

*IE308 Final Project*

# 医学超声图像去噪修复与增强

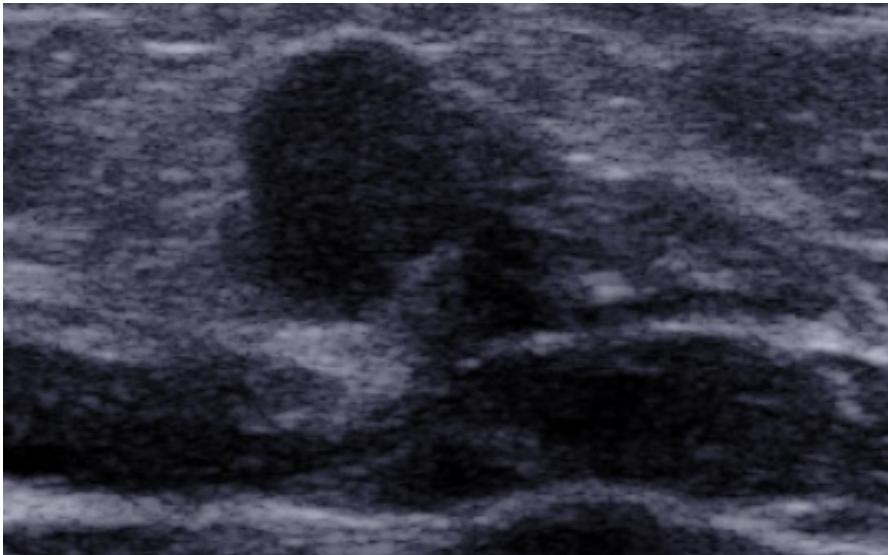
Denoising and Enhancing for  
Ultrasonic Images

Mingke Wang ( 王铭珂 )

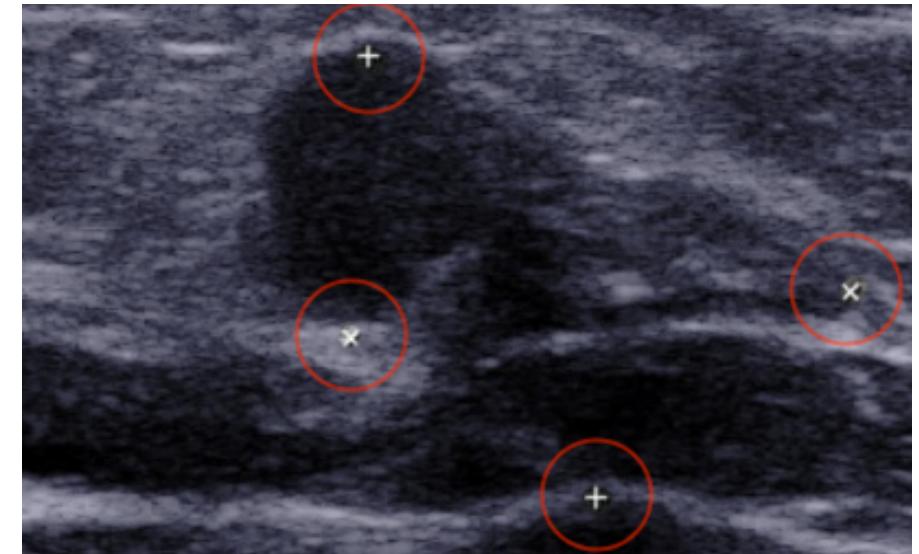
Zixuan Li ( 李紫轩 )

# Introduction—What the project is about

- 医生在保存超声图像过程中可能会在图上留下人工标记（artifacts）



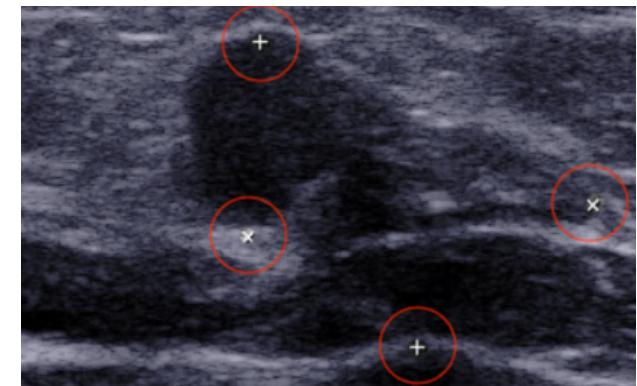
Without artifacts



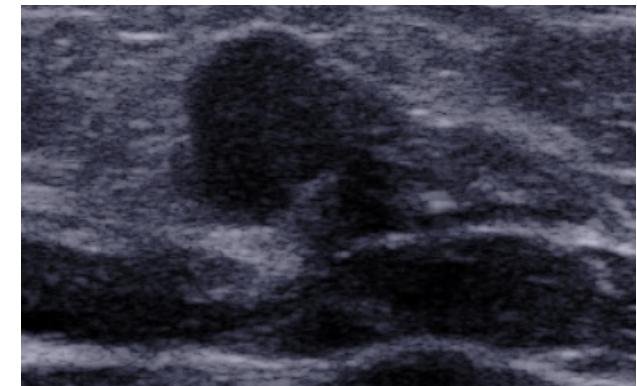
With artifacts

# Introduction—What the project is about

- 医生在保存超声图像过程中可能会在图上留下人工标记 ( artifacts )
- 外界干扰导致图像出现噪声和伪影，图像质量普遍较差



With **artifacts**



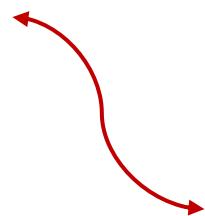
Without **artifacts**

# Introduction—What the project is about

- 医生在保存超声图像过程中可能会在图上留下人工标记 (artifacts)
- 外界干扰导致图像出现**噪声和伪影**，图像质量普遍较差

## 传统图像处理方法

The classic method



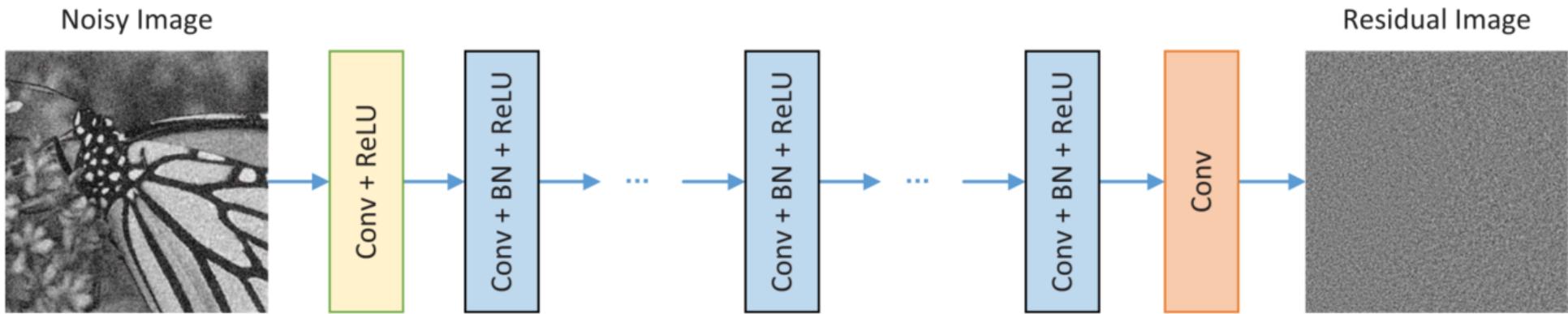
## The learning method

## 基于DnCNN神经网络的机器学习算法

The DnCNN-based[1] learning Method

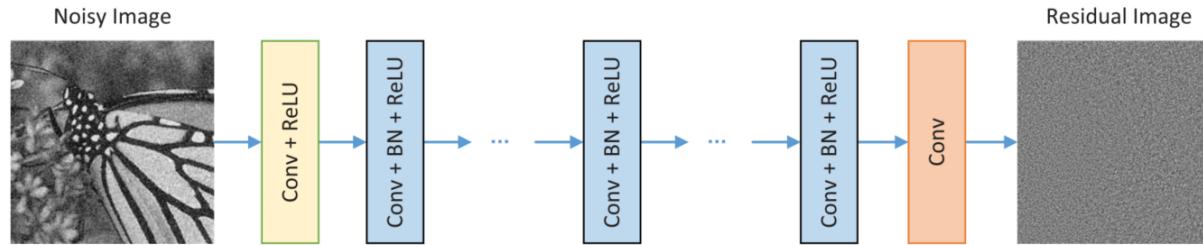
# The DnCNN-based[1] learning Method

网络结构



- [1]Kai Zhang, Wangmeng Zuo, Yunjin Chen, Deyu Meng, and Lei Zhang. Beyond a gaussian denoiser: Residual learning of deep cnn for image denoising. *IEEE Transactions on Image Processing*, 26(7):3142–3155, 2017.

# The DnCNN-based[1] learning Method

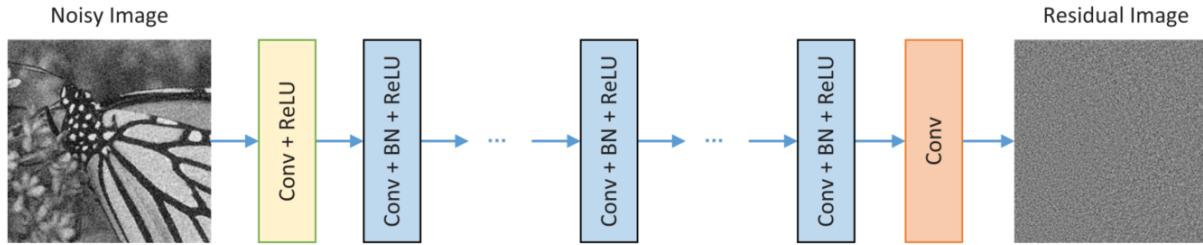


残差学习 ( residual learning )

ResNet[2]

- [1] Kaiming He, Xiangyu Zhang, Shaoqing Ren, and Jian Sun. Deep residual learning for image recognition. In *Proceedings of the IEEE conference on computer vision and pattern recognition*, pages 770–778, 2016.

# The DnCNN-based[1] learning Method

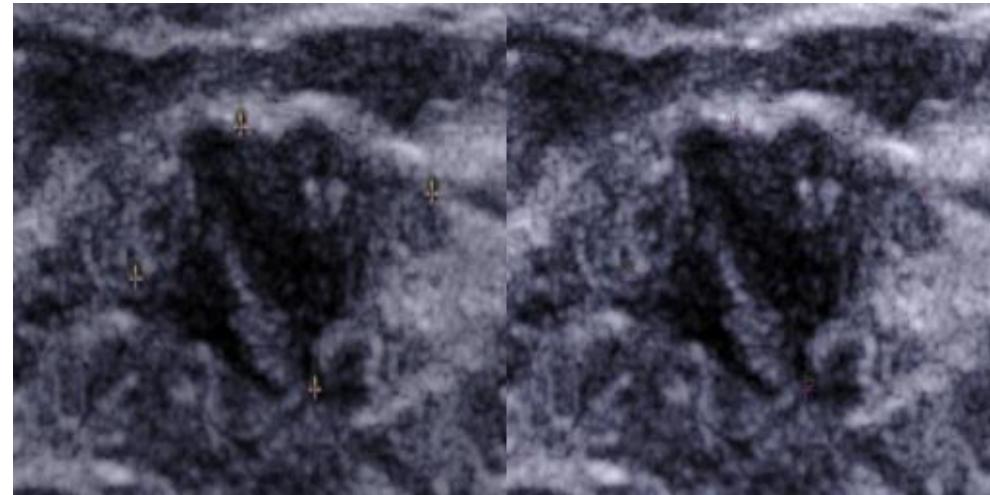
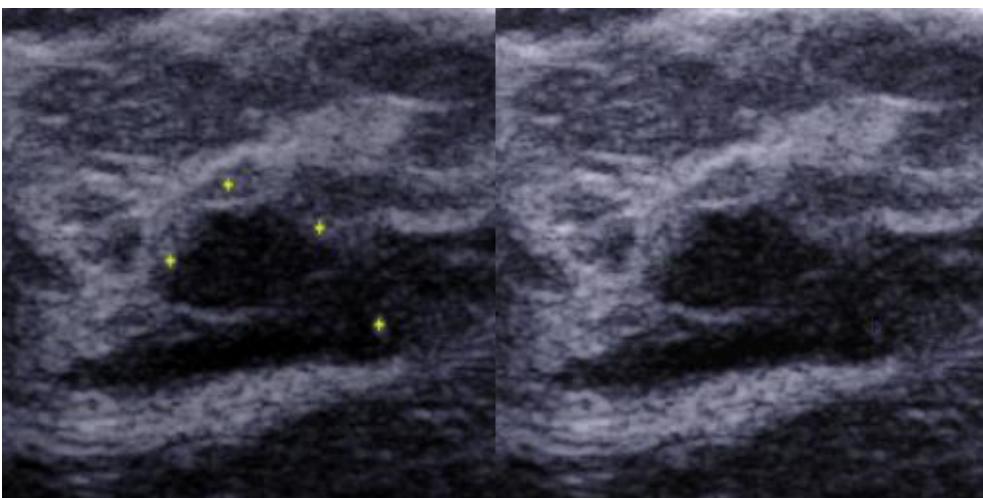
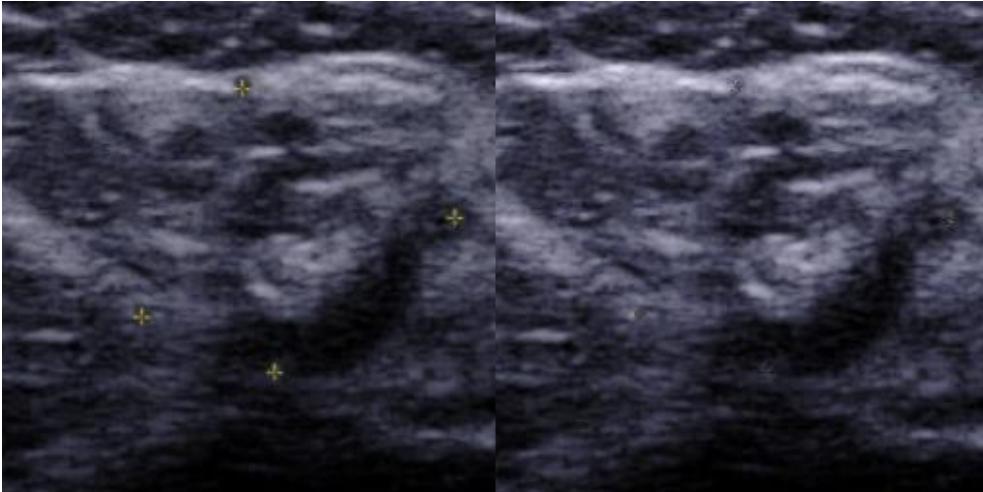


批量标准化 ( batch normalization )

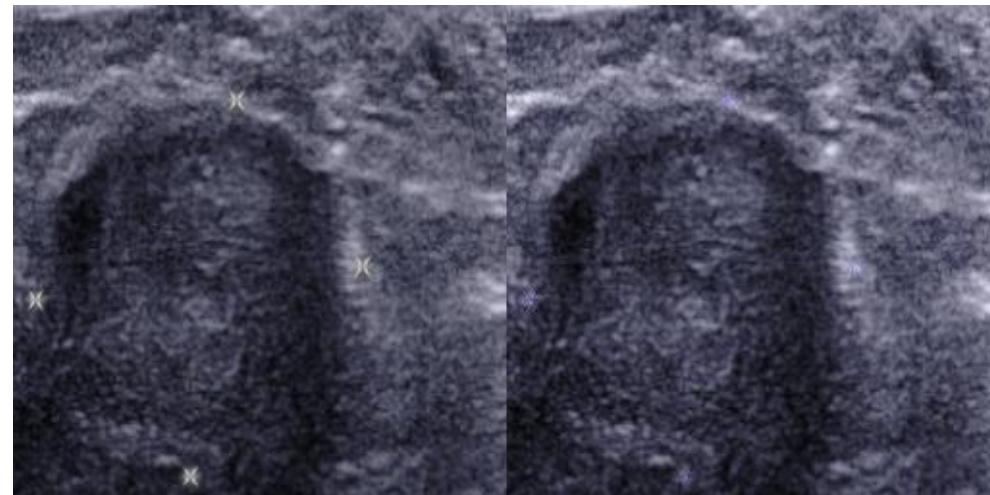
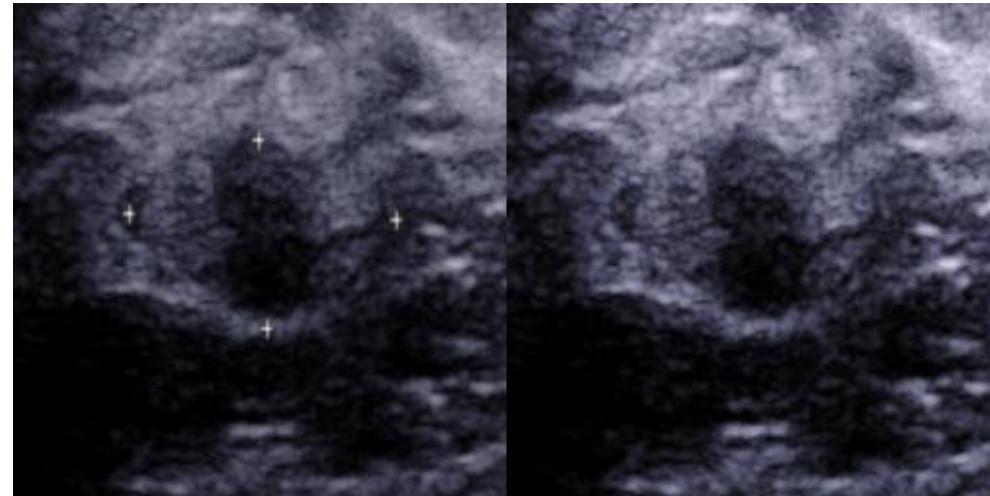
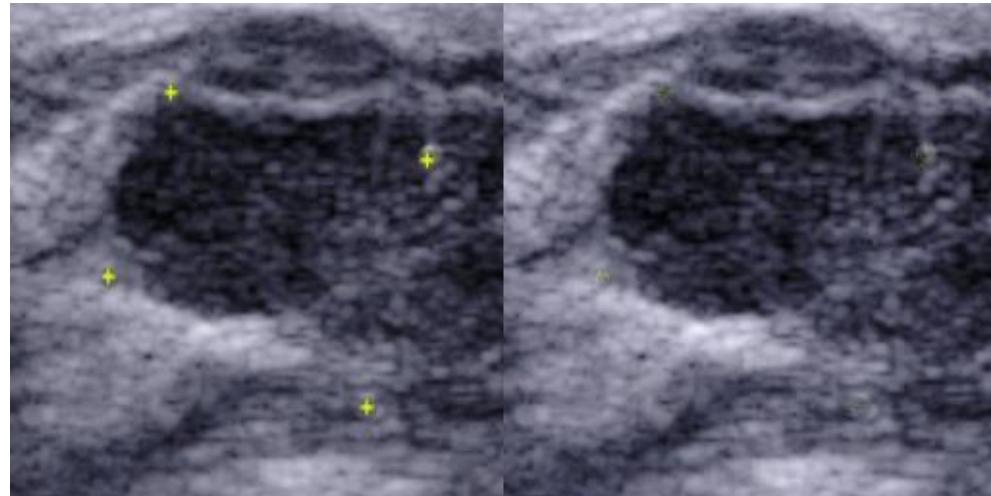
BN 就是在每一层的非线性处理之前加入标准化、缩放、移位操作来减轻内部协变量的移位。可以给训练带来更快的速度，更好的表现，使网络对初始化变量的影响没有那么大。

# Results of The DnCNN– based[1] Method

# Results of The DnCNN-based[1] Method



# Results of The DnCNN-based[1] Method



# The Classic Image Processing Method

# The Classic Method

图像内容分析  
与特征提取

基于纹理合成  
Inpainting 算法  
的图像复原

# The Classic Method

图像内容分析与特征提取

1. 色彩空间滤波和硬阈值滤波

RGB ?  HSV

产生二值化Mask图像

# The Classic Method

## 图像内容分析与特征提取

1. 色彩空间滤波和硬阈值滤波 **RGB** ?  **HSV**
2. 图像形态学处理 产生二值化Mask图像

闭操作: 7\*7 kernel      膨胀—腐蚀

开操作: 3\*3 kernel      腐蚀—膨胀

# The Classic Method

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## Algorithm 1: 图像内容分析与特征提取

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**Data:** 带噪声医学超声图像

**Result:** 带 mask (噪声上) 图像

初始化: 读入带 artifacts 图像;

将图像从 RGB 色彩空间转到 HSV 色彩空间;

提取出 H 通道的图片层;

设定阈值;

**if** 大于阈值 **then**

    | 数组值置为 255;

**else**

    | 数组值置为 0;

**end**

对二值化的图像用 7x7 的 kernel 进行闭操作;

对二值化的图像用 3x3 的 kernel 进行开操作;

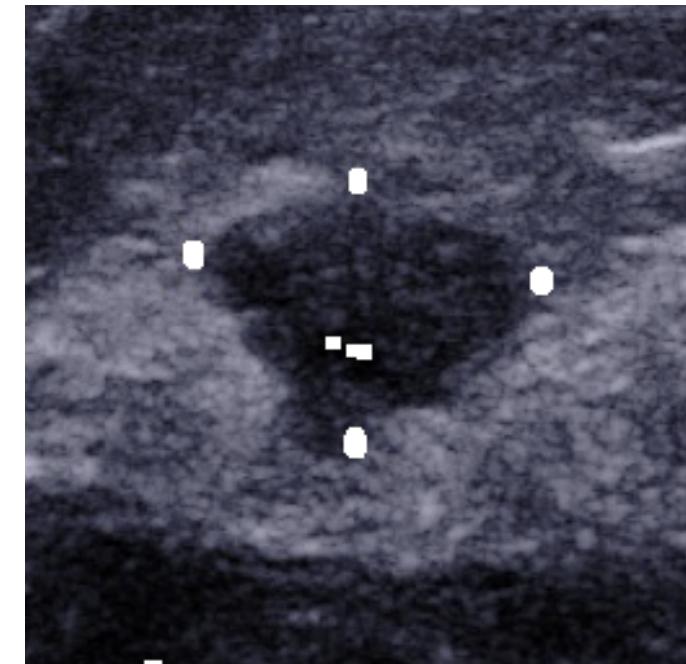
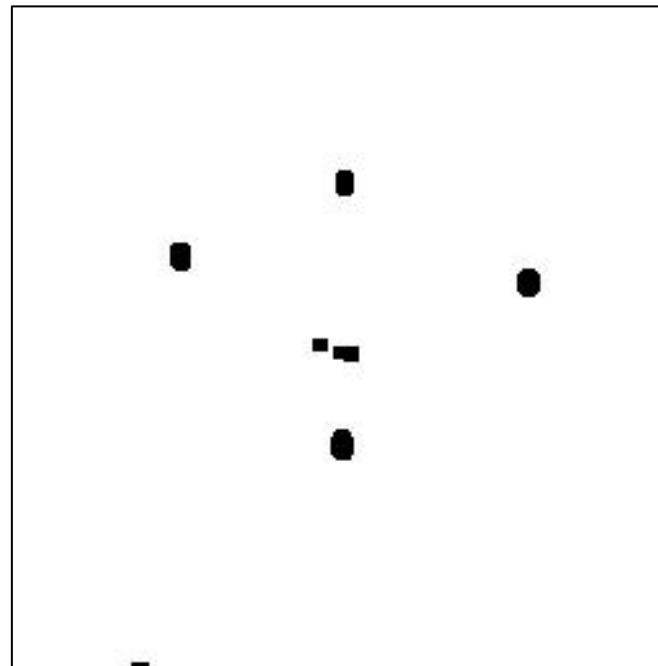
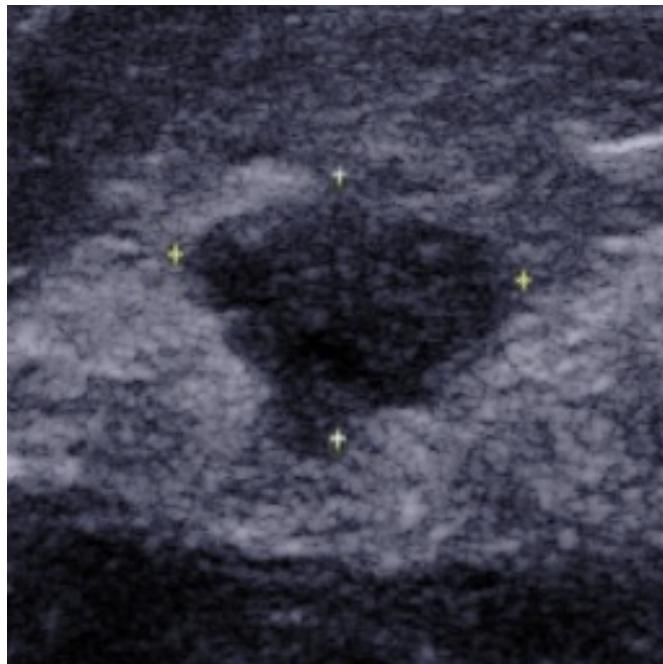
再用 3x3 的 kernel 对图像进行膨胀处理;

得到二值化图像和原图相叠加, 输出结果;

图像内容分析  
与特征提取

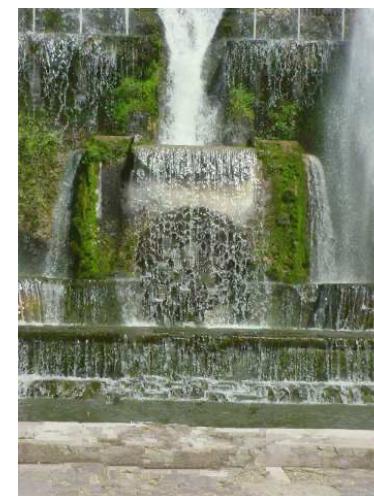
# The Classic Method

图像内容分析与特征提取



# The Classic Method

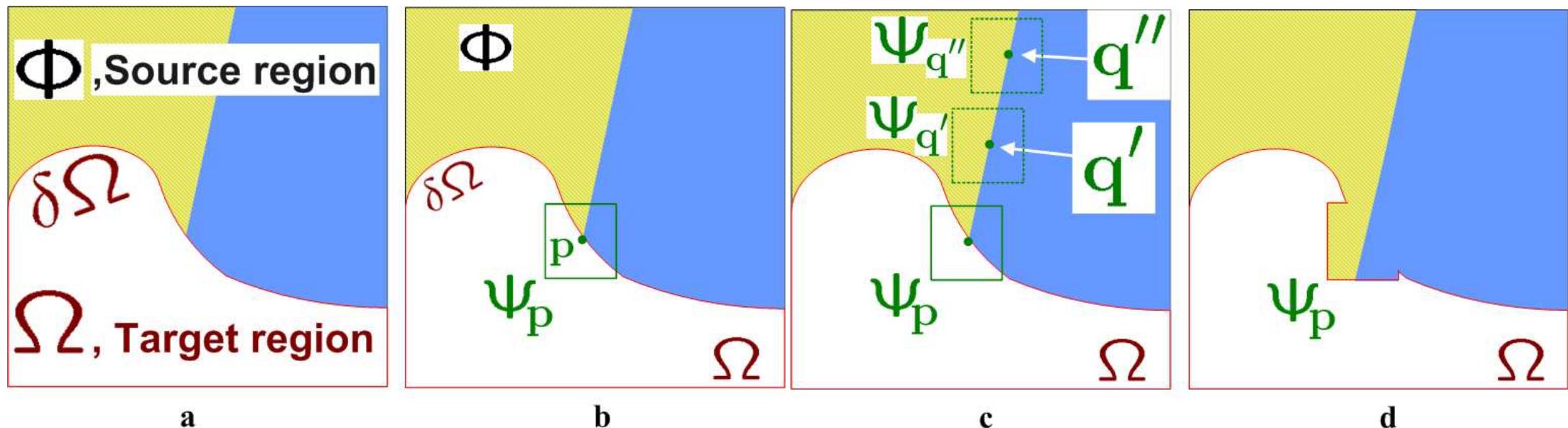
基于纹理合成 Inpainting 算法[3]的图像复原



- [3]Antonio Criminisi, Patrick Perez, and Kentaro Toyama. Region filling and object removal by exemplar-based image inpainting. *IEEE Transactions on Image Processing*, 13(9):1200–1212, 2004.

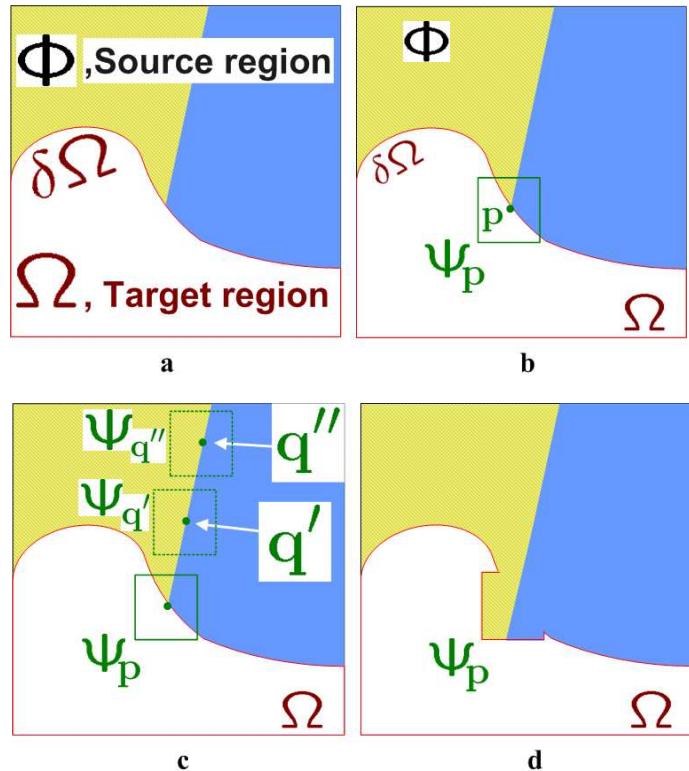
# The Classic Method

基于纹理合成 Inpainting 算法[3]的图像复原



# The Classic Method

基于纹理合成 Inpainting 算法[3]的图像复原



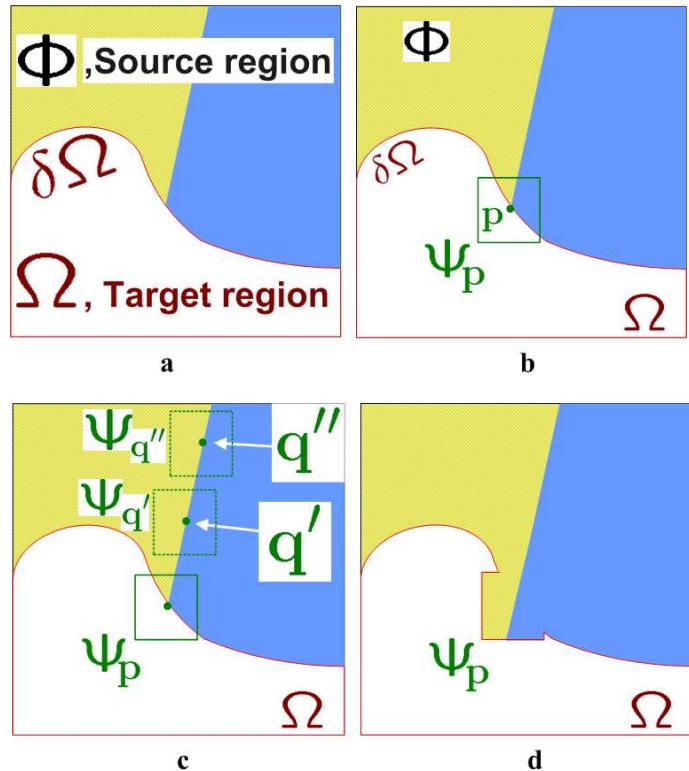
a) 优先级计算

b) 搜索

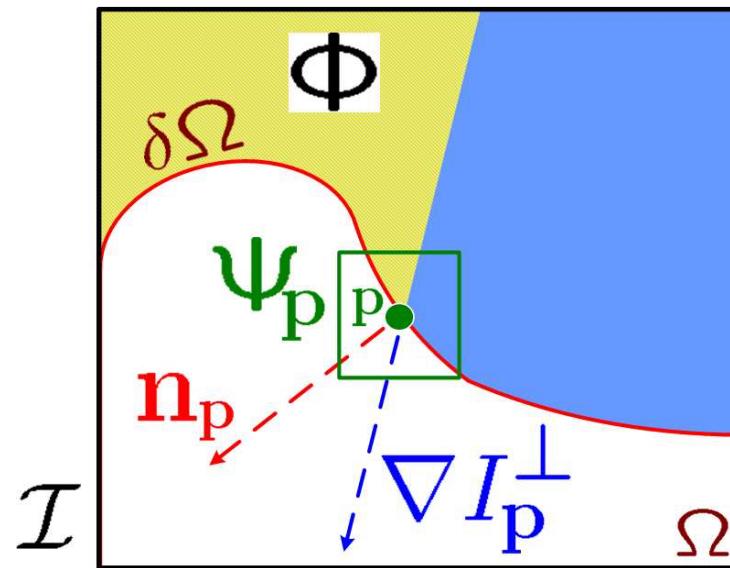
c) 复制

# The Classic Method

基于纹理合成 Inpainting 算法[3]的图像复原

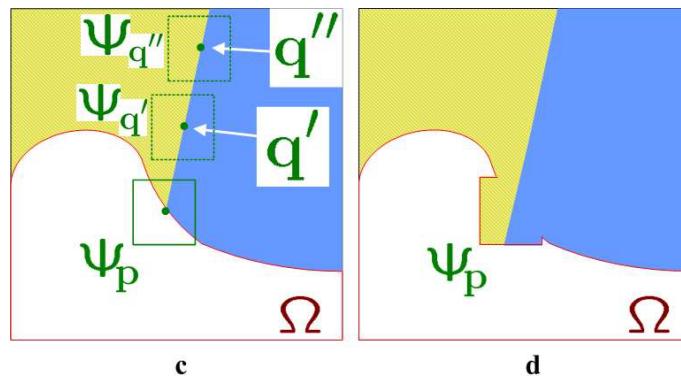
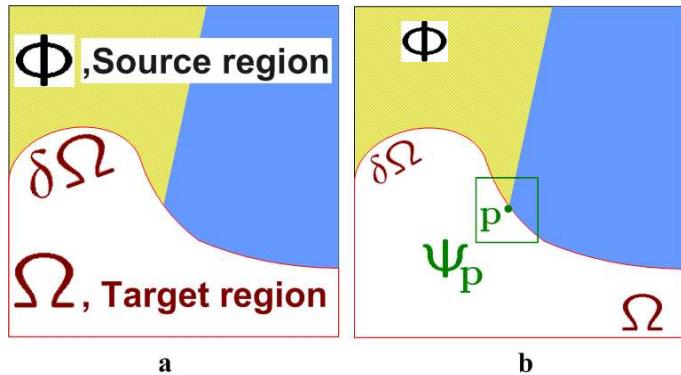


a) 优先级计算



# The Classic Method

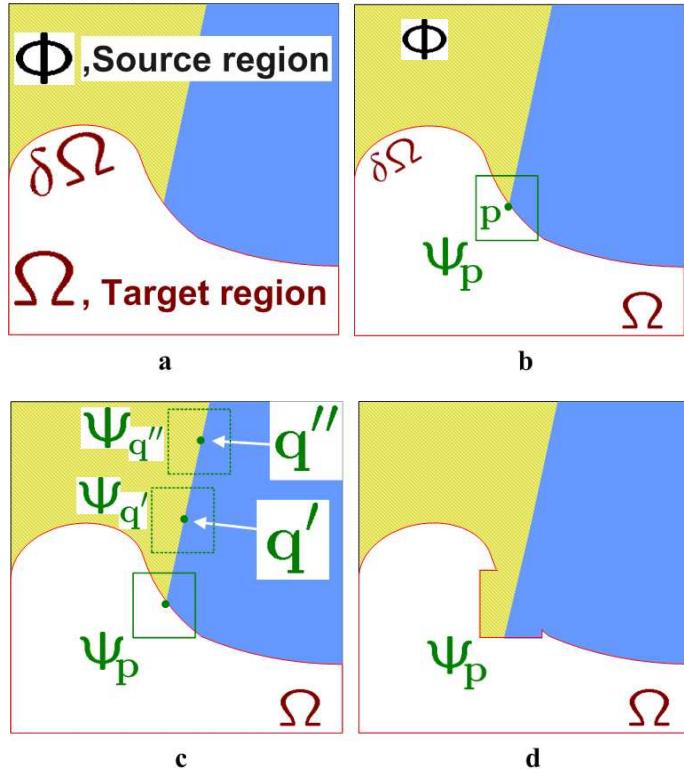
基于纹理合成 Inpainting 算法[3]的图像复原



b) 暴力搜索

# The Classic Method

## 基于纹理合成 Inpainting 算法实现



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**Algorithm 2:** 根据图像目标区域边缘中块的优先级对图像进行填充

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**Data:** 带 mask (噪声上) 图像

**Result:** 复原出的图像

初始化, 读入图像;

提取目标区域  $\Omega$  的边缘  $\delta\Omega$ ;

**while** 边缘不为空 **do**

    计算边缘  $\delta\Omega$  上所有块的优先级  $P(p)$ ;

    找到优先级最高的块  $\Psi_p$ ;

    从源区域  $\Phi$  中找到块  $\Psi_q$ , 使得  $d(\Psi_p, \Psi_q)$  最小;

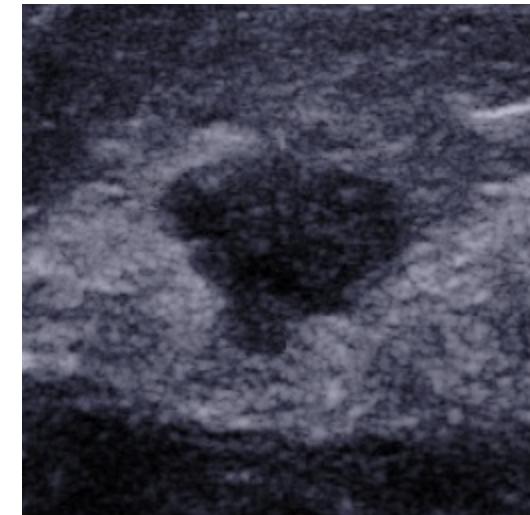
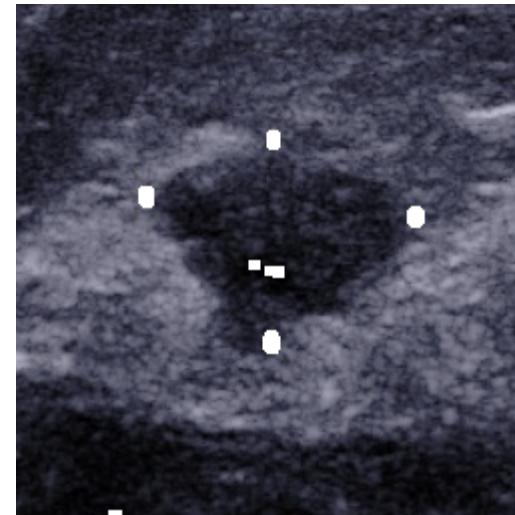
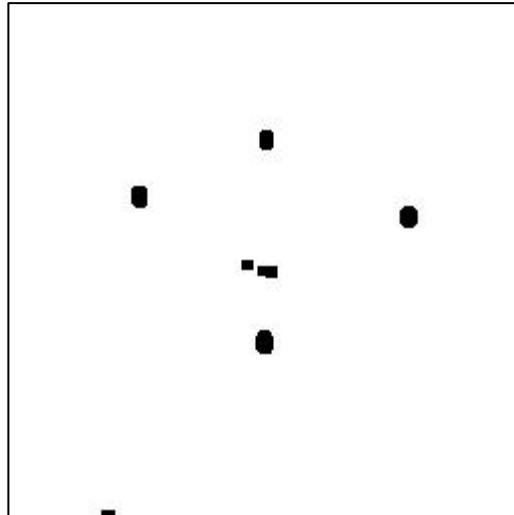
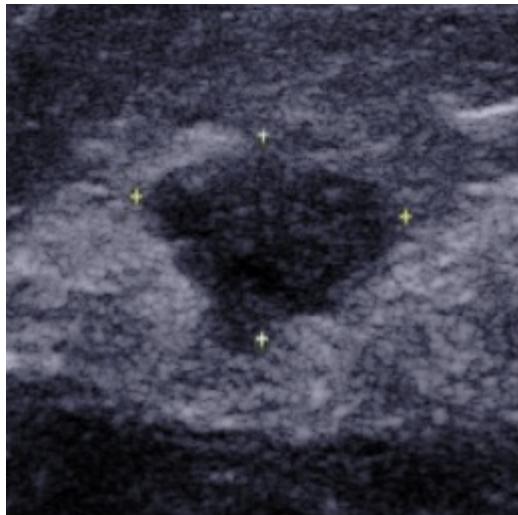
    将  $\Psi_q$  中的数据复制到  $\Psi_p$  中的目标填充点  $p$ ;

    更新  $C(p)$ , 更新边缘  $\delta\Omega$ ;

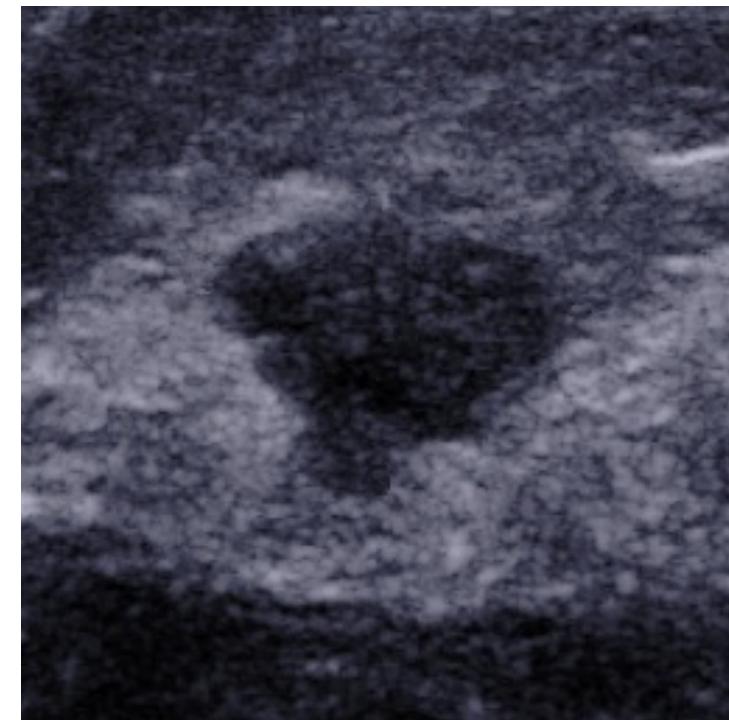
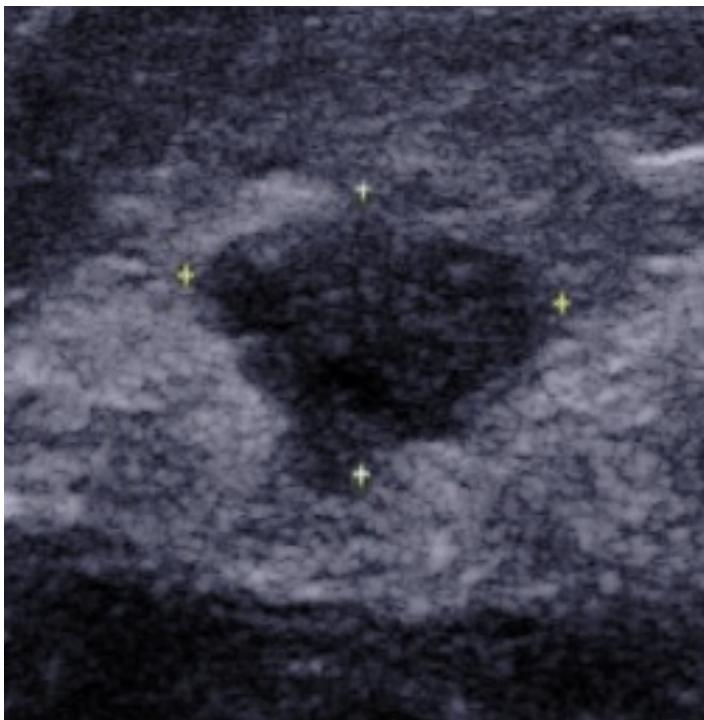
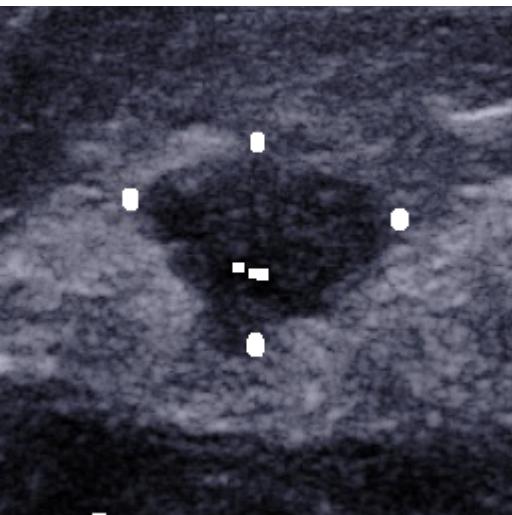
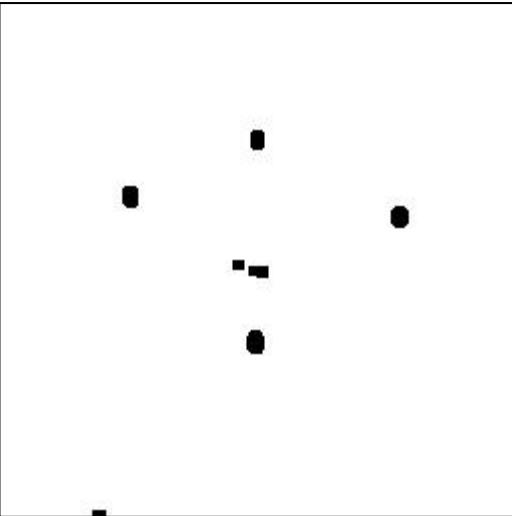
**end**

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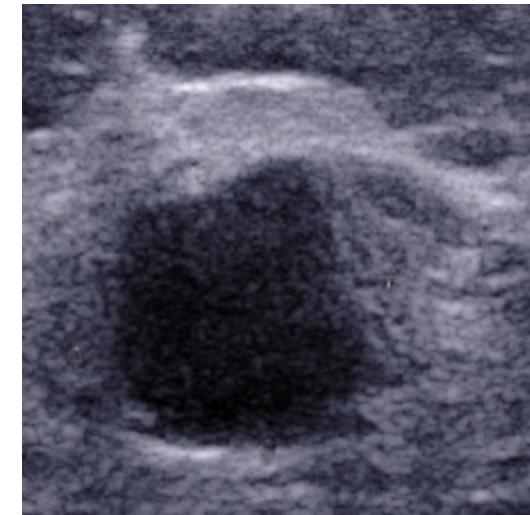
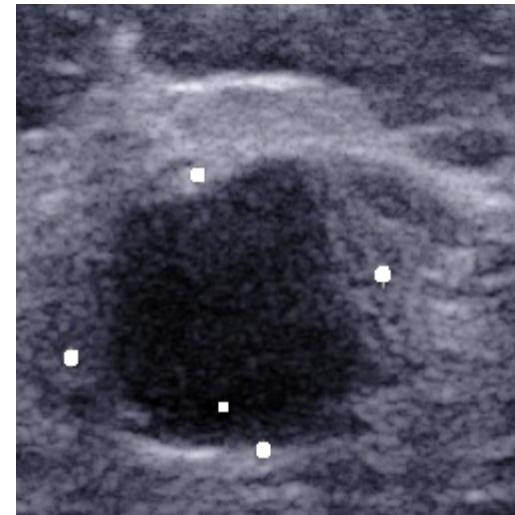
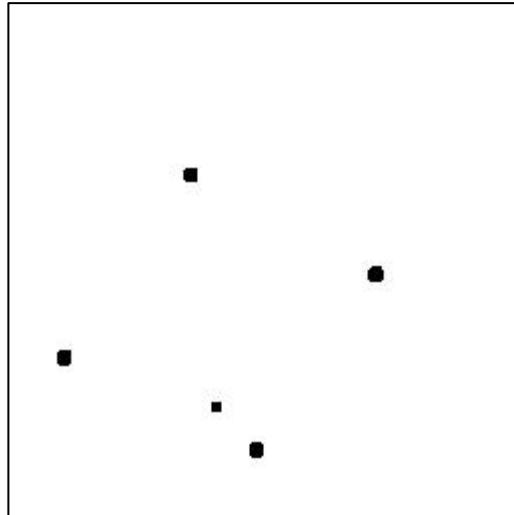
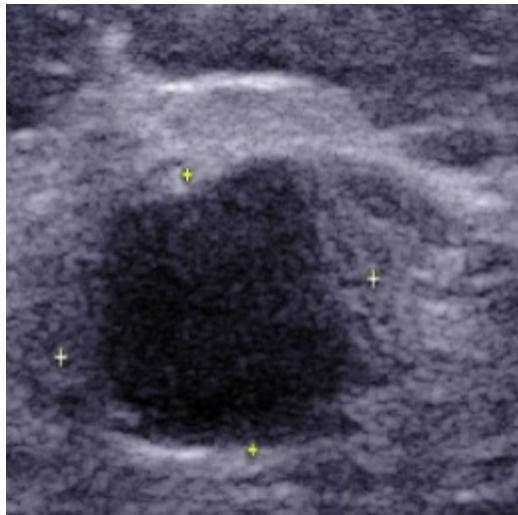
# Result of The Classic Method



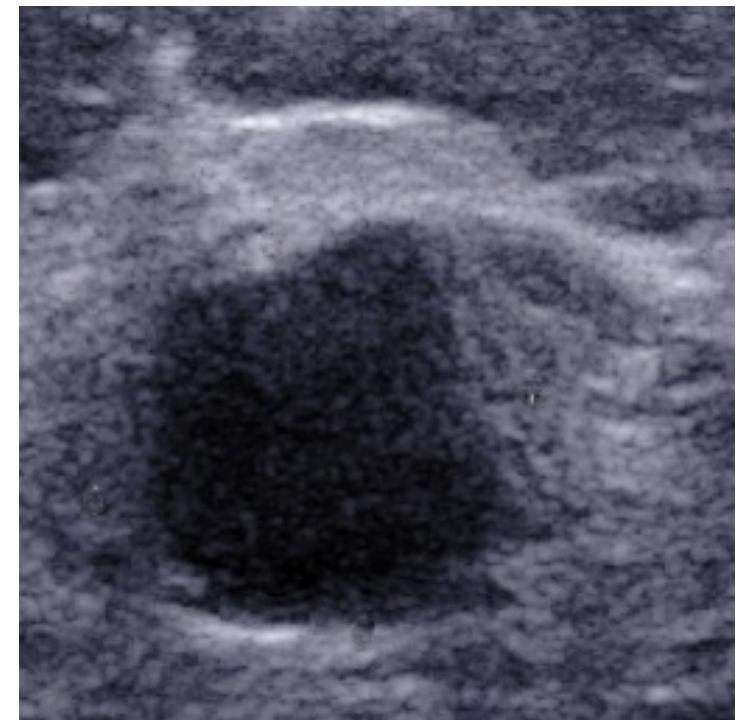
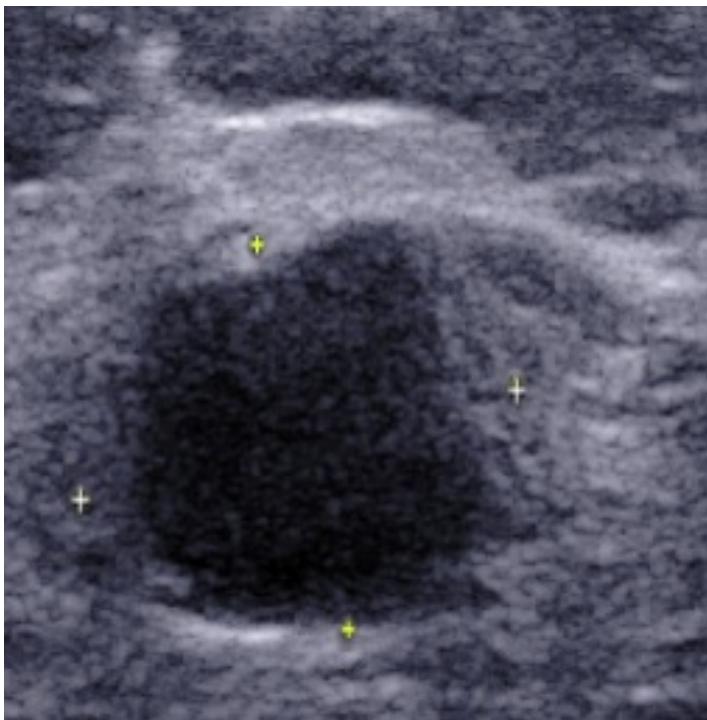
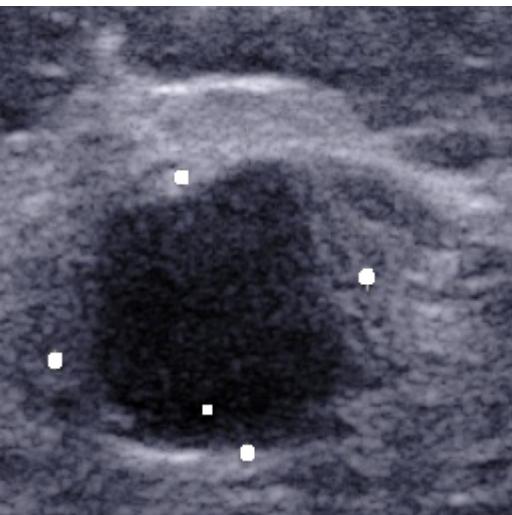
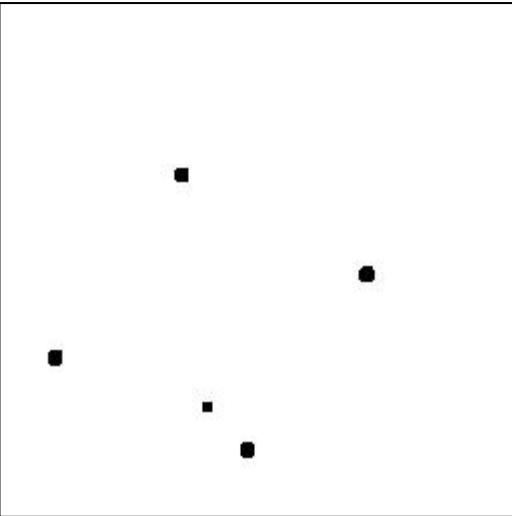
# Result of The Classic Method



# Result of The Classic Method



# Result of The Classic Method



# Comparing The Classic Method and The Learning Method

Thank you!