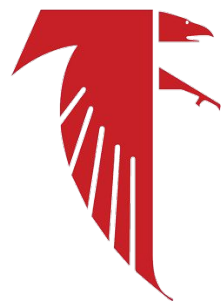


Noise2Quality: Non-Reference, Pixel-Wise Assessment of Low Dose CT Image Quality

Ayaan Haque, Adam Wang, Abdullah-Al-Zubaer Imran



Clinical Challenges and Motivation

- Important to quantitatively assess localized CT image quality
- Reference-free IQA is needed when scanning at low dose
- Deep learning models can be used to predict the scores

SSIM Map

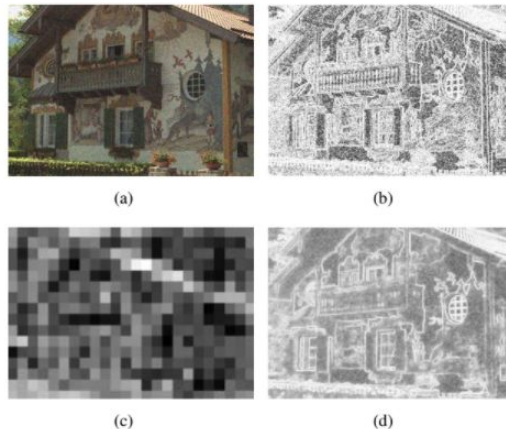
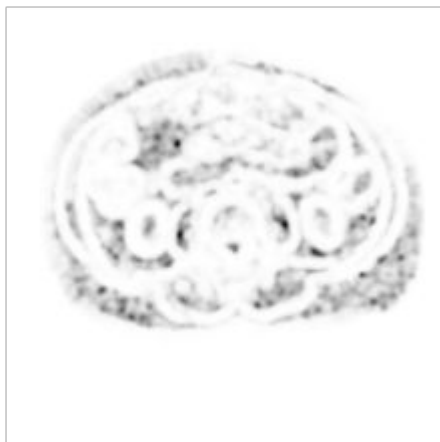


Fig. 1. Examples of predicted quality maps: (a) is a distorted image; (b) is a similarity map from FSIM; (c) is a patch-based quality map from BIECON [13]; (d) is a pixel-based quality map predicted from our proposed model.

Pan, Da, et al. 2018

Contributions

- Deep learning-based image quality map prediction
- One of the first localized, reference-free IQA methods
- Novel, self-supervised dose-level estimation auxiliary task

Dataset and Data Preparation

- Mayo CT Dataset
- Simulate 5 separate dose levels
 - 5%, 10%, 25%, 50%, 75%
 - 2500 total scans for training, 2500 for testing
- Produced SSIM Quality Maps
 - 11x11 kernels



Dose: 5%



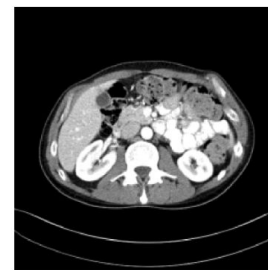
Dose: 10%



Dose: 25%



Dose: 50%



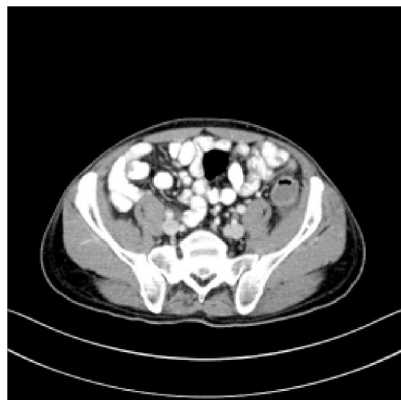
Dose: 75%



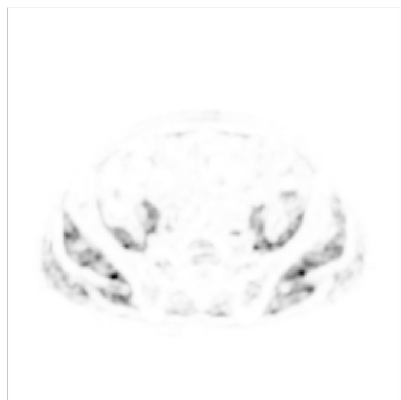
Full Dose

Images and SSIM Maps

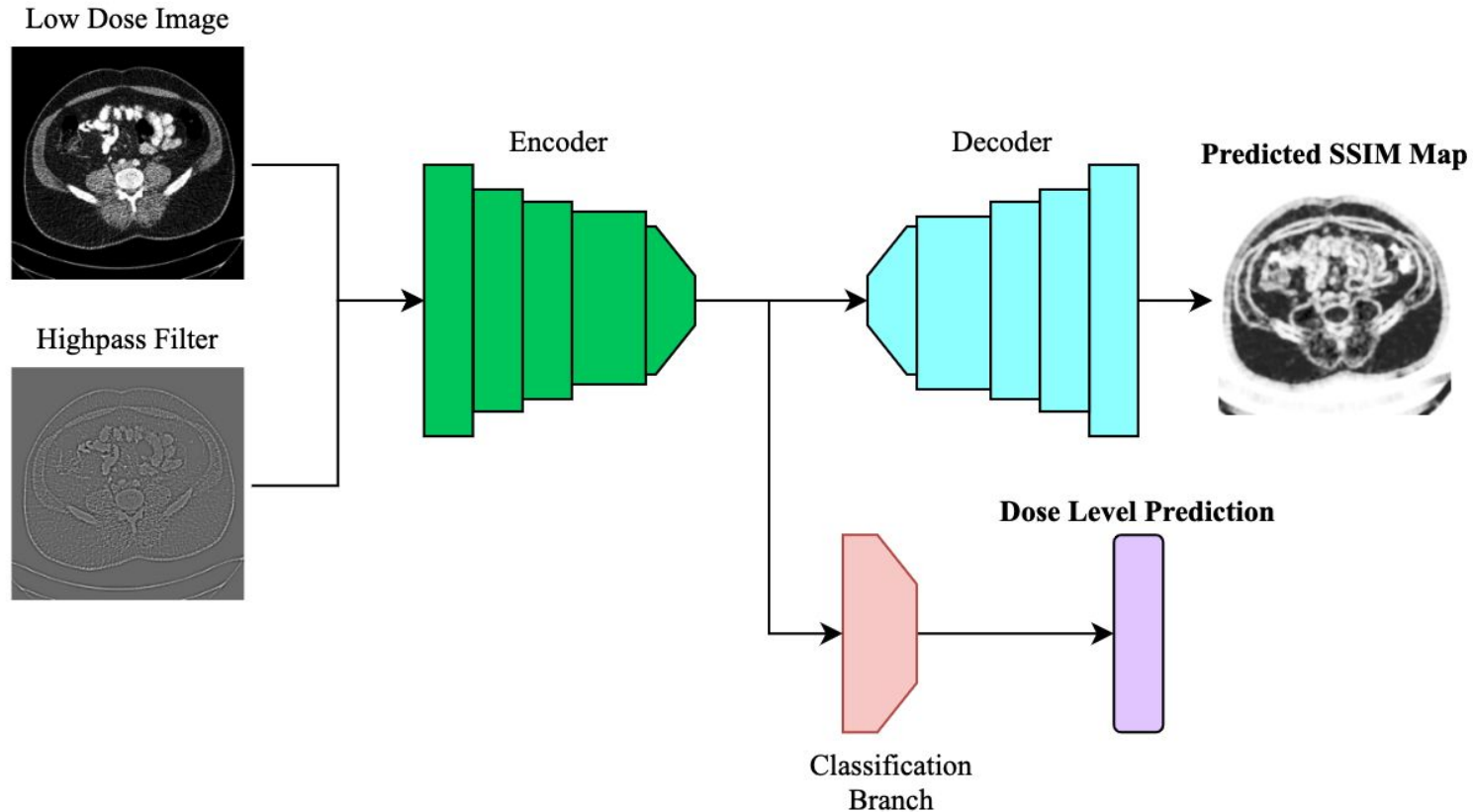
LDCT



SSIM Map



Noise2Quality

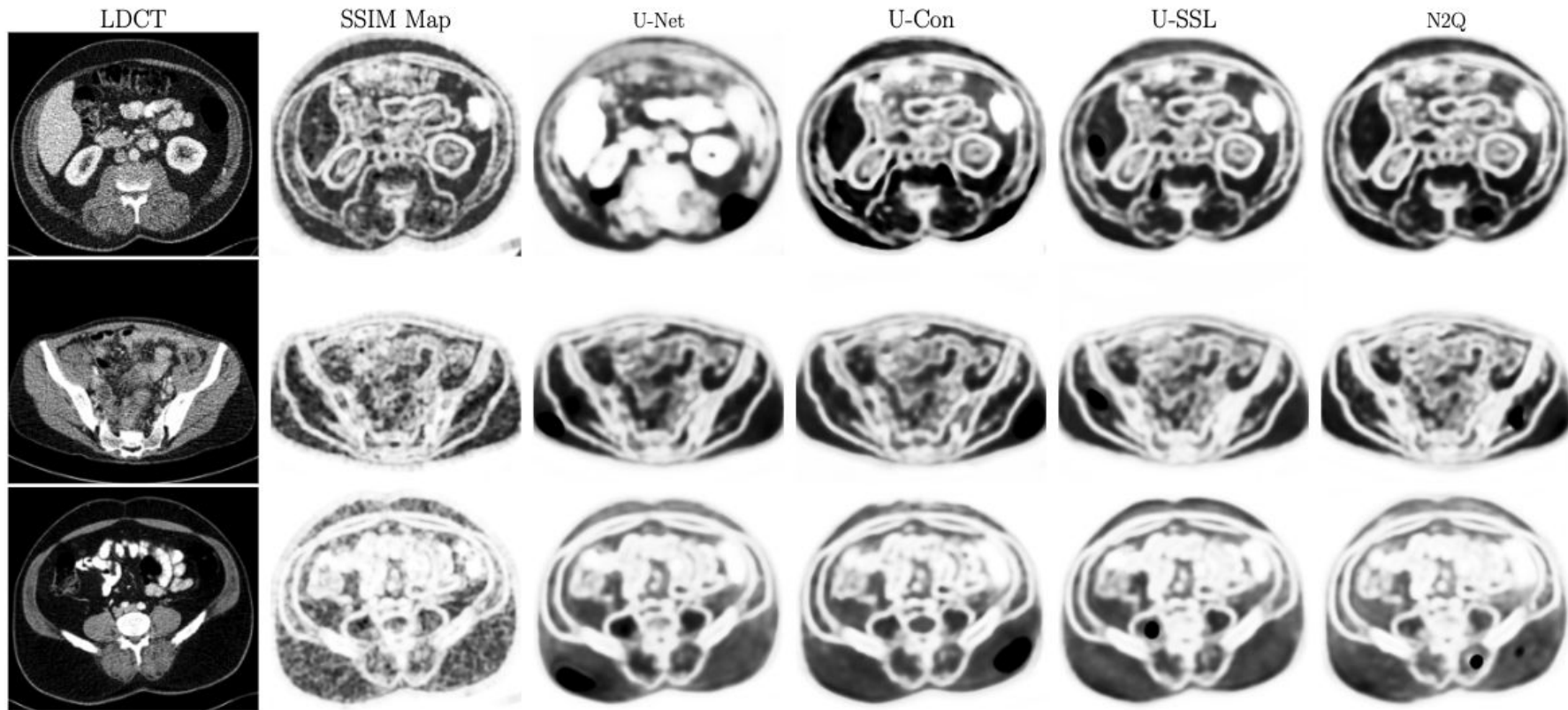


$$L(y, \hat{y}, c, \hat{c}) = L_{MSE}(\hat{y}, y) + \alpha \mathcal{L}_{CE}(\hat{c}, c)$$

Results (Quantitative)

Metrics	AE	RED-CNN	U-Net	U-HPF	U-Con	U-SSL	N2Q
SSIM	0.6761	0.7250	0.7448	0.7381	0.7484	0.7572	0.7664
MSE	0.1033	0.0594	0.0804	0.0979	0.0759	0.0669	0.0686
NRMSE	0.3226	0.2434	0.2830	0.3237	0.2794	0.2505	0.2437

Results (Qualitative)



Conclusions

- Novel non-reference IQA map prediction
- Self-supervised dose-level estimation
- Future work involves developing organ-specific IQA algorithms

Questions?

Noise2Quality: Non-Reference, Pixel-Wise Assessment of Low Dose CT Image Quality

Ayaan Haque, Adam Wang, Abdullah-Al-Zubaer Imran

