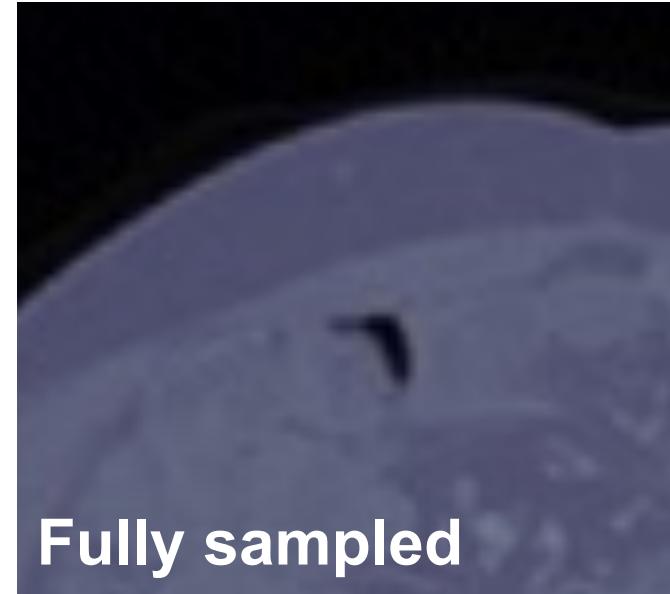
# What could go wrong?

Mukherjee et al., 2021



# What could go wrong?

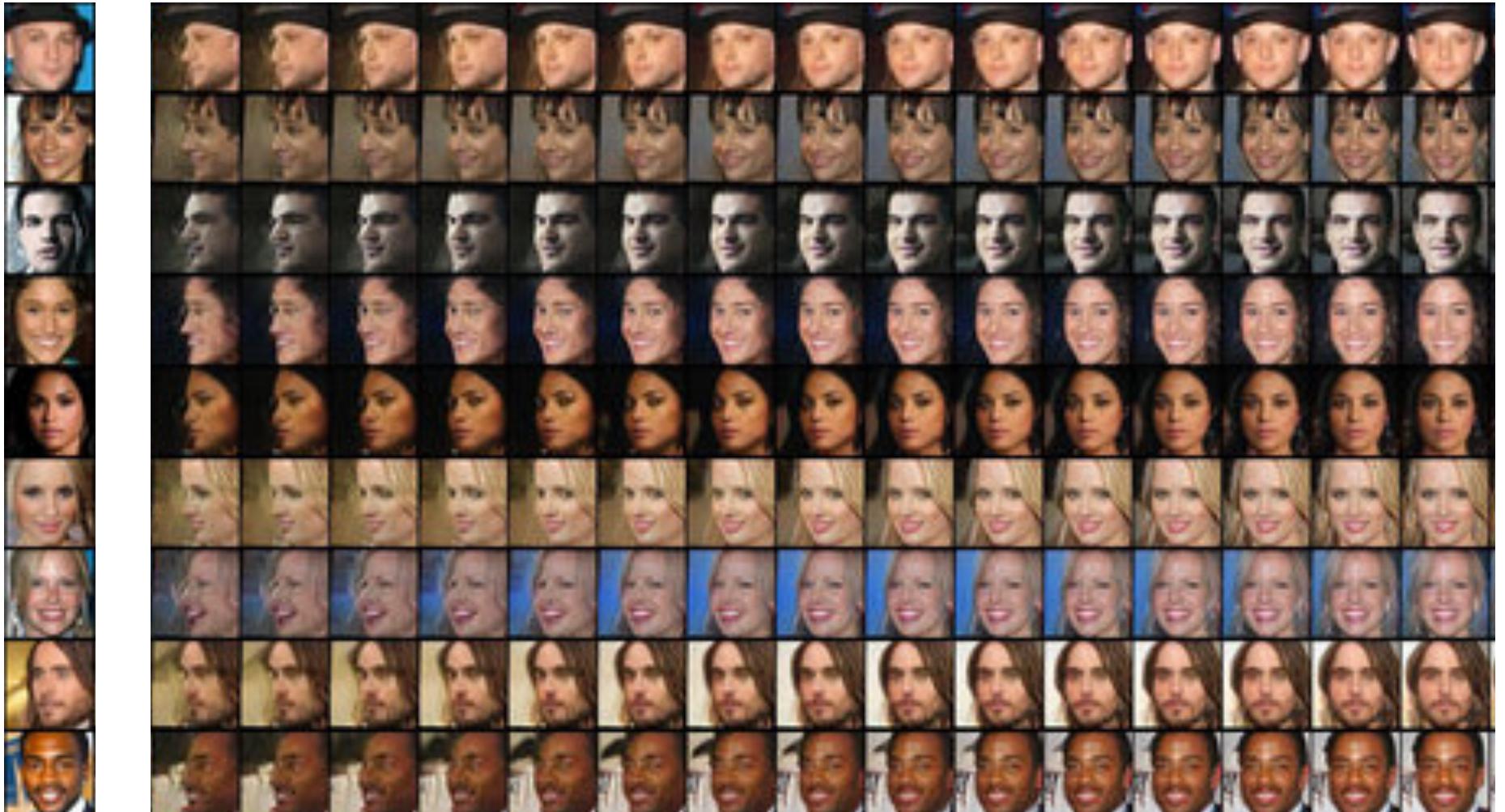
Mukherjee et al., 2021



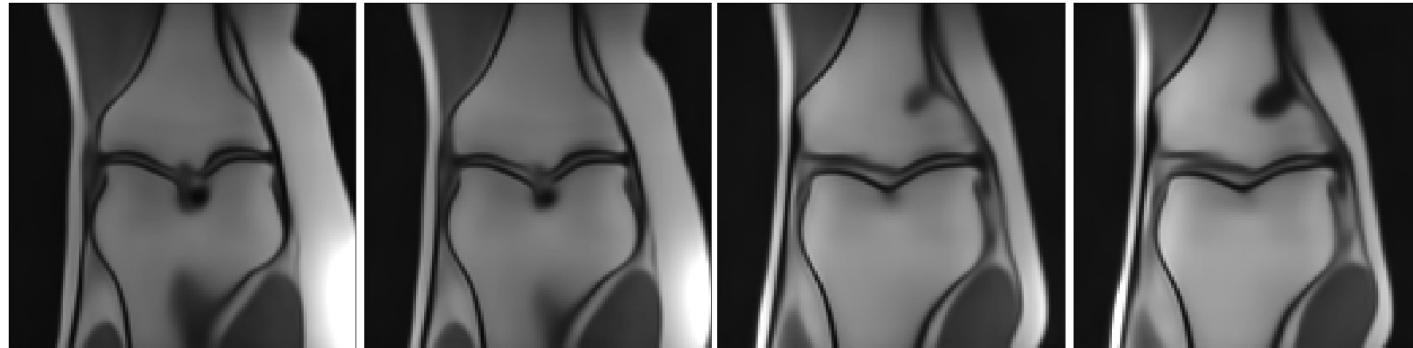
# Generative Models $G_\theta: Z \rightarrow X$

VAE, GAN, normalizing flow, score-based diffusion

$Z$  latent space, e.g.  $Z = \mathbb{R}^{1000}$   
 $X$  image space, e.g.  $X = \mathbb{R}^{256^2}$

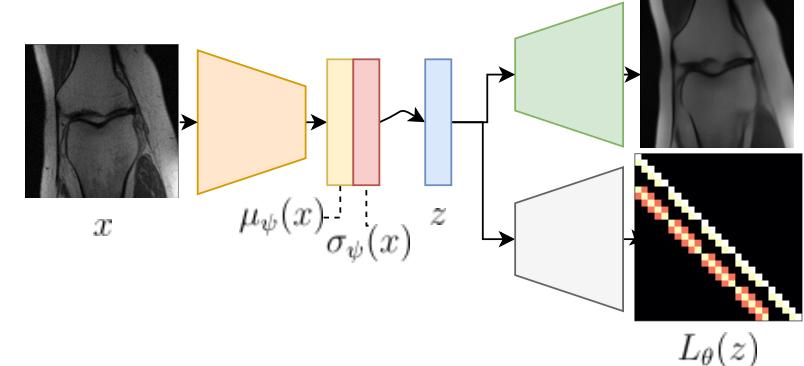
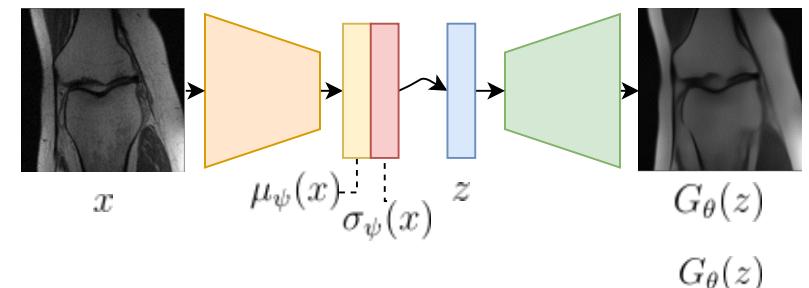
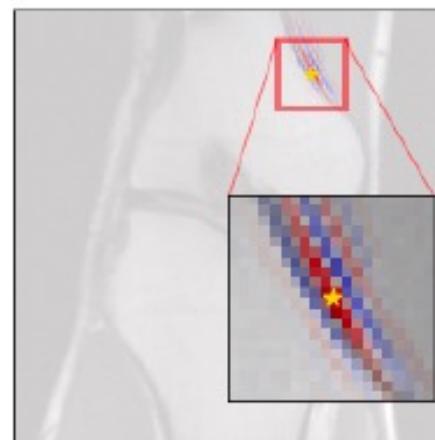
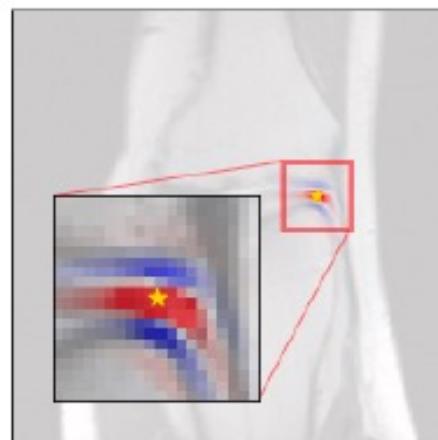


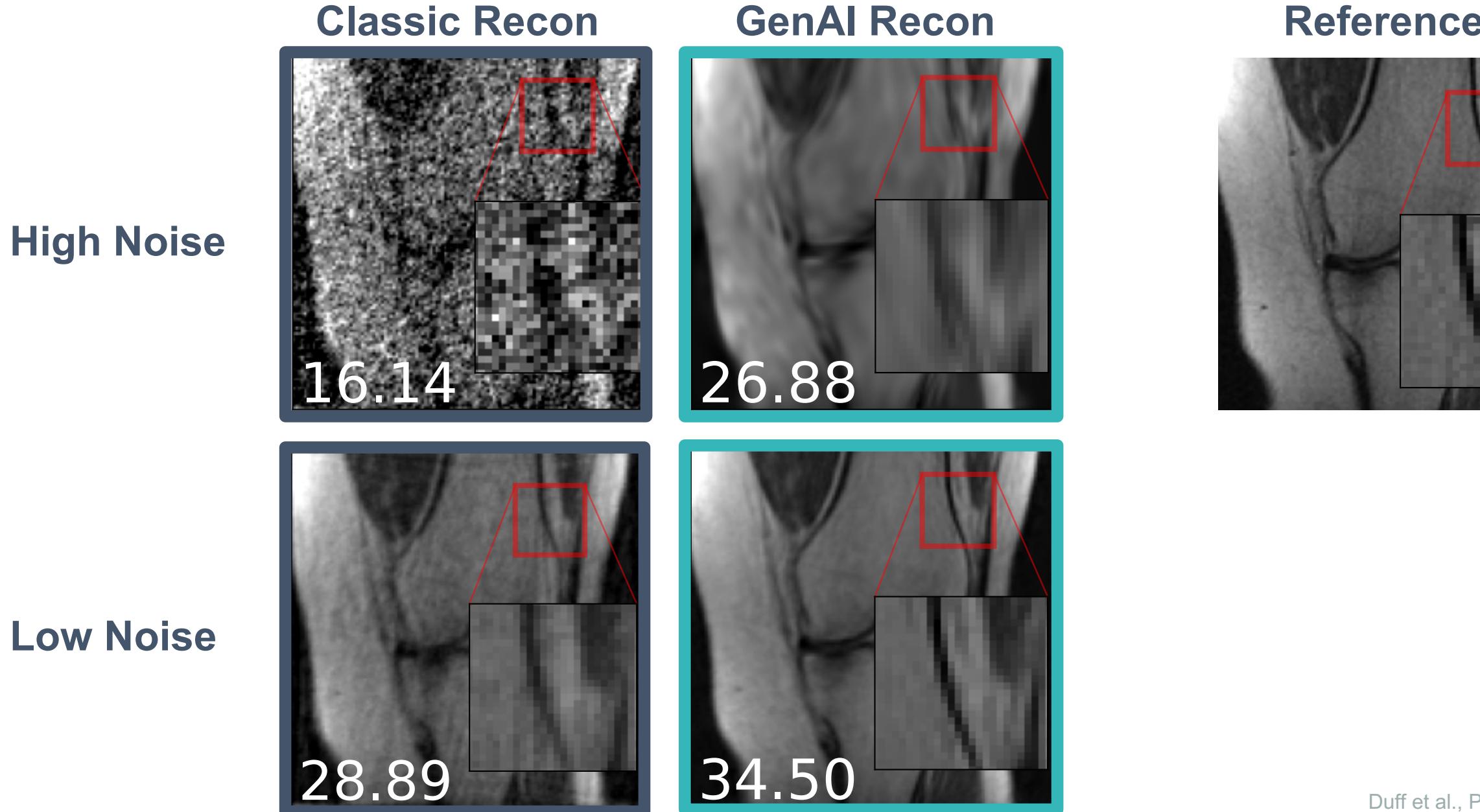
# Generative Model for MRI Knee Data



Margaret Duff

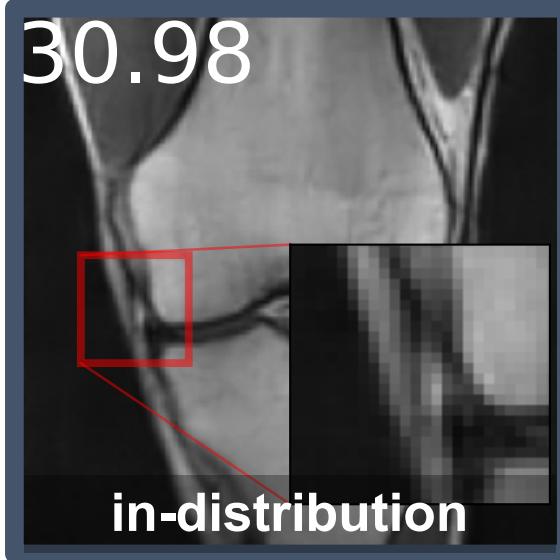
## Model Mean and Covariance





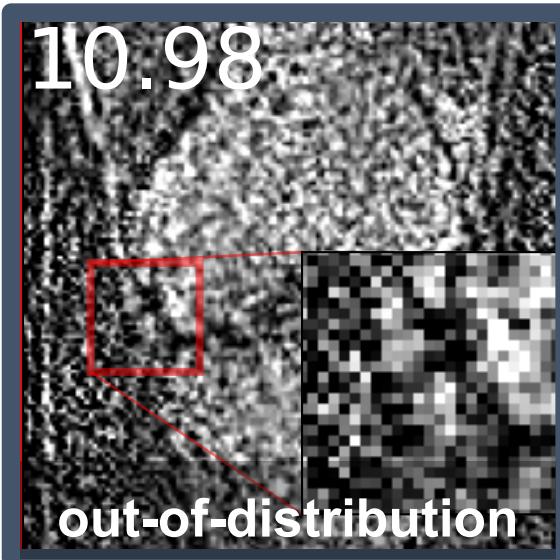
More Data

"SOTA" DL

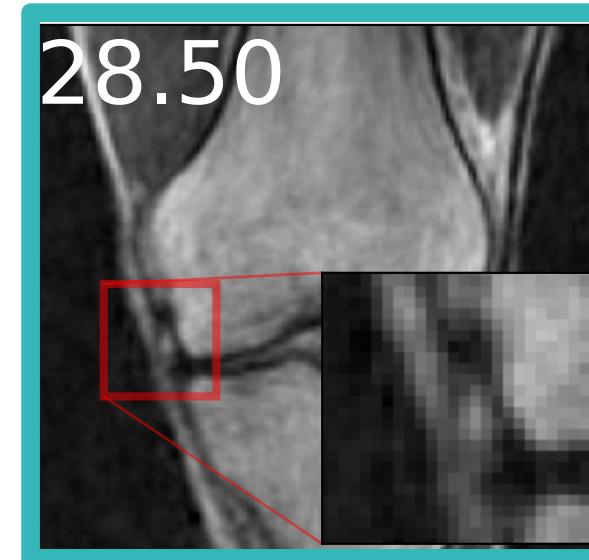
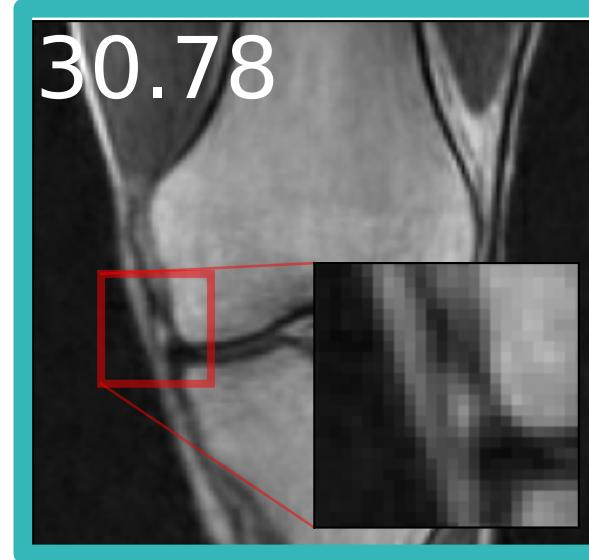


Less Data

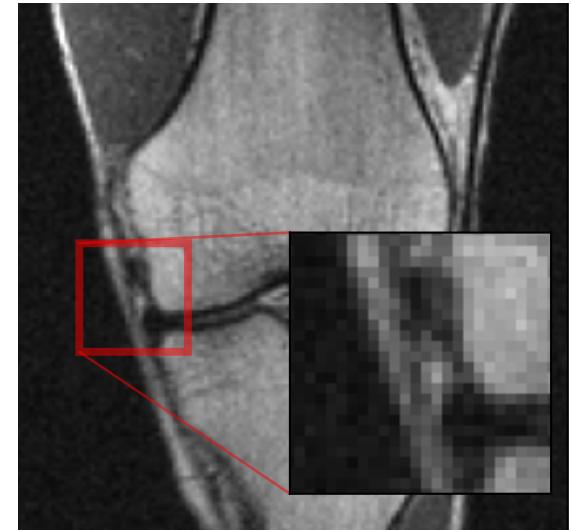
"SOTA" DL



GenAI Recon



Reference



# Conclusions

1. AI for medical imaging: faster scans, localisation, faster processing
2. Reliable medical imaging: no hallucinations, not pretty pictures
3. GenAI can be tailored to medical images
4. Robust to out-of-distribution data

