



Neural Network

GENERATIVE BREAST CANCER IMAGING

**Lesion Synthesis and Risk Prediction
with Latent Diffusion Models**

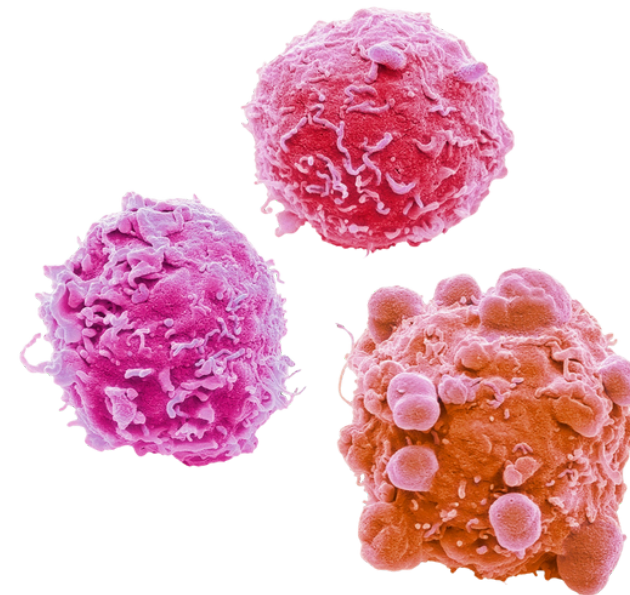


Presented By :
Nicola Todaro and Thomas CHen

OVERVIEW

Motivation

Overcoming data scarcity in breast cancer imaging by generating lesion-conditioned synthetic mammograms to boost diagnostic accuracy



Data Scarcity in Breast Cancer Imaging

Need for Synthetic Data Augmentation

Impact on Diagnostic Research

Medical Imaging

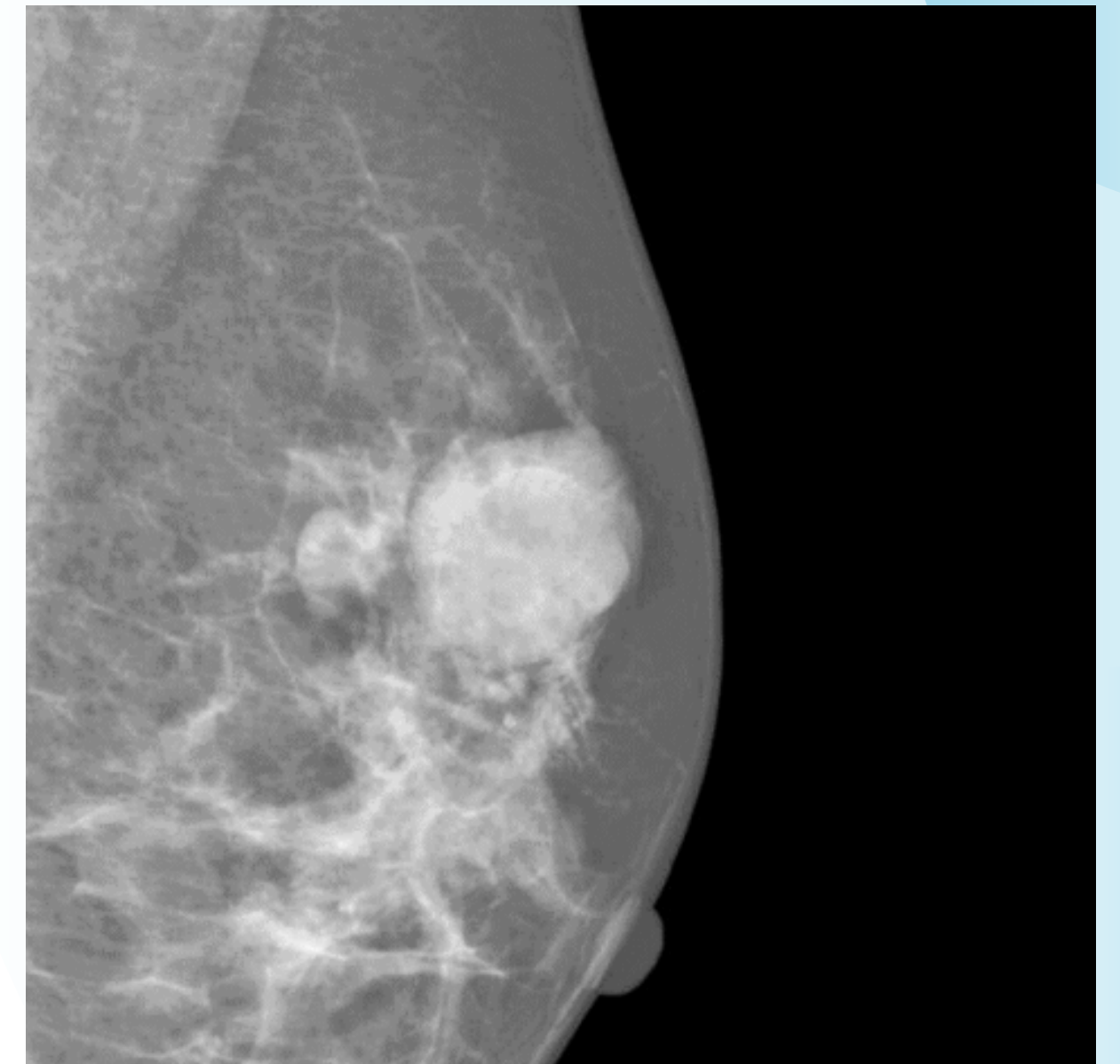
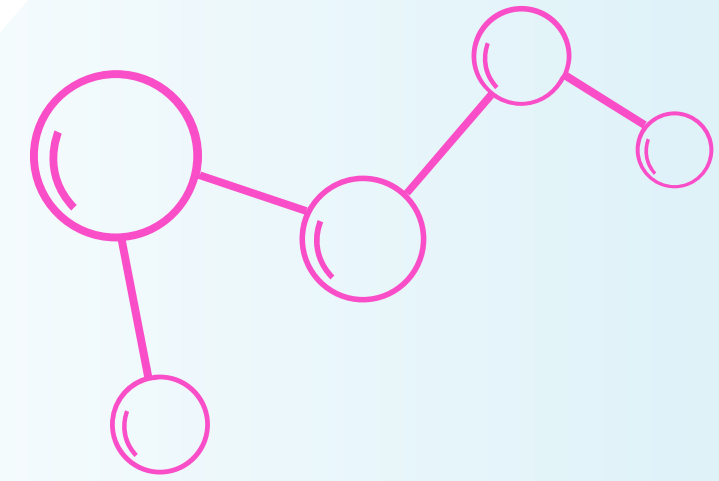
RELATED WORK

***High-resolution
image synthesis
using LDMs***

***Anatomically-
controllable
models with
segmentation
priors***

***Contributions from
recent literature
in tumor synthesis***

***How our approach
builds on
and extends
these works***



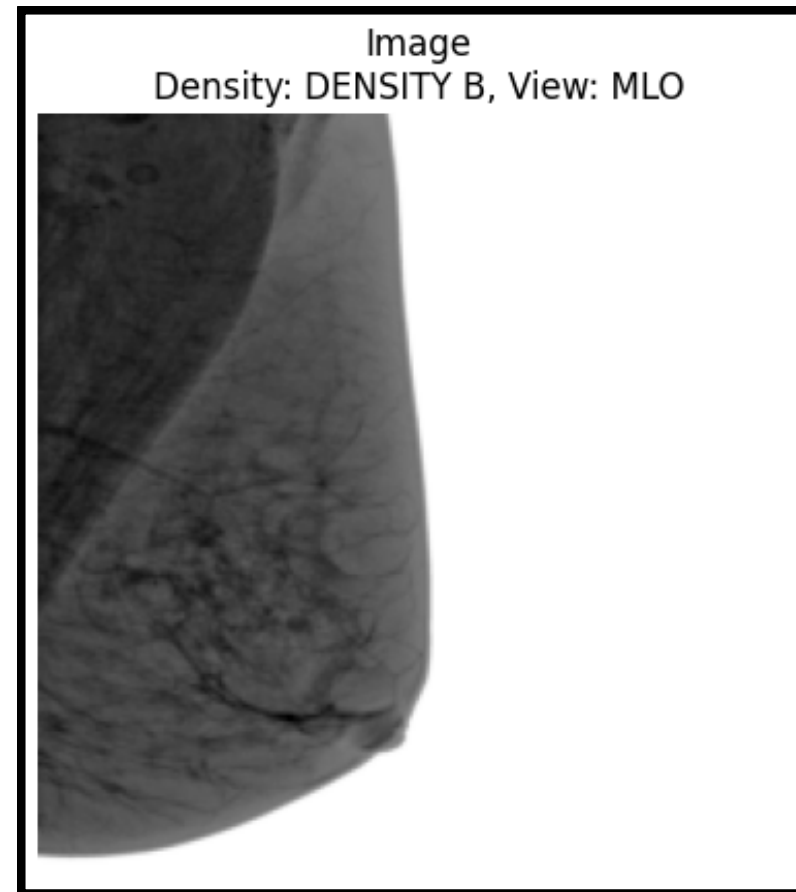
Synthetic Mass

Dataset

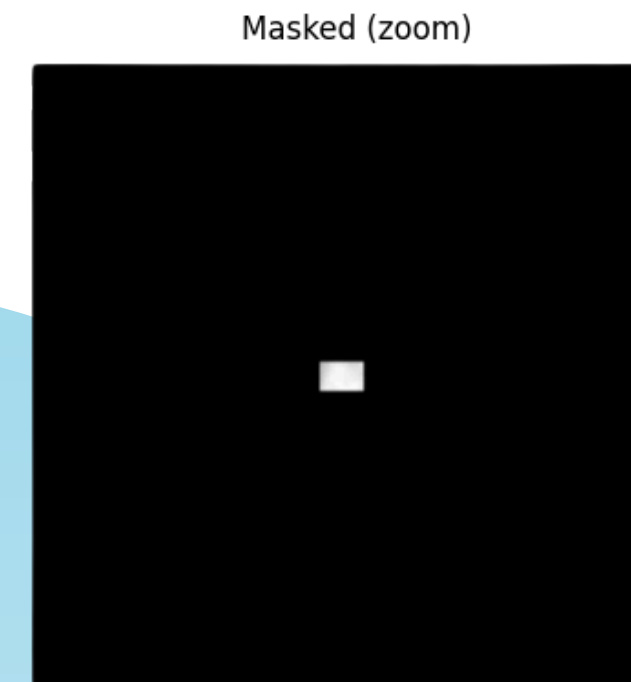
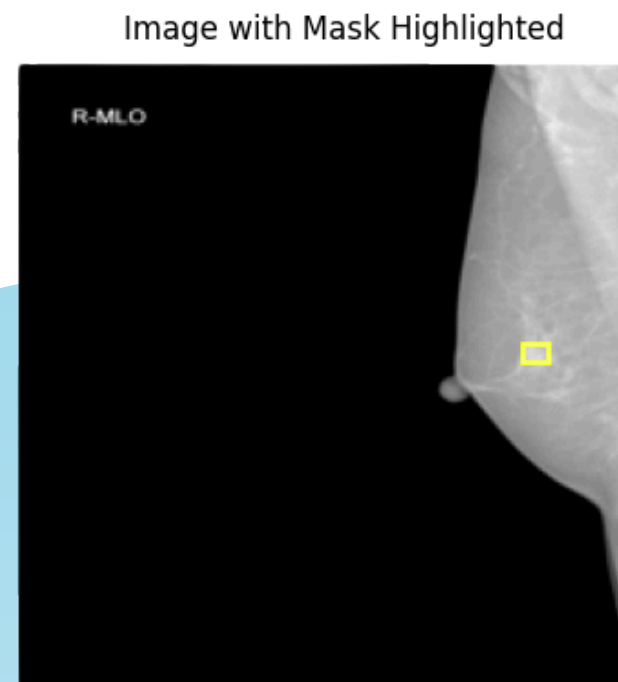
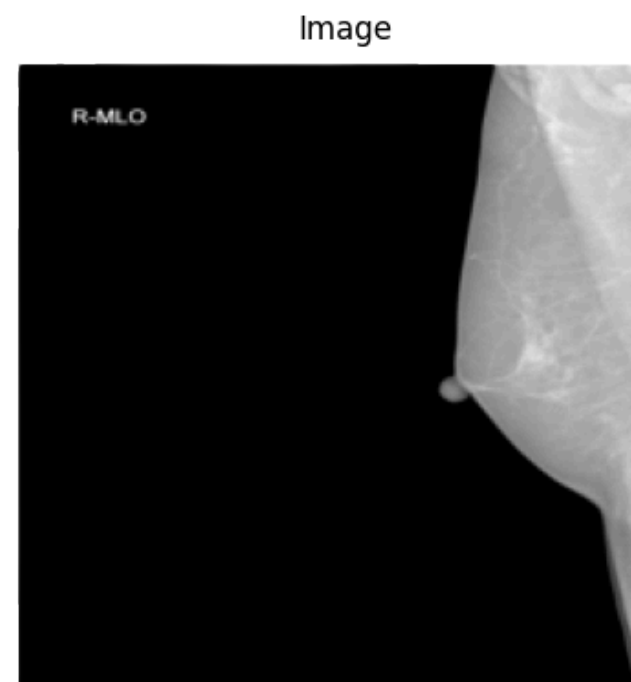
VinDr-Mammo 

Preprocessing

- normalization
- cropping (for visualization)
- resize 224x224
- masking RoI



Density: DENSITY B, View: MLO, Category: ['Mass'], BIRADS: BI-RADS 4, Split: training



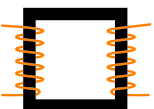
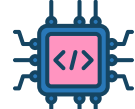



DATA & PREPROCESSING

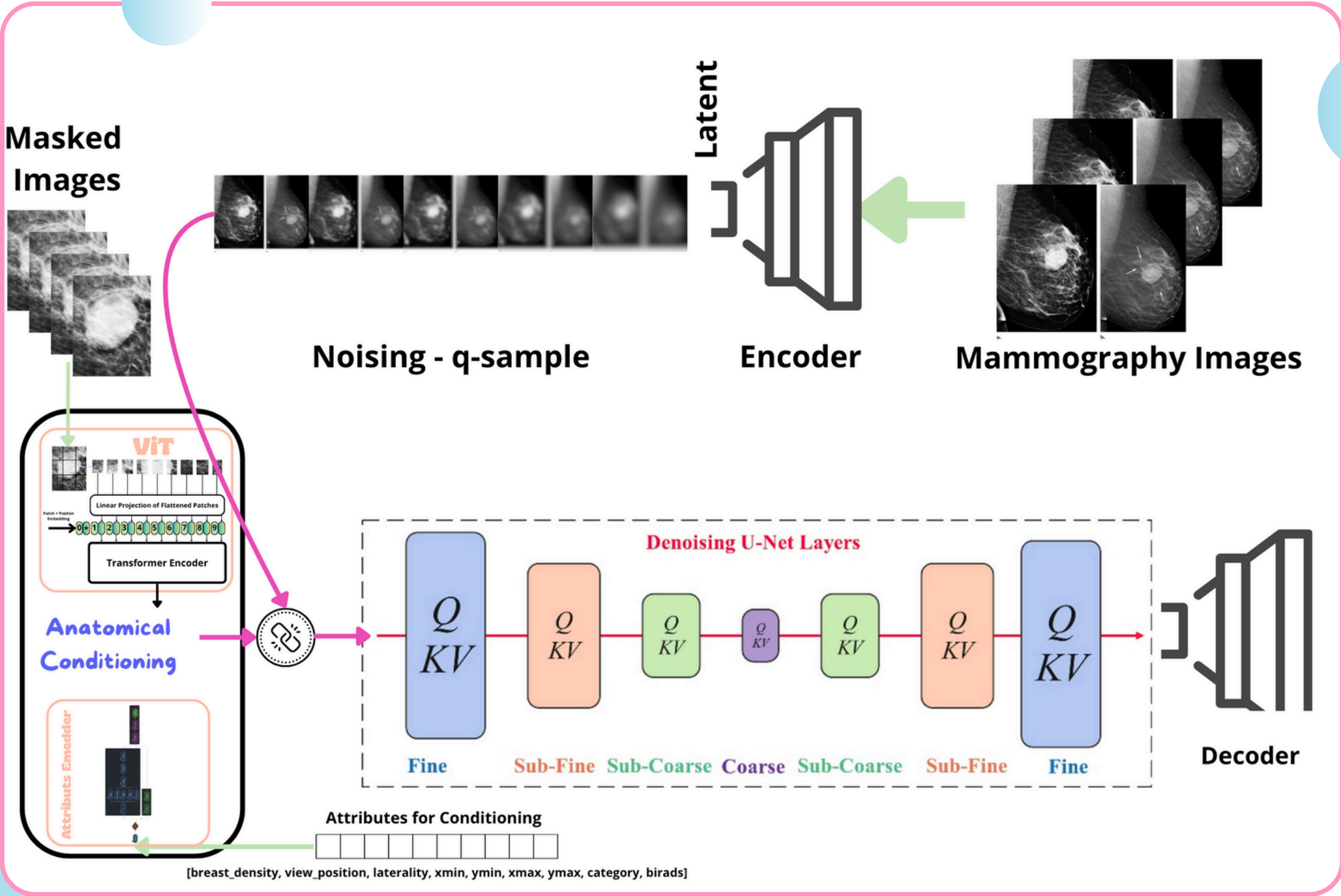
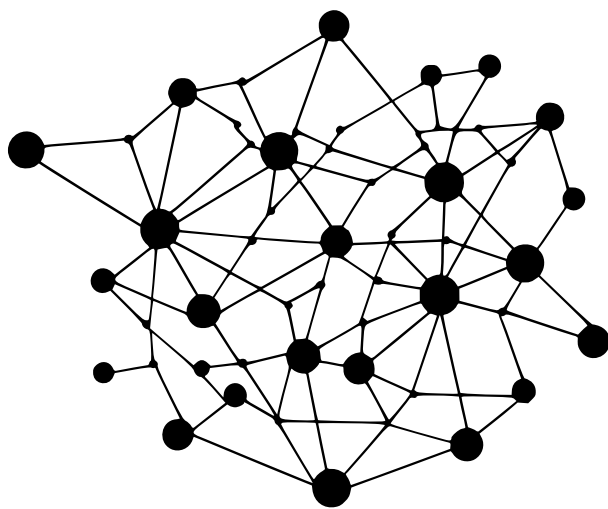
Medical Data

METHODOLOGY

Pipeline Architecture

Architecture

- Conditioning  
- Latent Noising 
- Multi-scale Denoising 
- High-res Decoding 

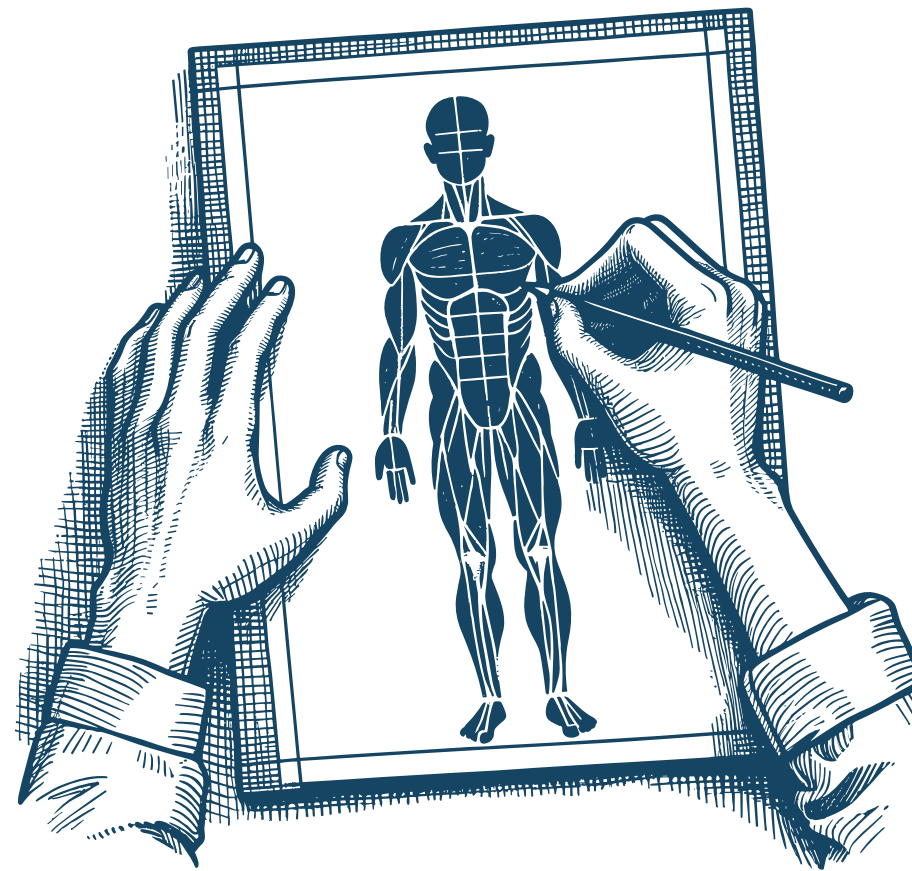


Conditioning

CONDITIONING & RECONSTRUCTION MECHANISMS

Benefits

In our diffusion-based pipeline, features from the ViT-encoded masked image, the anatomical attribute embedder, and the encoder's latent vector are fused via multi-head cross-attention within a transformer-based (or U-Net) denoising module, before being decoded into a synthetic mammogram. This conditioning enables the model to generate images that reflect both visual and anatomical information.



- Conditioning
 - cross-attention
 - FiLM layers
- Integration of
 - patient metadata
 - radiology report embeddings
- Reconstruction loop to verify
 - lesion integrity with a classifier model

Practice **EXPERIMENTS & EVALUATION**

- Datasets used: VinDr-Mammo
- Evaluation metrics for image quality :
 - Peak Signal-to-Noise Ratio (PSNR)
 - Structural Similarity Index Measure (SSIM)

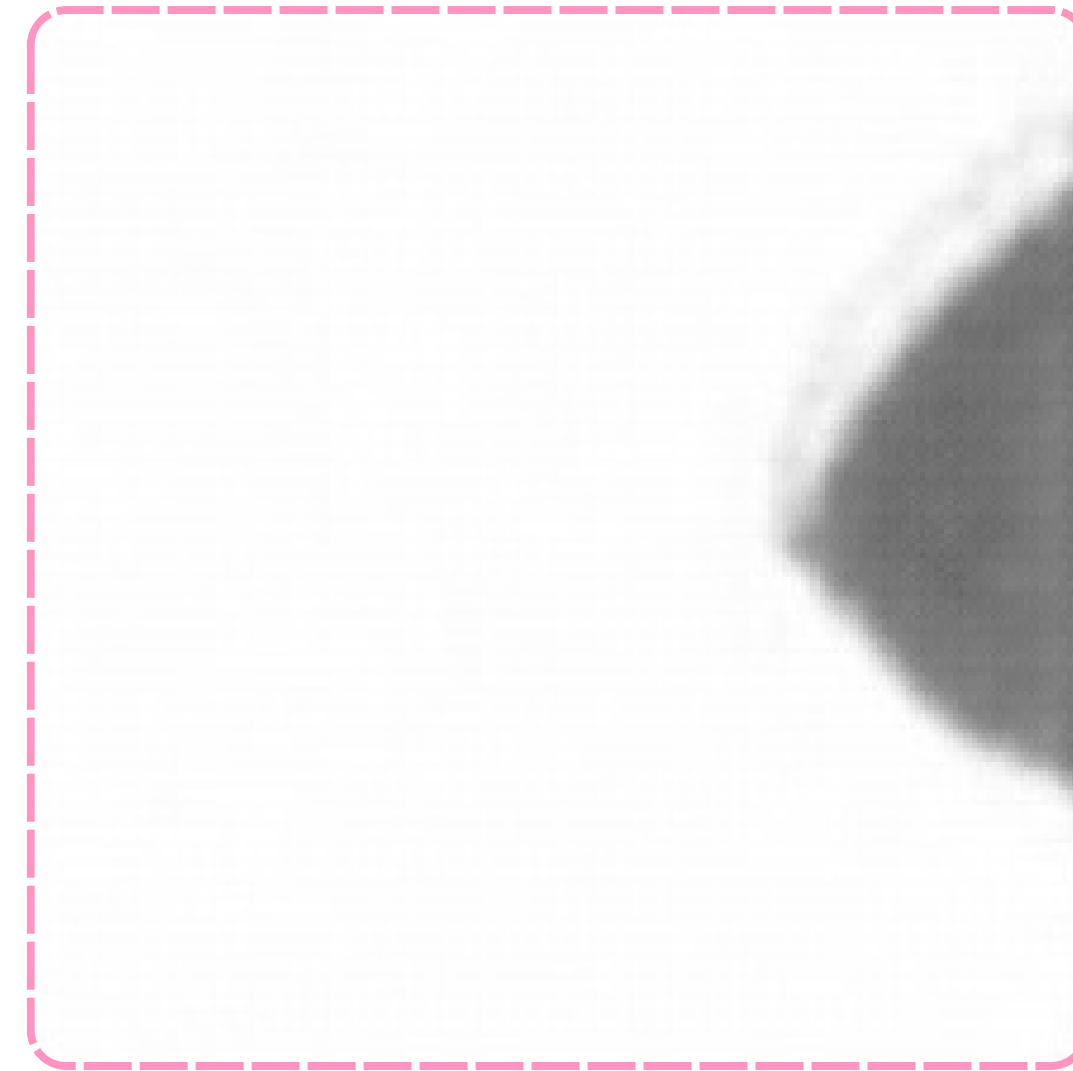
Average SSIM : 0.84
Average PSNR : 22.5 dB



RESULTS, EXTENSIONS & FUTURE WORK

Future enhancements

- Temporal lesion evolution modeling
- Counterfactual synthesis for risk assessment
- Multimodal image generation
(e.g., ultrasonography pairs)
- Reconstruction Loop for Risk Prediction



Generated Mammogram



***Diagnostic performance:
cycle-consistency check results***

BREAST *CANCER*

Let's Fight together



THANK YOU FOR YOUR ATTENTION

Repository :
GBCI - Repository

thomaschen178@gmail.com
todaronicola97@gmail.com

Presented By :
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