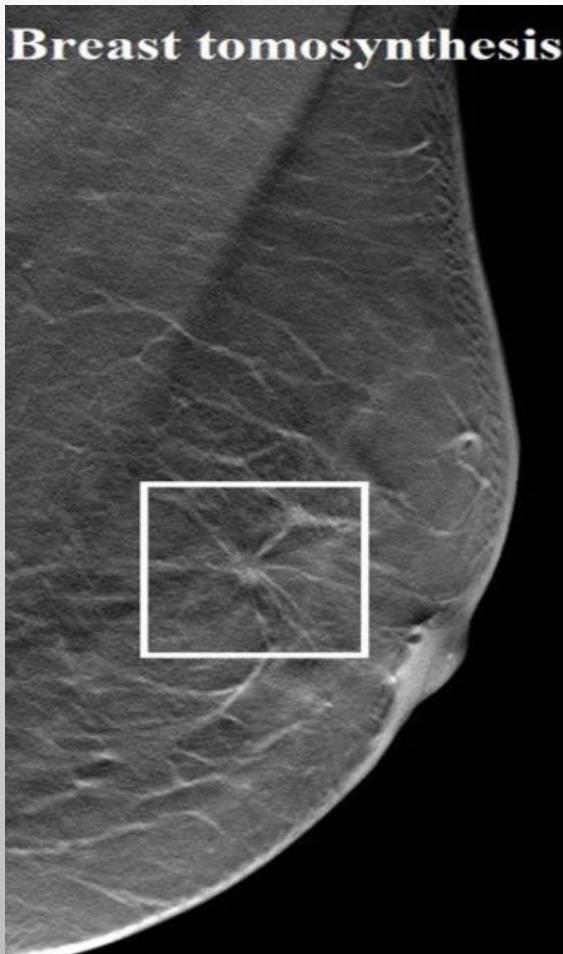


RADIOMICS IN DIGITAL BREAST TOMOSYNTHESIS



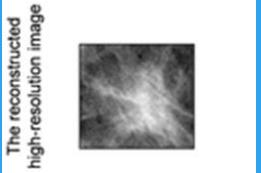
Breast tomosynthesis

Giovanni Mettivier

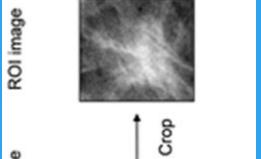
Napoli, Ferrara, Pisa



Super Resolution Module

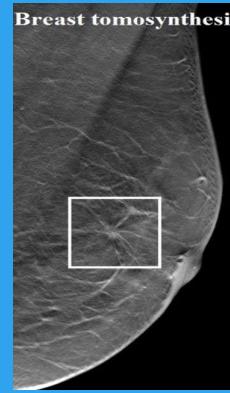
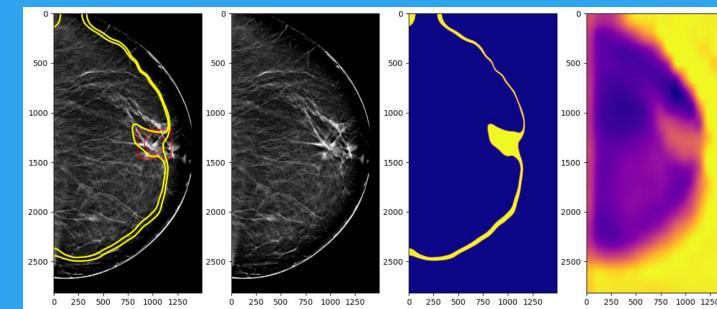
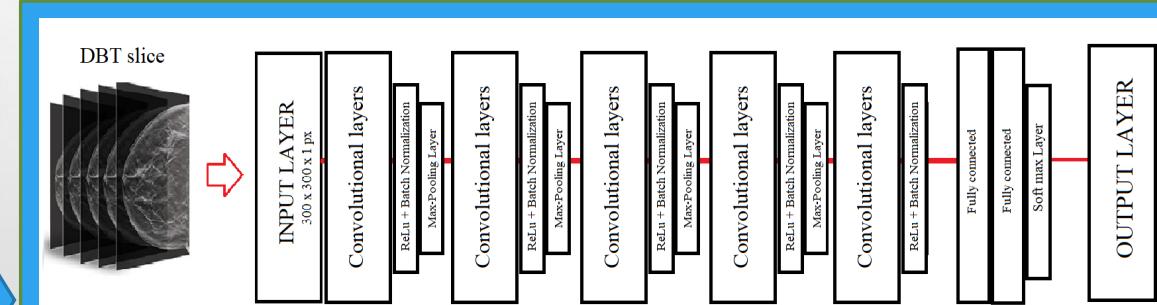
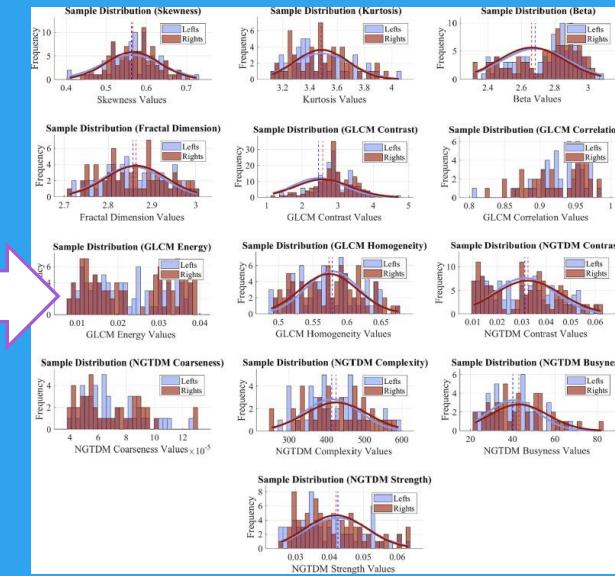
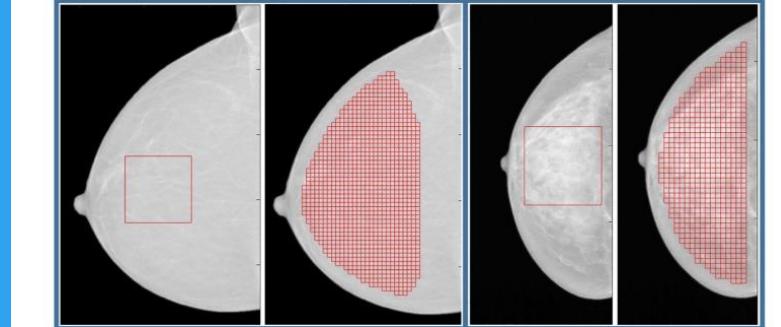


$\times 4$
Reconstruction



Crop

Radiomics Module



GradCA
M



Prediction

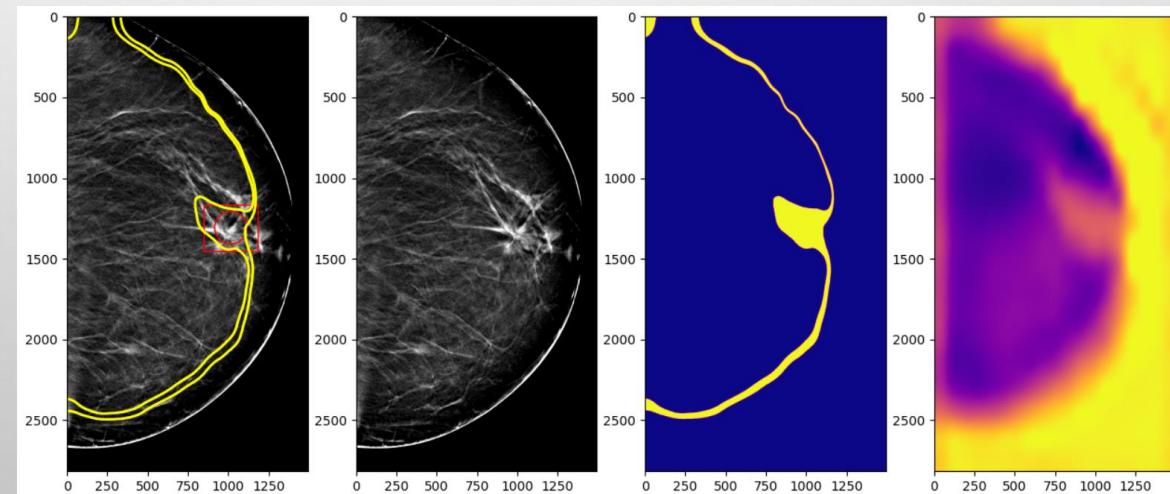
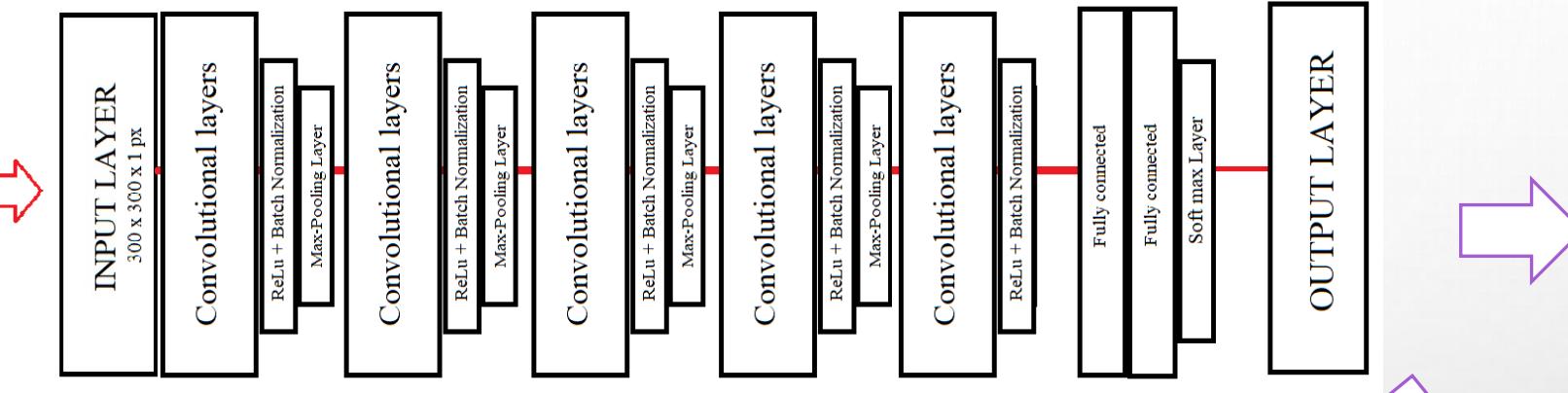
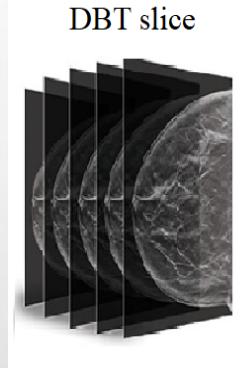
COLLABORATION



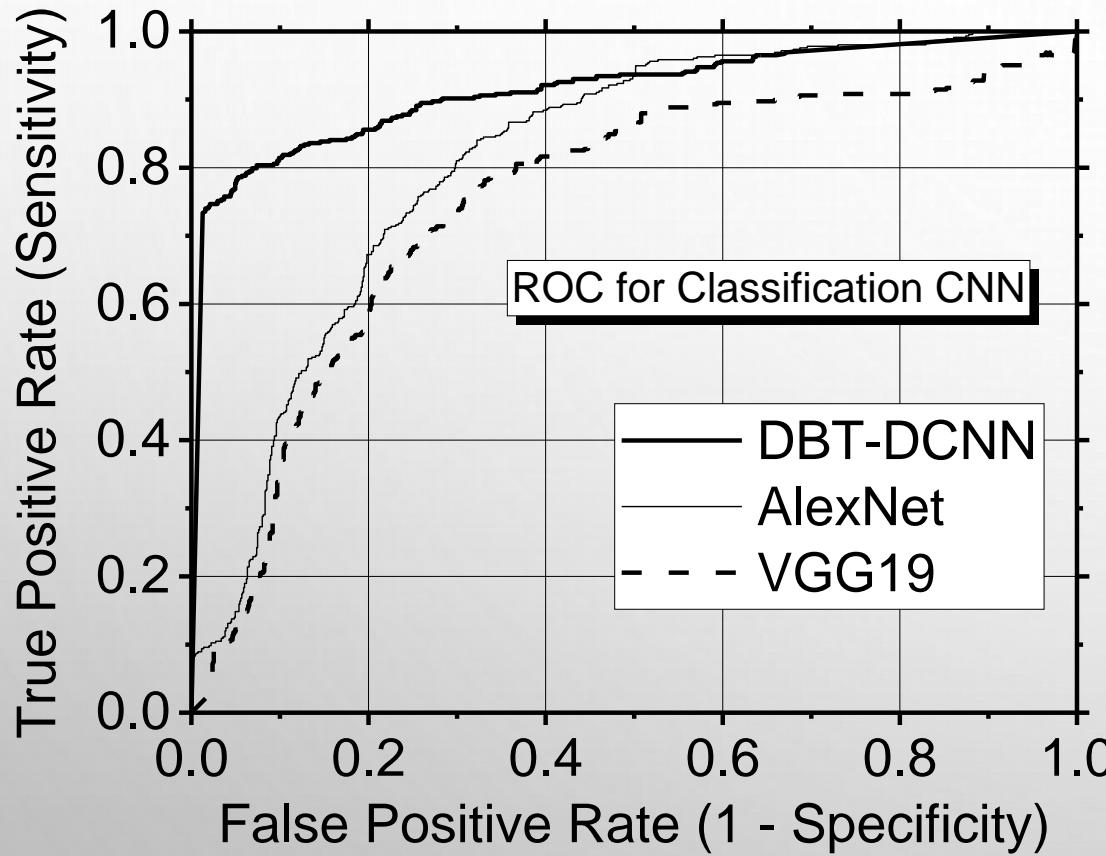
Data Agumentation
E-GAN
Monte Carlo Techniques



COMPUTED AIDED DETECTION

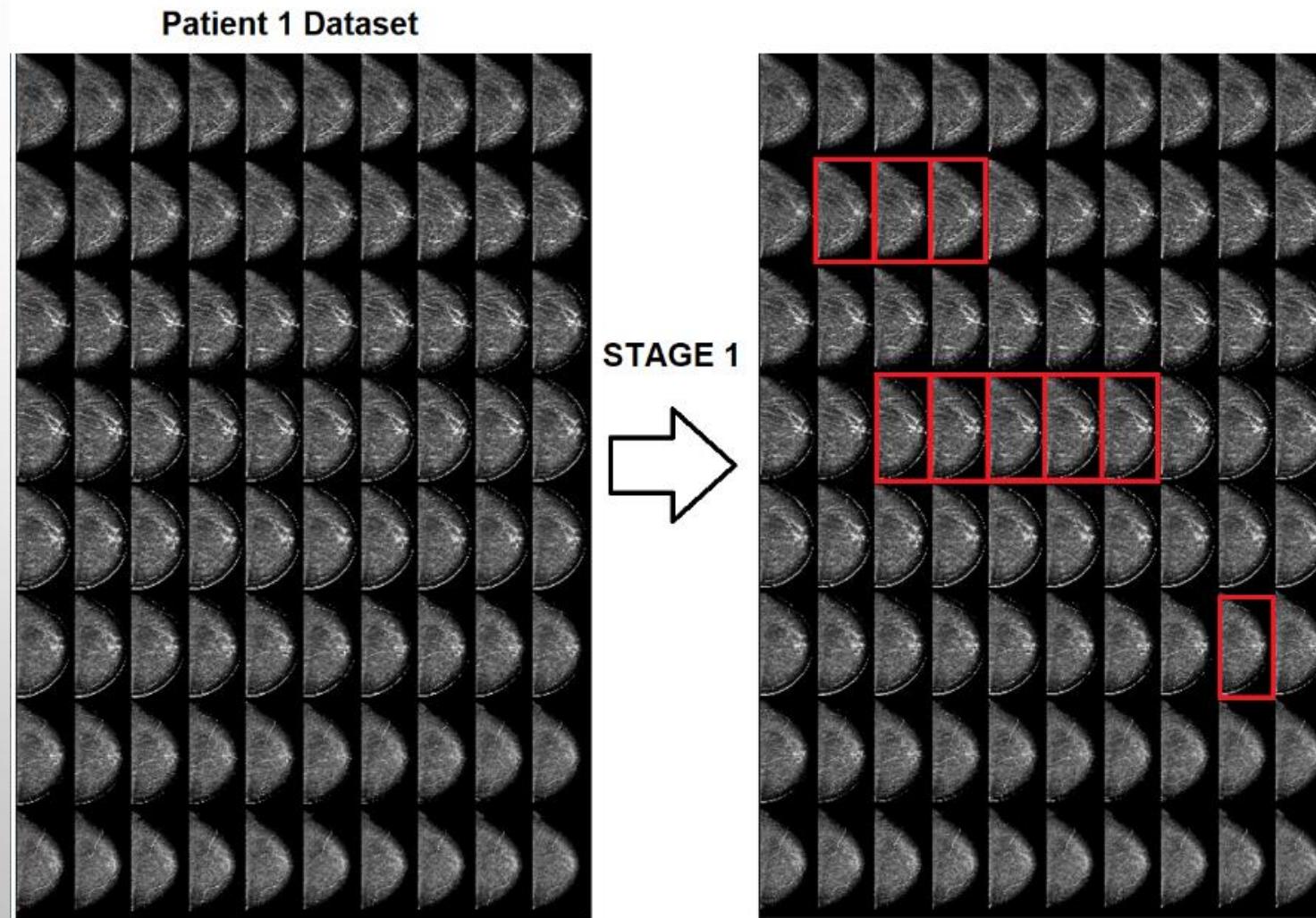


COMPUTED AIDED DETECTION

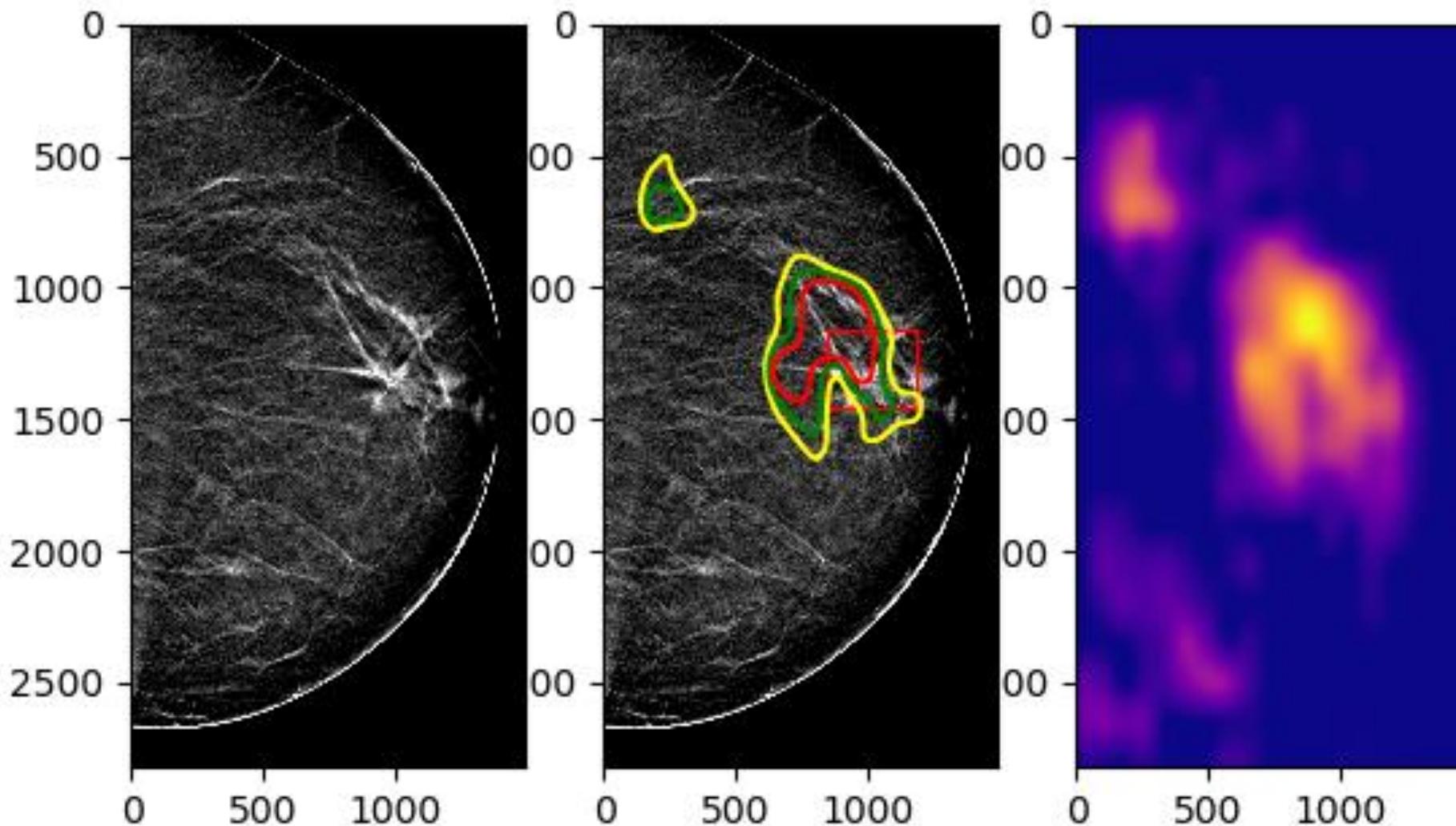


H1 dataset (N = 1406)						AUC
	TP (#)	TN (#)	FP (#)	FN (#)	Accuracy (%)	
TL-AlexNet	638	366	91	9	84.6 ± 0.2	0.81
TL-VGG19	832	215	2	17	74.5 ± 0.3	0.74
DBT-DCNN	948	374	83	1	94.0 ± 0.2	0.91

COMPUTED AIDED DETECTION



COMPUTED AIDED DETECTION



COMPUTED AIDED DETECTION

Live Editor - DA\Database_cardarelli\Rete_DBT_card.mlx

LIVE EDITOR INSERT VIEW

FILE NAVIGATE TEXT CODE SECTION RUN

Rete_DBT_card.mlx

```
1 %# + runBatchSize ,10,...  
2 'MaxEpochs' ,8,...  
3 'InitialLearnRate',1e-4,...  
4 'Shuffle','every-epoch',...  
5 'ValidationData',ds_res_valid,...  
6 'ValidationFrequency',20,...  
7 'ExecutionEnvironment',"multi-gpu",...  
8 "verbose",true,"Plots","training-progress")  
  
55  
56  
57  
58  
59  
60  
  
61 netDBT = trainNetwork(ds_res_train, layers, options);  
  
62  
  
63 save('ReteDBT_card_200_8ep','netDBT');  
  
Classificazione  
  
64  
65  
  
66 [YPred,scores] = classify(netDBT,ds_res_valid);  
YValidation = ds_valid.Labels;  
accuracy = sum(YPred == YValidation)/numel(YValidation)  
  
Matrice confusionale  
  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
  
Roc Curve  
  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
  
cgt = double(ds_valid.labels);  
cscores = scores;  
figure(1)  
  
[X,Y,T,AUC] = perfcurve(cgt,cscores(:,2),2);  
plot(X,Y);  
grid  
xlabel('False positive rate')  
ylabel('True positive rate')  
title('ROC Curve ')  
  
% fprintf('AUC value "%f", AUC)
```

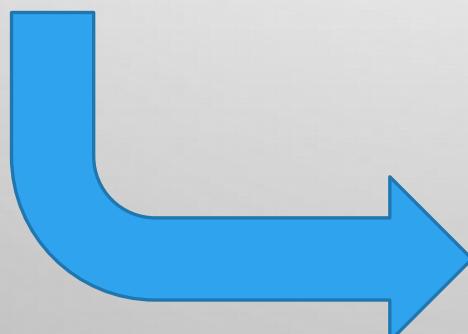
In smplLang.remoteBlockExecutionPlain (line 49)
In smplLang.remoteBlockExecution (line 15)
Lab 2:
Warning Support for GPU devices with Compute Capab
> In parallelInternal.gpu.selectDevice
In parallelInternal.gpu.selectDevice/current (line 44)
In gpuDevice (line 23)
In net.internal.cnUtil.isGPUCompatible (line 10)

accuracy = 0.6293

Confusion Matrix

	Malata	Sana	
Malata	365 13.0%	259 9.1%	59.8% 40.2%
Sana	632 28.0%	1116 49.4%	60.8% 39.2%
	32.6% 67.4%	84.0% 15.5%	62.9% 37.1%

Attiva Windows Passa a Impostazioni per Attivare Windows.



ter DBT_binary_classifier.py ✓ lo scorso mercoledì alle 09:14

lit View Language

```
odel = True  
ath = dataset_path + 'model.h5'
```

GradCAM = True

```
#####
# struct the dataset path
#- train, Path_val, Path_test = [dataset_path + data_type for data_type in dataset_structure]
(' Path_train: %s\n Path_val: %s\n Path_test: %s' % (Path_train, Path_val, Path_test))
#####

```

```
print(platform.system()) # 'Linux' on 'Windows'
```

```
Print GPU's info  
int("number of GPUs Available: ", len(tf.config.list_physical_devices('GPU'))))
```

device in gpus:

```
# avoid to allocate all the GPU memory
tf.config.experimental.set_memory_growth(True)
# print GPU name
print(tf.test.gpu_device_name())
```

VIA ID: 001

Disable the GPUs and enable CPU

```
disabledGPU.  
try:  
    # Disable all GPUs  
    tf.config.set_visible_devices([], 'GPU')  
    visible_devices = tf.config.get_visible_devices()  
    print("GPU disabled")
```

```
        print(visible_devices)
        for device in visible_devices:
            assert device.device_type != 'GPU'
    except Exception as e:
        # Invalid device or cannot modify virtual devices once initialized

```

RADIOMICS MODULE

Focus on Computer Resources

Cancer Research

Computational Radiomics System to Decode the Radiographic Phenotype

Joost J.M. van Griethuysen^{1,2,3}, Andriy Fedorov⁴, Chintan Parmar¹, Ahmed Hosny¹, Nicole Aucoin⁴, Vivek Narayan¹, Regina G.H. Beets-Tan^{2,3}, Jean-Christophe Fillion-Robin⁵, Steve Pieper⁶, and Hugo J.W.L. Aerts^{1,4}



Abstract

Radiomics aims to quantify phenotypic characteristics on medical imaging through the use of automated algorithms. Radiomic artificial intelligence (AI) technology, either based on engineered hard-coded algorithms or deep learning methods, can be used to develop noninvasive imaging-based biomarkers. However, lack of standardized algorithm definitions and image processing severely hampers reproducibility and comparability of results. To address this issue, we developed *PyRadiomics*, a flexible open-source platform capable of extracting a large panel of engineered features from medical

images. *PyRadiomics* is implemented in Python and can be used standalone or using 3D Slicer. Here, we discuss the workflow and architecture of *PyRadiomics* and demonstrate its application in characterizing lung lesions. Source code, documentation, and examples are publicly available at www.radiomics.io. With this platform, we aim to establish a reference standard for radiomic analyses, provide a tested and maintained resource, and to grow the community of radiomic developers addressing critical needs in cancer research. *Cancer Res*; 77(21); e104–7. ©2017 AACR.

RADIOMICS MODULE



The screenshot shows the "Welcome to pyradiomics documentation!" page. The left sidebar contains links for Home, Installation, Usage, Customizing the Extraction, Pipeline Modules, Radiomic Features, Excluded Radiomic Features, Contributing to pyradiomics, Developers, pyradiomics labs, FAQs, and Release Notes. The main content area includes a "Docs" link, a search bar, and a "Edit on GitHub" button. A large Python logo is displayed next to the title "PyRadiomics". Below the title, there is a "Warning" section with the text "Not intended for clinical use." and a list of contributors: Ahmed Hosny¹, Steve Pieper⁴, and Hugo Aerts (PI)^{1,2}. At the bottom, there is a note about the department of radiation oncology at Dana-Farber Cancer Institute and Brigham and Women's Hospital, Harvard Medical School, Boston, MA.

<https://pyradiomics.readthedocs.io/en/latest/index.html#>

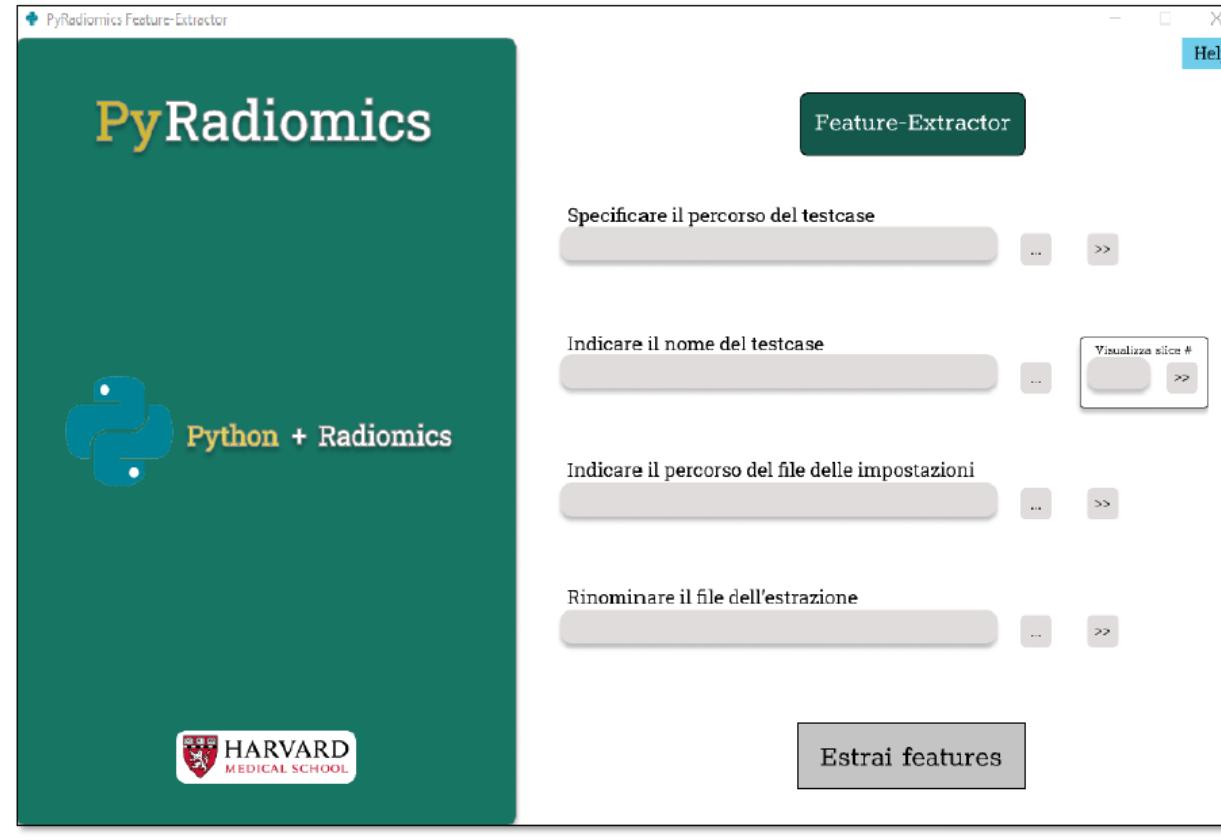
PyRadiomics

Warning

Not intended for clinical use.

¹Department of Radiation Oncology, Dana-Farber Cancer Institute, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, ²Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA ³Department of Radiology, Netherlands Cancer Institute, Amsterdam, The Netherlands, ⁴GROW-School for Oncology and Developmental Biology, Maastricht University Medical Center, Maastricht, The Netherlands, ⁵Kitware, ⁶Isomics

RADIOMICS MODULE



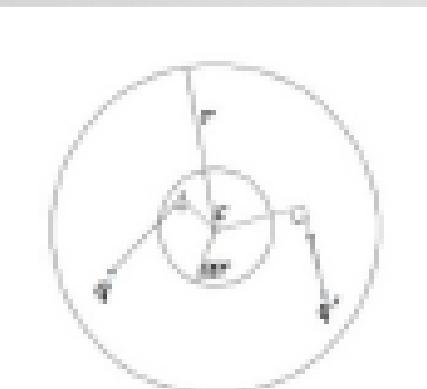
RADIOMICS MODULE

GLCM, GLRLM, and GLSZM features

A method for the automated classification of benign and malignant masses on digital breast...

Table 2 Texture features extracted using GLCM, GLRLM, and GLSZM

	GLCM features	GLRLM features	GLSZM features
Mean	Entropy	Grey level non-uniformity (GLN)	Small area emphasis (SAE)
Variance	Homogeneity1	High grey level run emphasis (HGLRE)	Large area emphasis (LAE)
Auto-correlation	Homogeneity2	Long run emphasis (LRE)	Intensity variability (IV)
Cluster prominence (cProminence)	Inverse difference moment normalized (IDMN)	Long run high grey level emphasis (LRHGLE)	Size zone variance (SZV)
Cluster shade (cShade)	Inverse difference moment (IDN)	Long run low grey level emphasis (LRLGLE)	Zone percentage (ZP)
Cluster tendency (cTendency)	Inverse variance	Low grey level run emphasis (LGLRE)	Low intensity (LIE)
Contrast	Maximum probability (maxProb)	Run length non-uniformity (RLN)	High-intensity emphasis (HIE)
Correlation	Sum average	Run percentage (RP)	Low-intensity small area emphasis (LISAE)
Difference entropy	Sum entropy	Short run emphasis (SRE)	High-intensity small area emphasis (HISAE)
Dissimilarity	Sum variance	Short run high grey level emphasis (SRHGLE)	Low-intensity large area emphasis (LILAE)
Energy		Short run low grey level emphasis (SRLGLE)	High-intensity large area emphasis (HILAE)



Gabor filtering

```
Features_Extracted00.txt - Blocco note di Windows
File Modifica Formato Visualizza ?
Computed diagnostics_Versions_PyRadiomics: v3.0.1
Computed diagnostics_Versions_Numpy: 1.21.4
Computed diagnostics_Versions_SimpleITK: 2.1.1
Computed diagnostics_Versions_PyWavelet: 1.2.0
Computed diagnostics_Versions_Python: 3.9.7
Computed diagnostics_Configuration_Settings: {'minimumROIDDimensions': 2, 'minimumROISize': None,
'normalize': False, 'normalizeScale': 1, 'removeOutliers': None, 'resampledPixelSpacing': None,
'interpolator': 'sinc2BSpline', 'preCrop': False, 'padDistance': 5, 'distances': [1], 'force2D': False,
'force2DDimension': 0, 'resegmentRange': None, 'label': 1, 'additionalInfo': True, 'binWidth': 25, 'weightingNorm': None}
Computed diagnostics_Configuration_EnabledImageTypes: {'Original': {}}
Computed diagnostics_Image-original_Hash: 5c9ce3ca174f0f8324aa4d277e0fe82dc5ac566
Computed diagnostics_Image-original_Dimensionality: 3D
Computed diagnostics_Tomo_original_Slicing: (0_78124000000000000000_0_78124000000000000000_6_4000000000000000)
Computed original_shape_Elongation: 0.562117162717412
Computed original_shape_Flatness: 0.4610597534658264
Computed original_shape_LeastAxisLength: 28.584423185376508
Computed original_shape_MajorAxisLength: 61.99722046980875
Computed original_shape_Maximum2DDiameterColumn: 49.490854979101925
Computed original_shape_Maximum2DDiameterRow: 65.88905951721043
Computed original_shape_Maximum2DDiameterSlice: 53.59397776919529
Computed original_shape_Maximum3DDiameter: 69.60099030590368
Computed original_shape_MeshVolume: 16147.51180013021
Computed original_shape_MinorAxisLength: 34.84970166685475
Computed original_shape_Sphericity: 0.4798234536231475
Computed original_shape_SurfaceArea: 6438.821603779402
Computed original_shape_SurfaceVolumeRatio: 0.3987500788652454
Computed original_shape_VoxelVolume: 16412.658691406243
< Linea 41, colonna 1 100% Windows (CRLF) UTF-8
```

RADIOMICS MODULE

Implementazione

- Realizzazione del codice
- Individuazione delle features

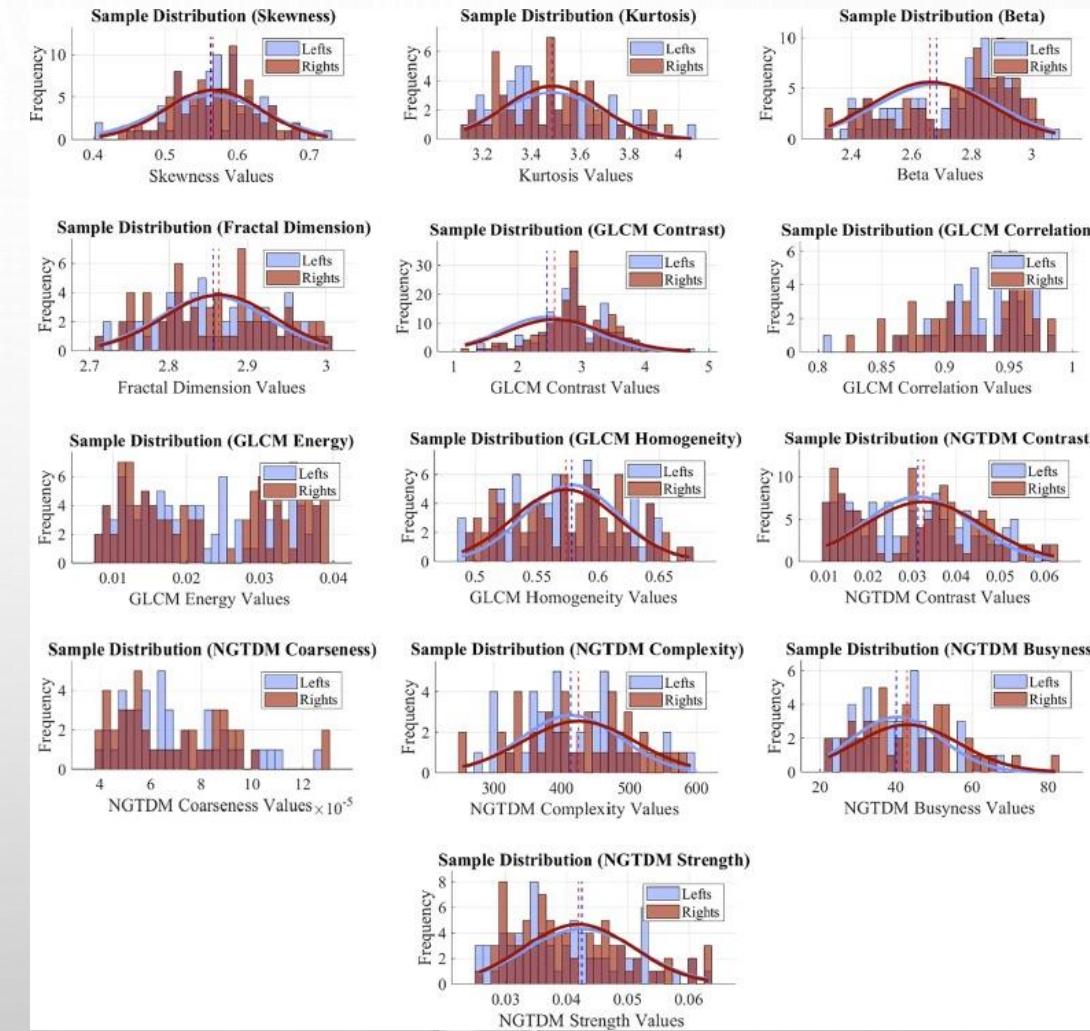
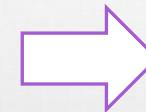
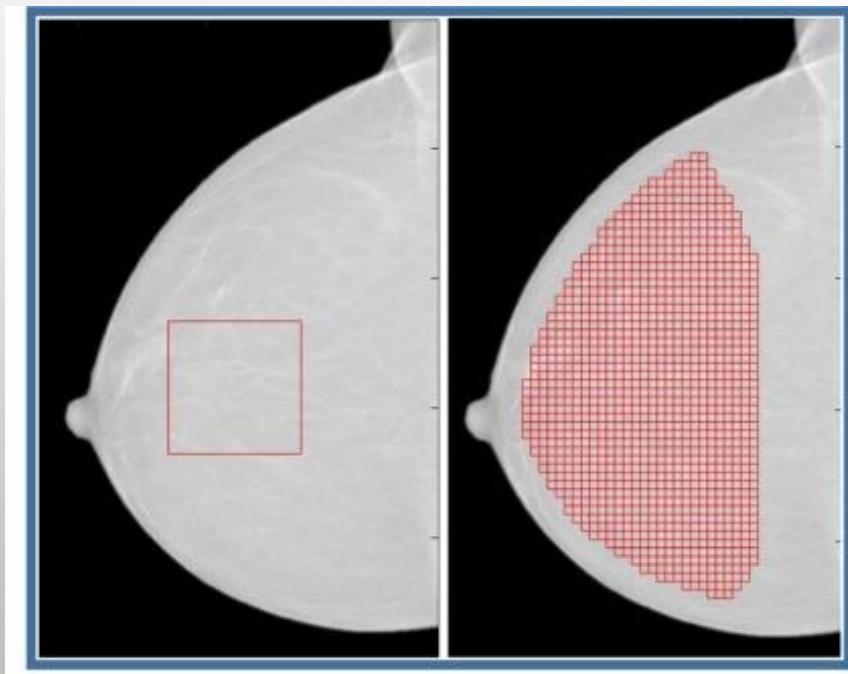
Ricerca positività

-

Valutazione

- Uso della GradCam
- Indicazione indice di positività

RADIOMICS MODULE



CLOUD



- Napoli
Disponibilità di IBISCO (una persona dedicata)
- Pisa
- Ferrara