Preliminary Exploration Using MNIST Dataset Highlights Autoencoders Limitations in Denoising Medical Images

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Questions this project attempts to answer:

- Would autoencoders (AE) effectively denoise medical imaging?
- How do they compare to traditional methods qualitatively and quantitatively?
- Is the output quality consistent?

Methodology

- Simple grayscale images were used to evaluate the AE’s denoising capabilities.
- Gaussian or Poisson noise was added to the images.
- The resulting image outputs and PSNRs were compared to traditional denoising methods.

Results and Conclusions

- The AE outperforms other techniques qualitatively, especially with higher noise levels, but exhibits some shape discrepancies.
- Quantitatively, it slightly surpasses other techniques, particularly with Gaussian noise.

- PSNR is not always a reliable metric for the AE evaluation as it can lead to high scores even when the AE makes a reconstruction error / misclassification due to the latent space limitations.

- An autoencoder is not a good choice for denoising medical images due to shape discrepancies in the reconstructed images and limitations in the capacity of the latent space.

- AE shines at higher noise levels, but the noise level of quarter-dose CT scans are relatively low (left: full dose, right: quarter dose).

- In medical imaging, accurate representation of anatomical structures is crucial, and shape discrepancies can significantly affect the diagnostic value of the images.

![PSNR of Different Denoising Methods for Different Noise Levels and Types](image)

Columns: Gauss. 0.1 - Gauss. 0.3 - Gauss. 0.5 - Pois. 0.1 - Pois. 0.3 - Pois. 0.5

Literature Reviewed
