

# Augmentation of Medical Imaging Data using ConSinGan

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Deep Learning For Computer Vision

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**01**

# Problem

Limited medical annotated data for  
training deep-learning models



**02**

**About**

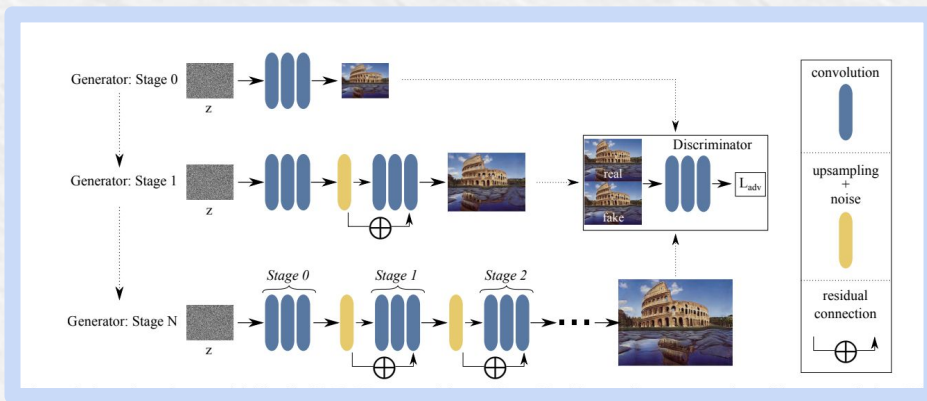


# About SinGan ConSinGan

## Single Image Models

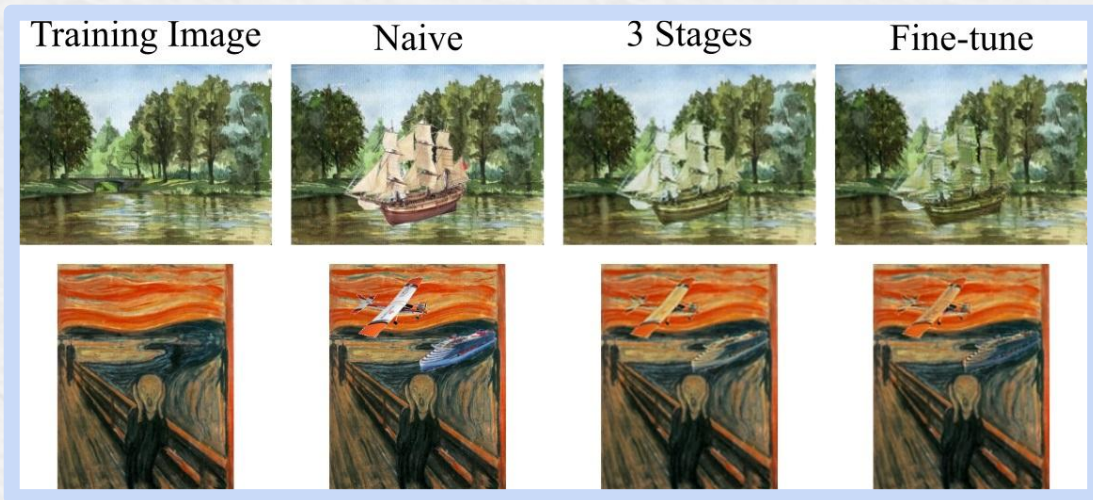
"SinGan model learns the image's patch statistics across multiple scales, using a dedicated multi-scale adversarial training scheme; it can then be used to generate new realistic image samples that preserve the original patch distribution while creating new object configurations and structures."  
SinGAN paper.

ConSinGAN, an evolution of SinGAN, through strategic architectural and training modifications achieves remarkable improvements in generating realistic images while significantly reducing overall training time compared to the original SinGAN framework. ConGan paper.





# Manipulation Tasks Both Model Achieves



03

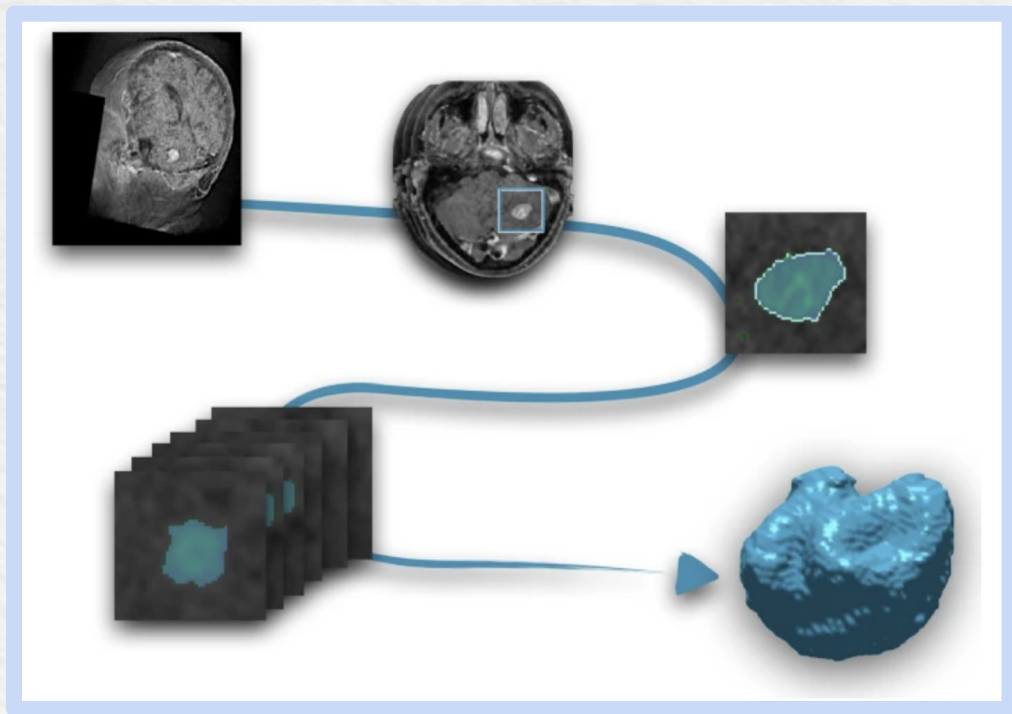
# Solution

Leveraging ConSinGAN for adding and removing cancer metastases in medical scans.



Utilize the **harmonization** technique for the addition of metastases, and employ the **editing** method for the removal of metastases.

# Dataset



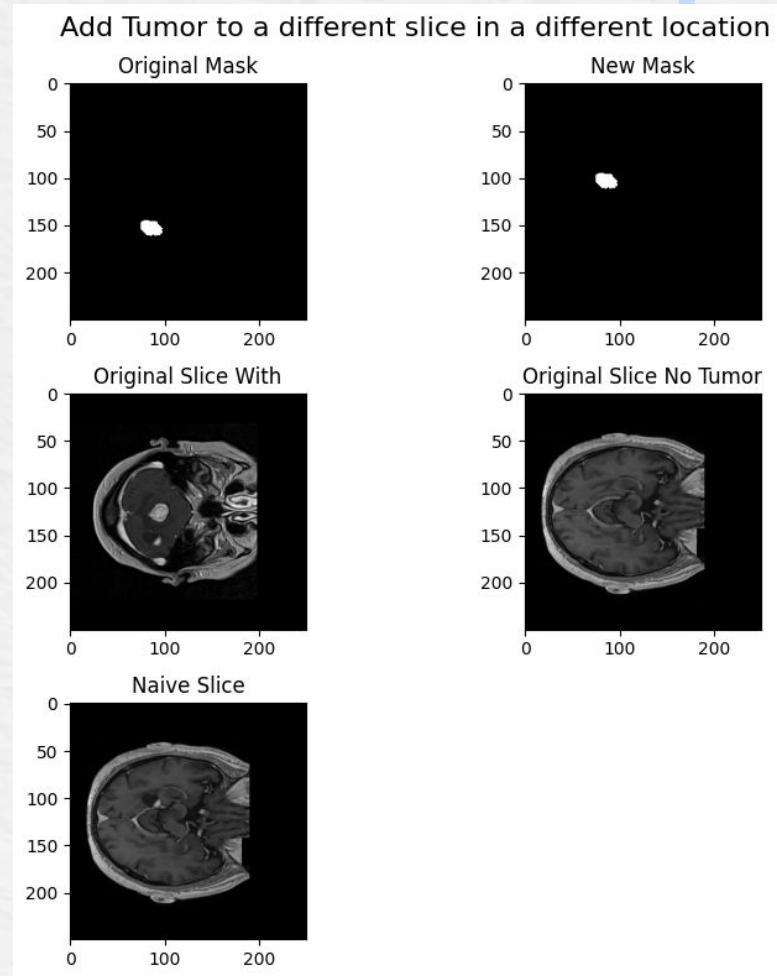
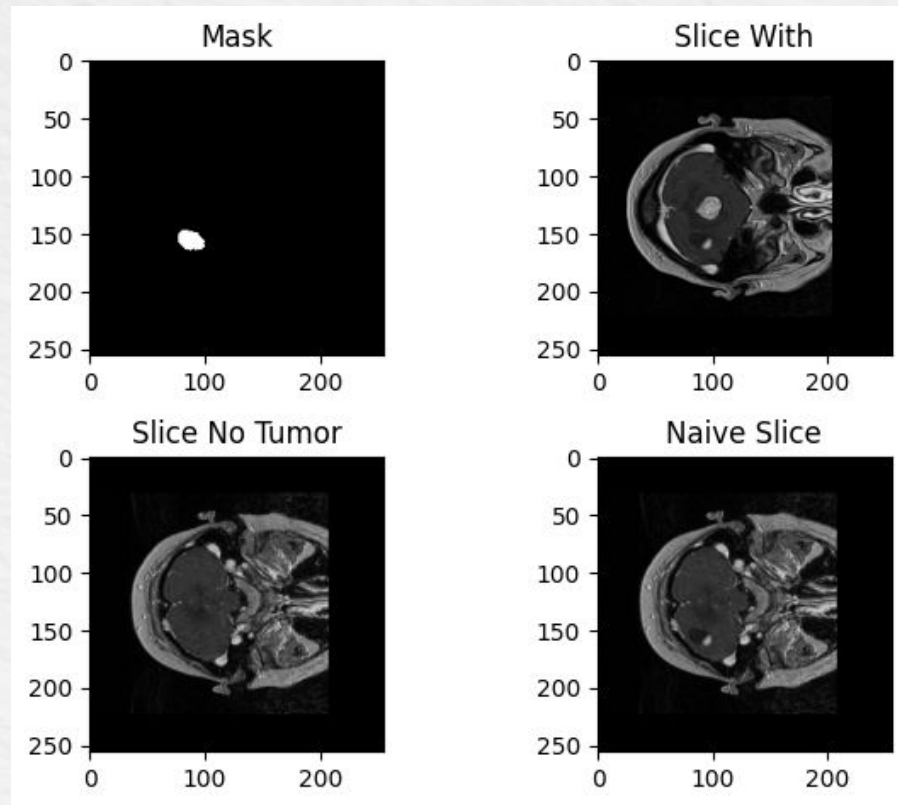
Brain Metastasis MR Images with Segmentations

- Brain Metastasis MR images from 75 patients.
- Semi-automatic segmentations of 593 metastases.
- Work with 2D slices

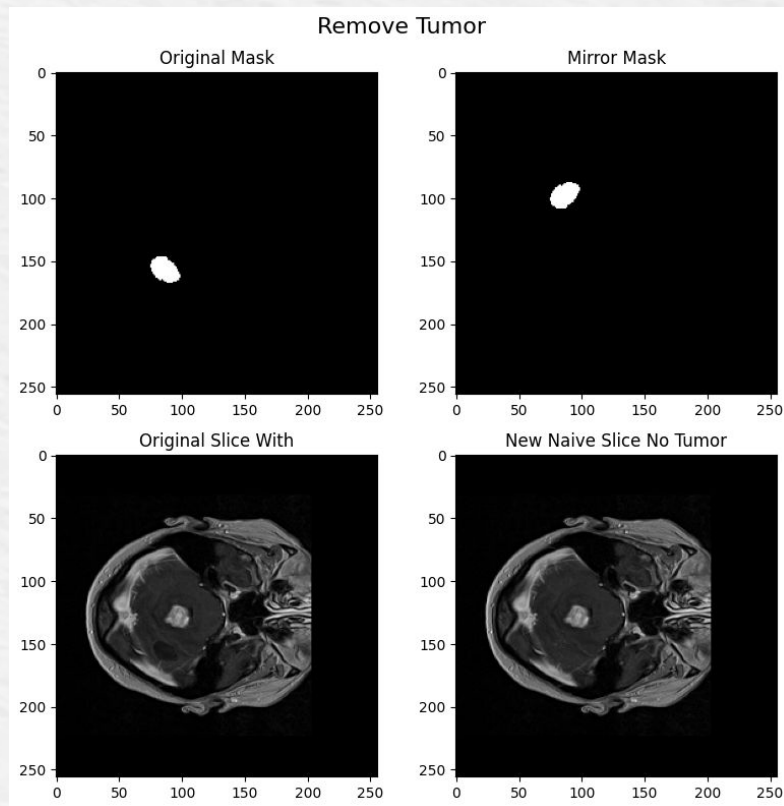
|



# Harmonization Task



# Editing Task



**04**

# Results



# FID score as a quantitative measure

FID is a well-established metric in the field of generative models, particularly suited for tasks like image synthesis and generation. **It quantifies the quality and diversity of generated images by measuring how closely they align with the distribution of real images.** It's essential to note that FID scores typically range from 0 to positive infinity, with lower scores indicating better performance.





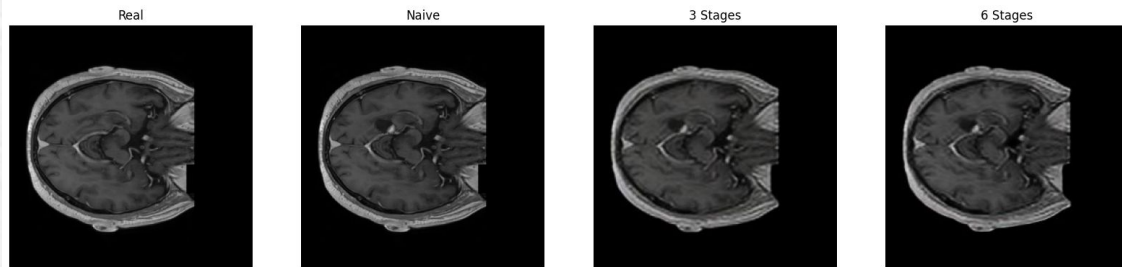
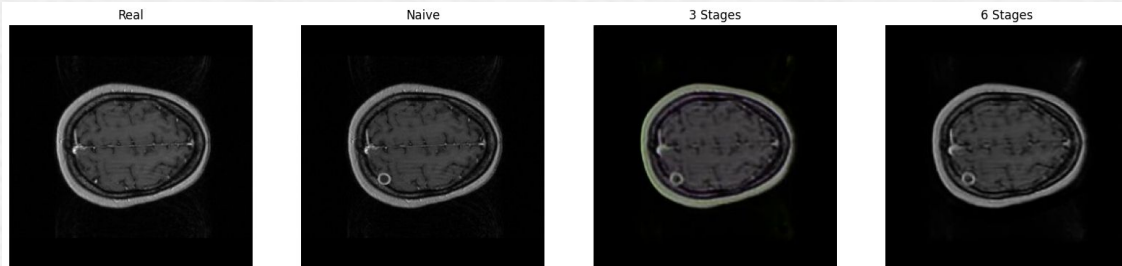
# Harmonization Task

## Configuration 1:

- Stages: 6
- Learning Rate Scaling: 0.1
- Minimum Size: 120
- Number of Concurrently Trained Stages: 3
- Training Time:  $\sim 21$  minutes per model

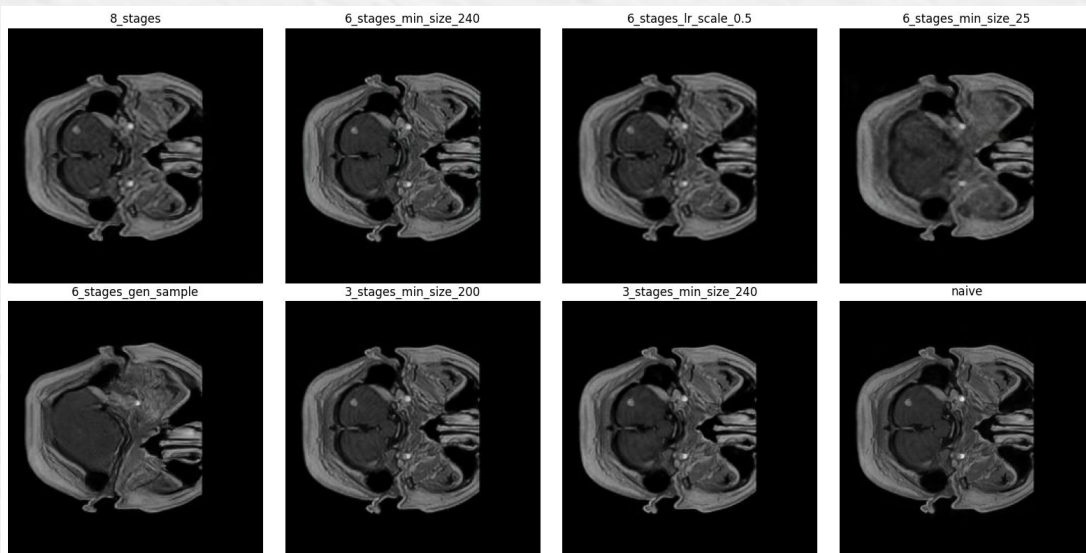
## Configuration 2:

- Stages: 3
- Learning Rate Scaling: 0.1
- Minimum Size: 120
- Number of Concurrently Trained Stages: 3
- Training Time:  $\sim 9$  minutes per model



- FID score between real and naive slices: 10.018
- FID score between real and slices generated by models with 6 stages (first configuration): 99.386
- FID score between real and slices generated by models with 3 stages (second configuration): 105.757

# More tests...



## Configuration 3:

- Stages: 6
- Learning Rate Scaling: 0.1
- Minimum Size: 240
- Number of Concurrently Trained Stages: 3
- Training Time: ~42 minutes per model

## Configuration 4:

- Stages: 3
- Learning Rate Scaling: 0.1
- Minimum Size: 240
- Number of Concurrently Trained Stages: 3
- Training Time: ~16 minutes per model

The obtained FID scores were as follows:

- FID score between real and naive slices: 88.96
- FID score between real and slices generated by models with 6 stages (third configuration): 88.07
- FID score between real and slices generated by models with 3 stages (fourth configuration): 94.04

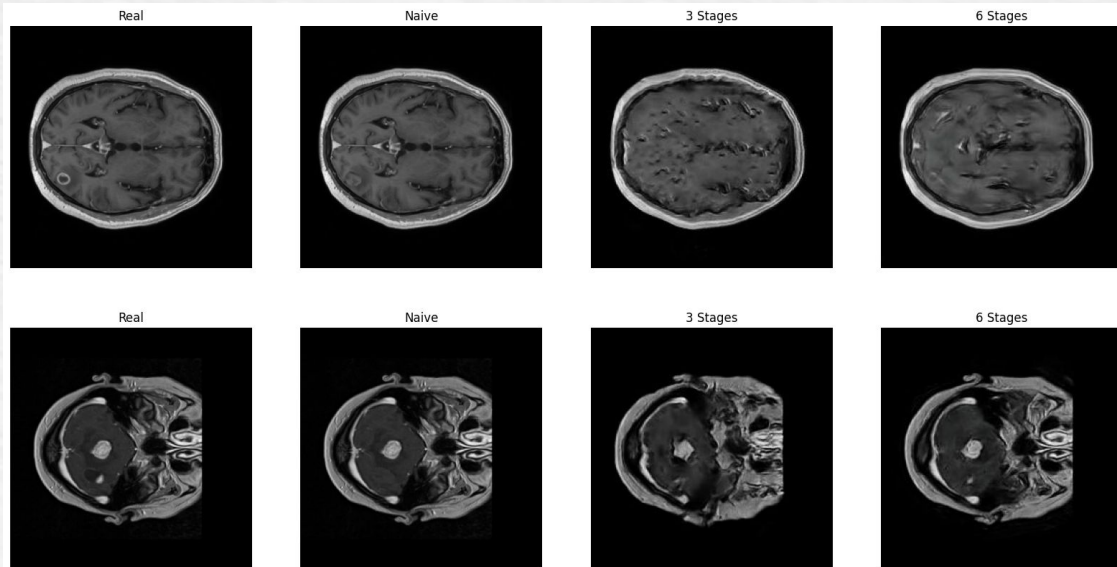
# Editing Task

## Configuration 1:

- Stages: 6
- Learning Rate Scaling: 0.1
- Minimum Size: 25 (default suggested for this task)
- Number of Concurrently Trained Stages: 3
- Training Time:  $\sim 9$  minutes per model

## Configuration 2:

- Stages: 3
- Learning Rate Scaling: 0.1
- Minimum Size: 25
- Number of Concurrently Trained Stages: 3
- Training Time:  $\sim 6$  minutes per model



- FID score between real and naive slices: 4.463
- FID score between real and slices generated by models with 6 stages (first configuration): 187.324
- FID score between real and slices generated by models with 3 stages (second configuration): 184.125

# More tests...

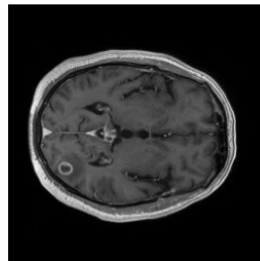
## Configuration 3:

- Stages: 6
- Learning Rate Scaling: 0.1
- Minimum Size: 240
- Number of Concurrently Trained Stages: 3
- Training Time: ~34 minutes per model

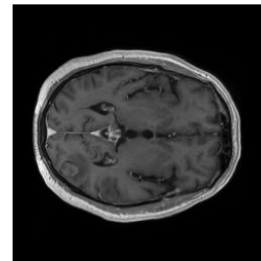
## Configuration 4:

- Stages: 3
- Learning Rate Scaling: 0.1
- Minimum Size: 240
- Number of Concurrently Trained Stages: 3
- Training Time: ~14 minutes per model

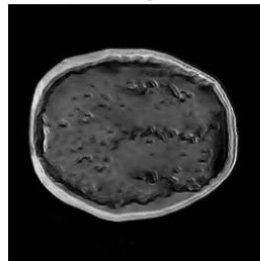
Real



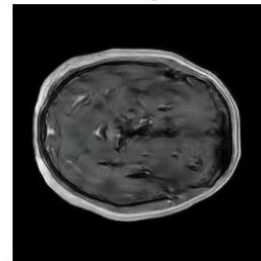
Naive



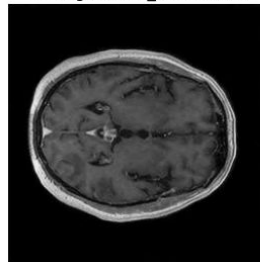
3 Stages



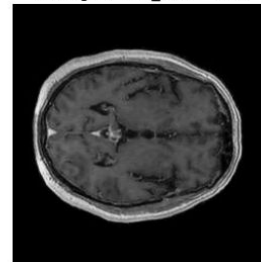
6 Stages



3 Stages, min\_size = 240



6 Stages, min\_size = 240





**05**

# Further Work



# Further Work



## Improve Resolution

Fine-tuning of hyperparameters

Training Time

Model's Complexity



## Turn into 3D model