# A Generative Model for Tumor Stimulus Synthesis

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## Introduction

Recent studies have shown that previous visual stimuli can affect current visual perception (Fisher & Whitney, 2014). Such serial dependence has been found in daily search tasks which can help the human vision system stabilize perception. However, it can strongly influence radiologists' decisions and diagnoses (Manassi et al., 2019). Previous studies utilized naive synthetic stimuli which appeared to be too inauthentic. To tackle this stimulus problem, we adopted the latest generative model, the Generative Adversarial Network (GAN), to generate vivid mammograms. Results from a perception test showed the success of the generation via GAN.

## Methods

We built our generative model based on Digital Database for Screening Mammography (DDSM) dataset, which has 2,620 cases of normal, benign, and malignant cases. We utilized a progressive training strategy (Karras et al., 2017) to generate high-resolution mammograms, i.e, the higher layers were appended to the network for training until the lower layers finished training. Finally, similar stimuli were generated via interpolation of latent noise vectors.
Next, we showed 100 mammograms mixed with equal amount of real and generated samples to participants and asked them to differentiate between real and fake images.

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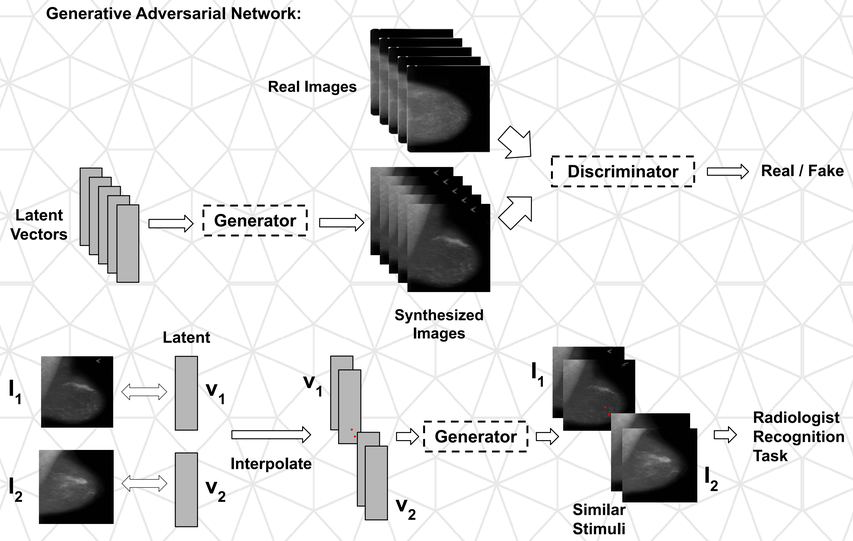
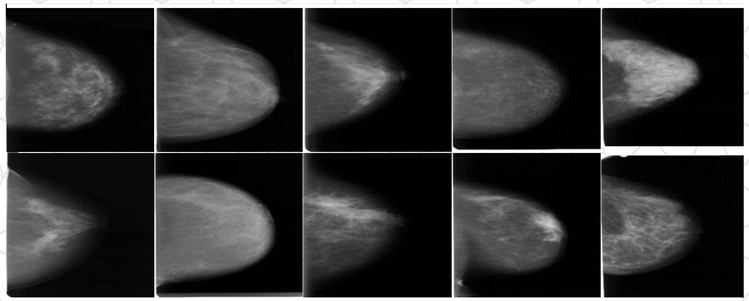
## Pipeline

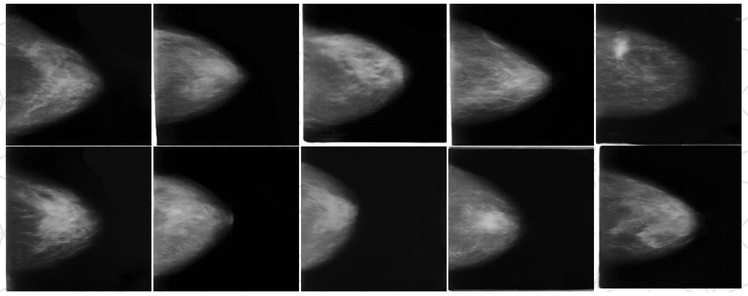



## Results

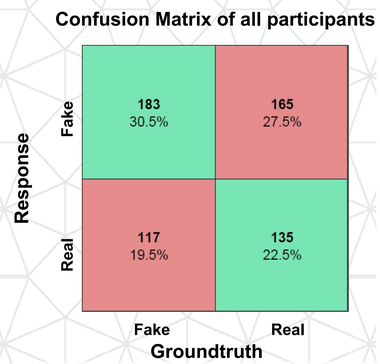
- Samples of real mammograms

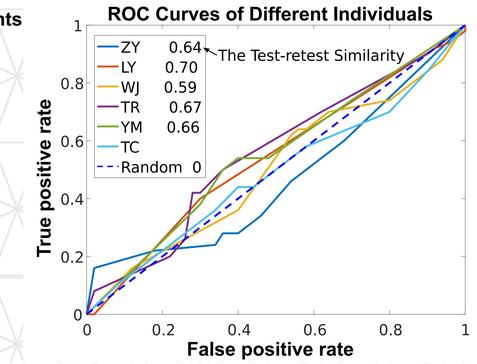


- Samples of generated mammograms



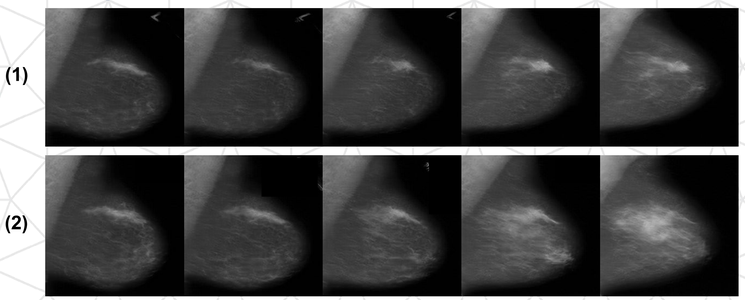
## Human Perception Test




After a short period, we asked participants to retake the test and the similarity between test and retest responses is shown aside with subject initials.

## Interpolation Results




## Conclusion

Our perception test data showed the success of the GAN generation. We have generated vivid, lifelike mammograms for the purpose of perception research in radiology from GAN interpolated images.

## References

1. Fischer, J., & Whitney, D. (2014). Serial dependence in visual perception. Nature neuroscience, 17(5), 738-743.
2. Manassi, M., Kristjánsson, Á., & Whitney, D. (2019). Serial dependence in a simulated clinical visual search task. Scientific Reports, 9(1), 1-10.
3. Karras, T., Aila, T., Laine, S., & Lehtinen, J. (2017). Progressive growing of gans for improved quality, stability, and variation. arXiv preprint arXiv:1710.10196.