

# Forgeries in Medical Images

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Detection and Localization

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**01**

**PROBLEM**

**02**

**DATA PREPARATION**

**03**

**METHOD**

**04**

**RESULTS**

**05**

**FUTURE**

01

## PROBLEM

Detection and localization of forgeries in thoracic CT Scan images

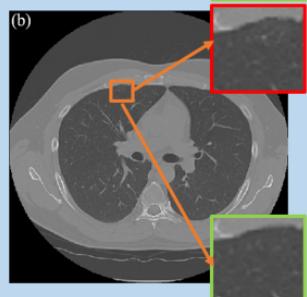
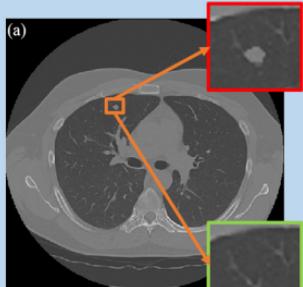


02

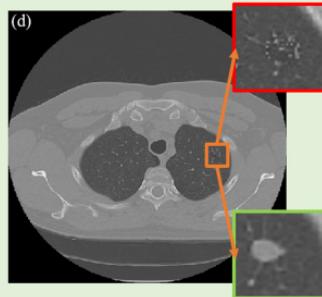
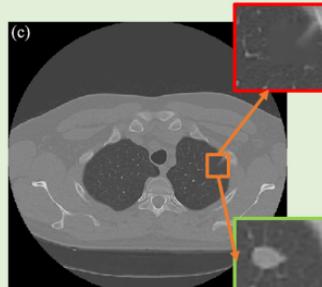
# Dataset

LuNoTim

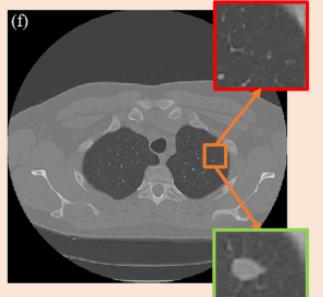
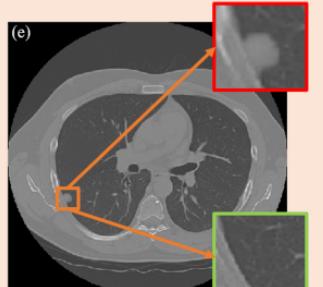
Copy-Move



Classical Inpainting



Deep Inpainting



**154,919**

tampered images

LuNoTim Dataset

# 02

## Dataset

### Dataset

**Total 1. tampered slices in each tampering category.**

Tampering Category	Total No. tfrecords
Added inner tissue different slice (ITDS-add)	031,666
Added inner tissue same slice (ITSS-add)	029,887
Added outer tissue different slice (OTDS-add)	032,074
Added outer tissue same slice (OTSS-add)	030,597
Added ct gan inpainting (ctGAN-add)	001,595
Removed patchmatch guided inpainting (PGI-rem)	013,678
Removed simple inpainting (SI-rem)	044,497
Removed ct gan inpainting (ctGAN-rem)	927,000

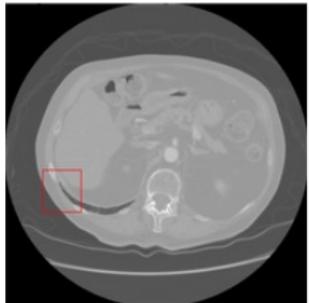
**Total 2. Dataset split**

Total No. Train	099,148
Total No. Validation	024,787
Total No. Test	030,984
Total No. Samples	154,920

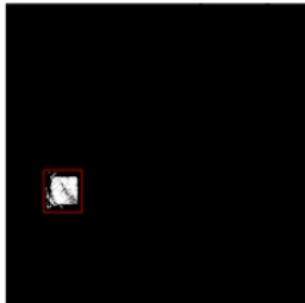
# 02

## Dataset

Data integration and curation



(a) Tampered image, slice 26.



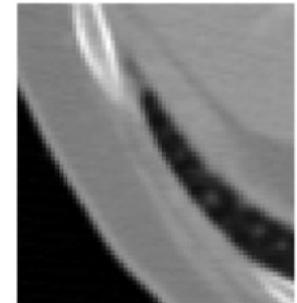
(b) Mask for tampering.



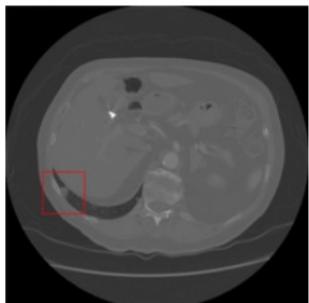
(c) Mask for tampering.



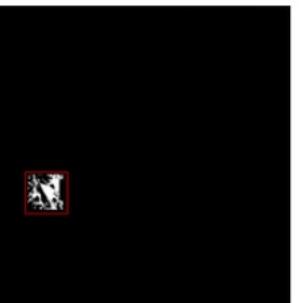
(d) Tampered image.



(e) Pristine image.



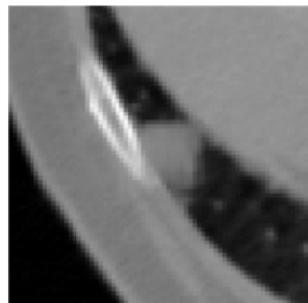
(f) Tampered image, slice 31.



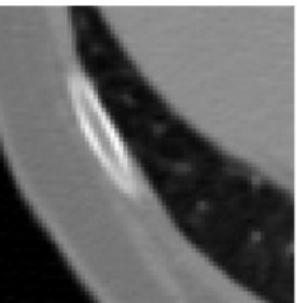
(g) Mask for tampering.



(h) Mask for tampering.



(i) Tampered image.



(j) Pristine image.

# 02

## Dataset

### Data Preparation Steps

- Extract bounding box
- Converting dataset into Pascal VOC format
  - Create XML Files
  - Converting XML format to tfrecords format

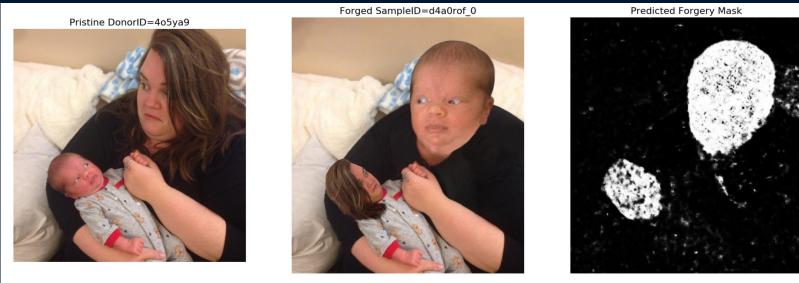
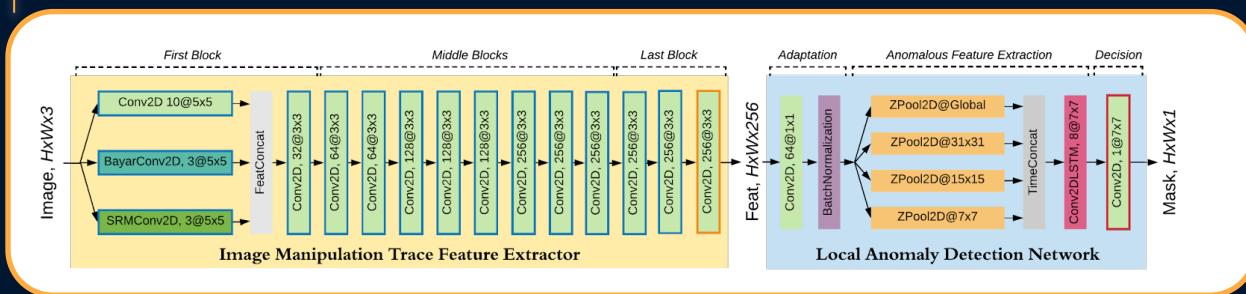
# 03

## METHODS

### Related work

#### MantraNet

Detect and localize tampered areas in **natural images**



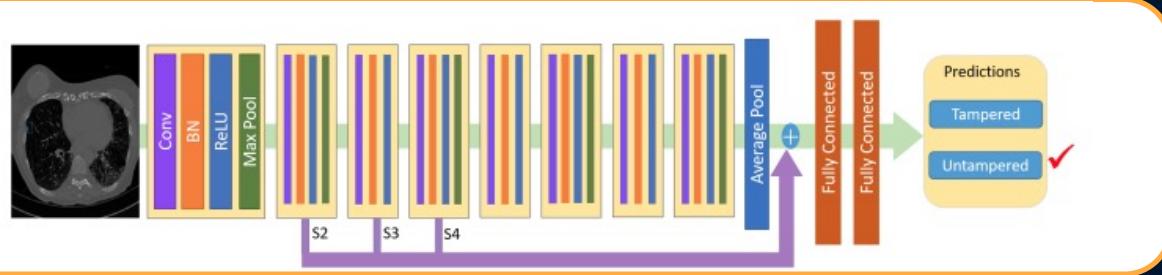
# 03

## METHODS

### Related work

#### LuNoTim

Binary classifier for **medical images**



- VGG11 backbone
- Only predict if an image is manipulated
- we do not know where the forgery is located

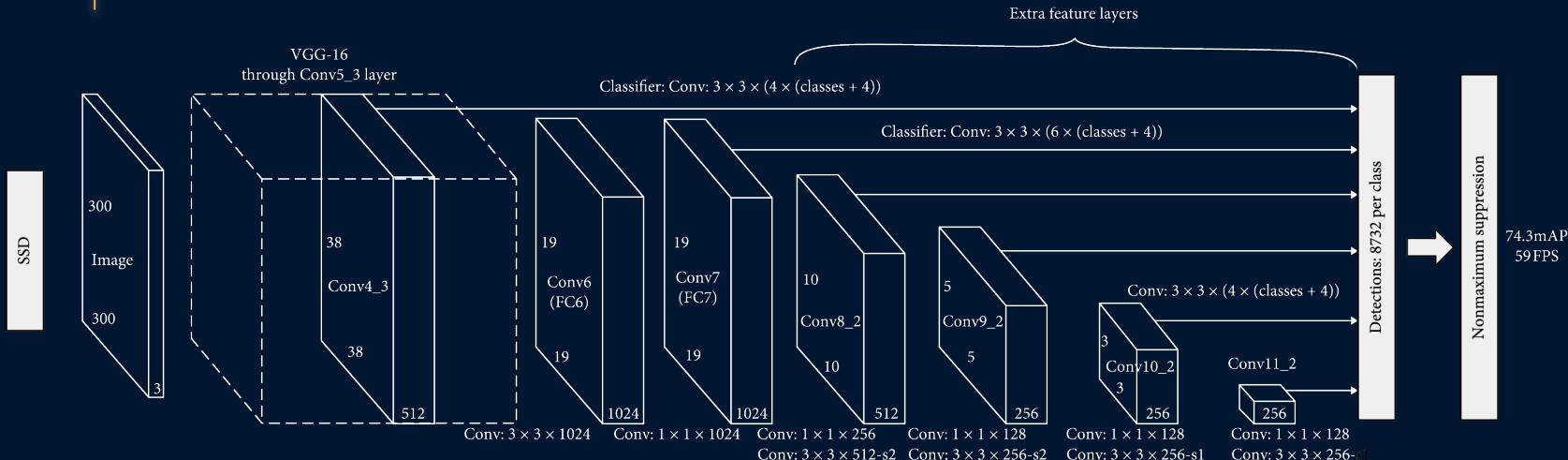
# 03

## METHODS

### Solution

#### Single Shot MultiBox (SSD) Detection

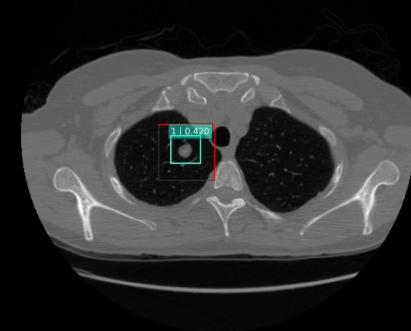
Detecte and localize **OBJECTS** in **natural images**



- We fine-tuned SSD to work to detect **forgery areas in medical images**

# 04

## RESULTS



# 04

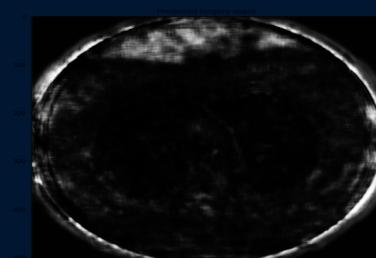
## RESULTS - ManTraNey

Ave. F1 score: 0.08

Original image



predicted forgery mask



suspicious region detected

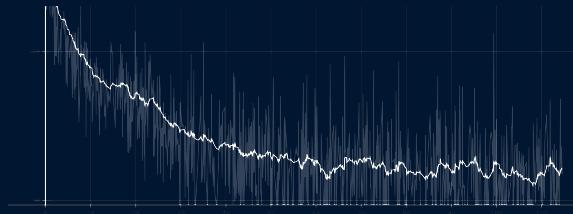


# 04

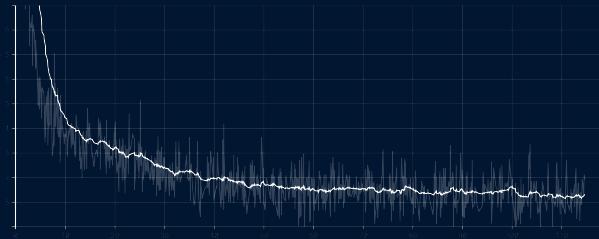
## RESULTS -SSD

### Training

Total Loss



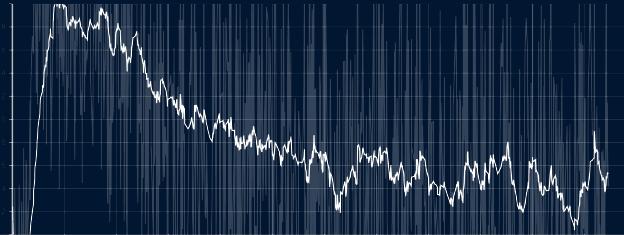
Cross entropy Loss (Negative)



Localization Loss



Cross entropy Loss (Positive)



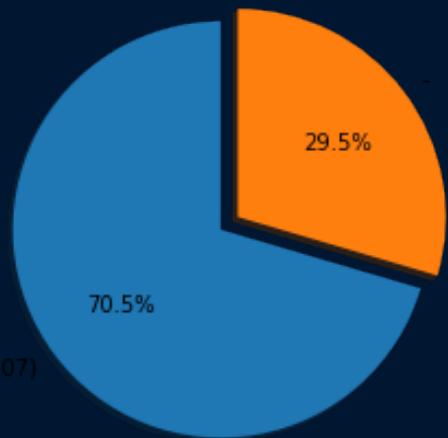
# 04

## RESULTS

Test - mAP metric

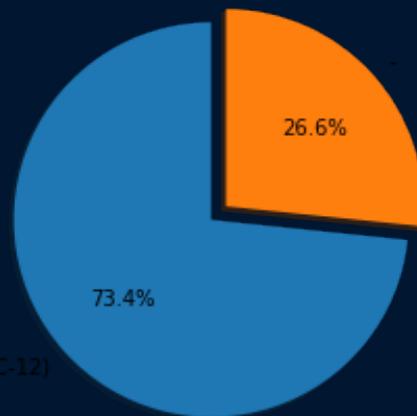
Pascal VOC 07

**mAP** = 0.705



Pascal VOC 12

**mAP** = 0.734

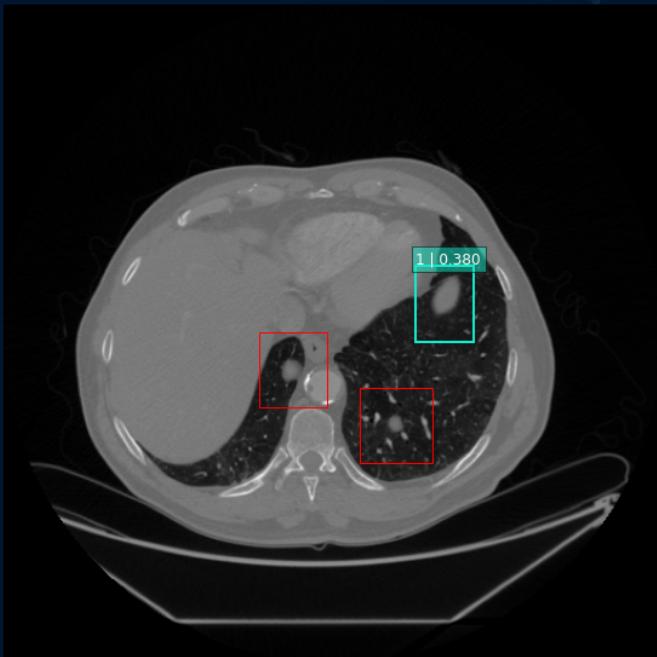
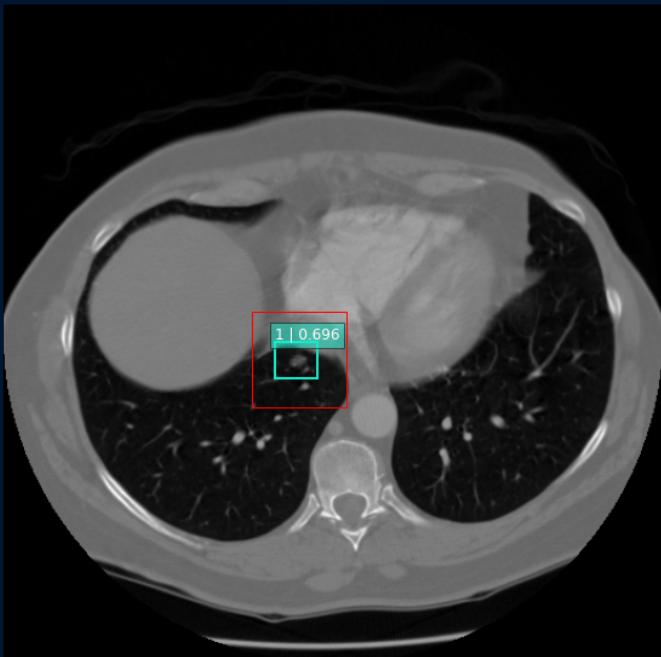


# 04

## RESULTS

Testset

Tampered images using CTGAN



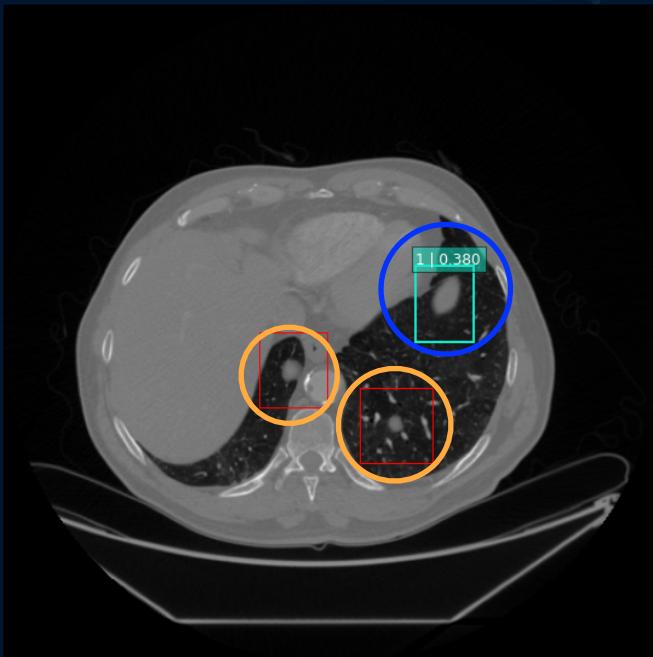
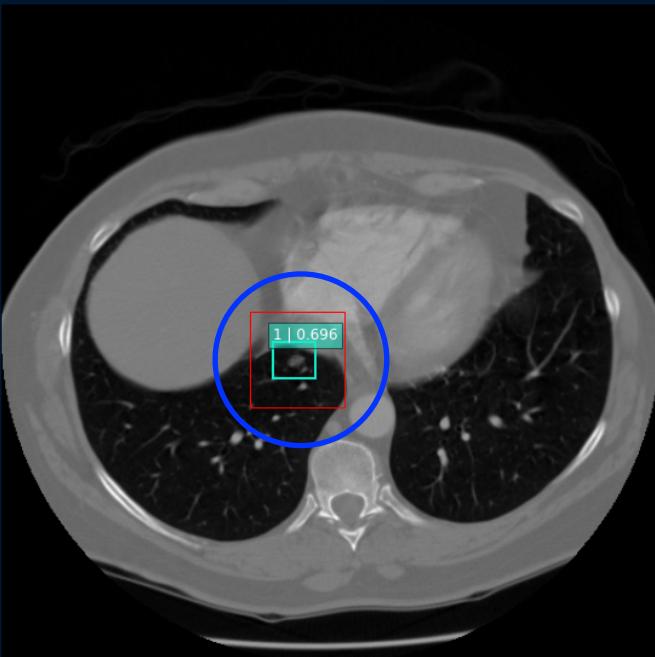
# 04

## RESULTS

Testset

Tampered images using CTGAN

TP FP  
No detected

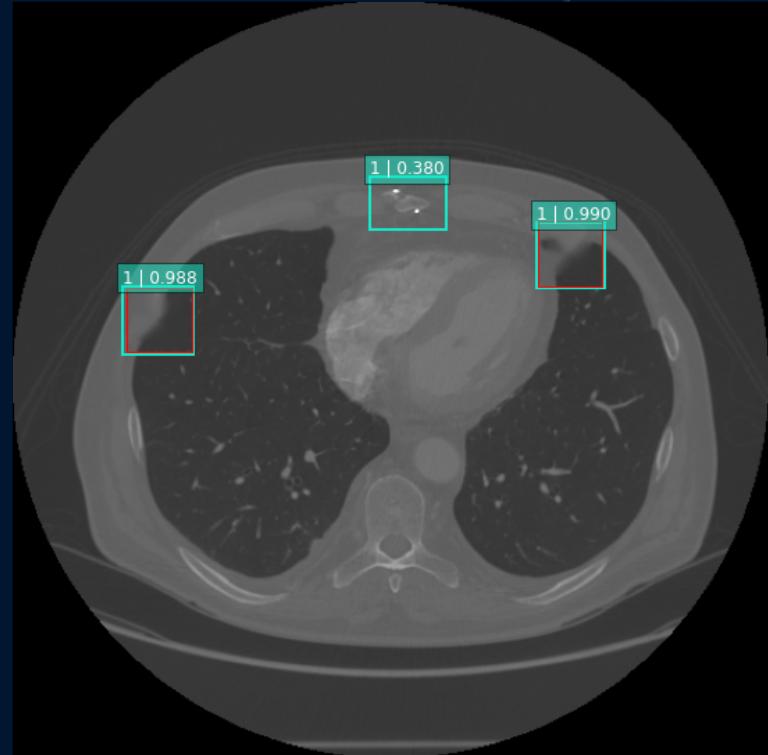
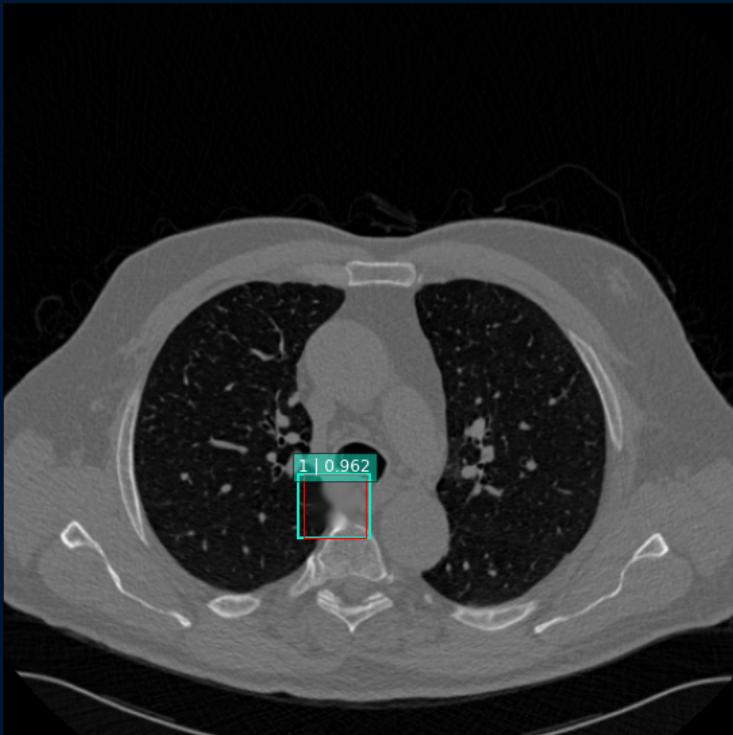


# 04

## RESULTS

Testset

Classical Inpainting



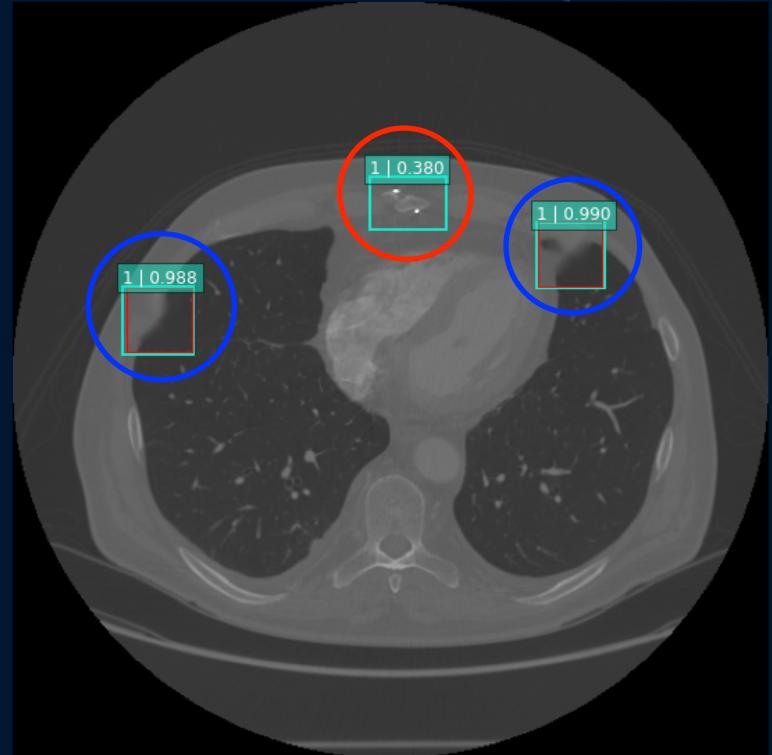
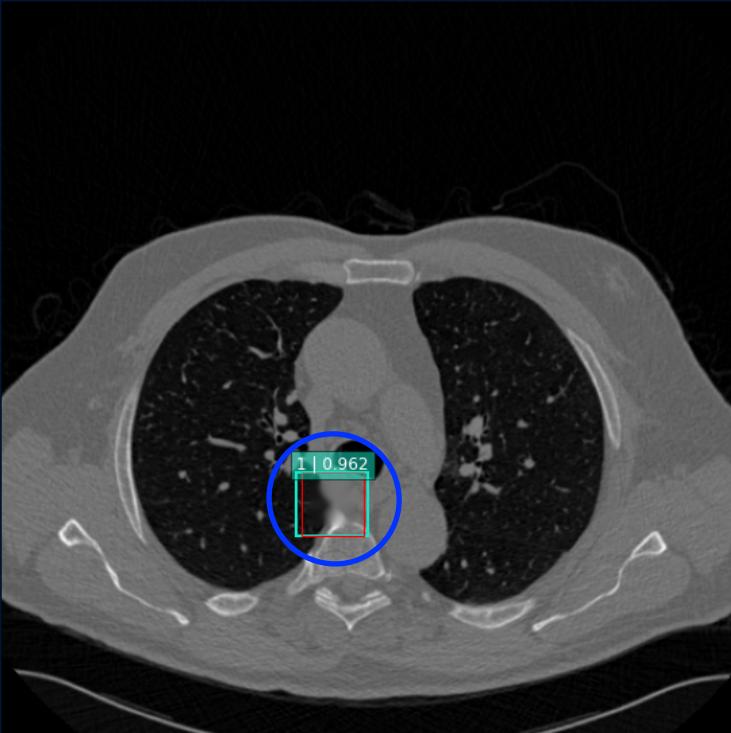
# 04

## RESULTS

Testset

Classical Inpainting

TP FP  
No detected

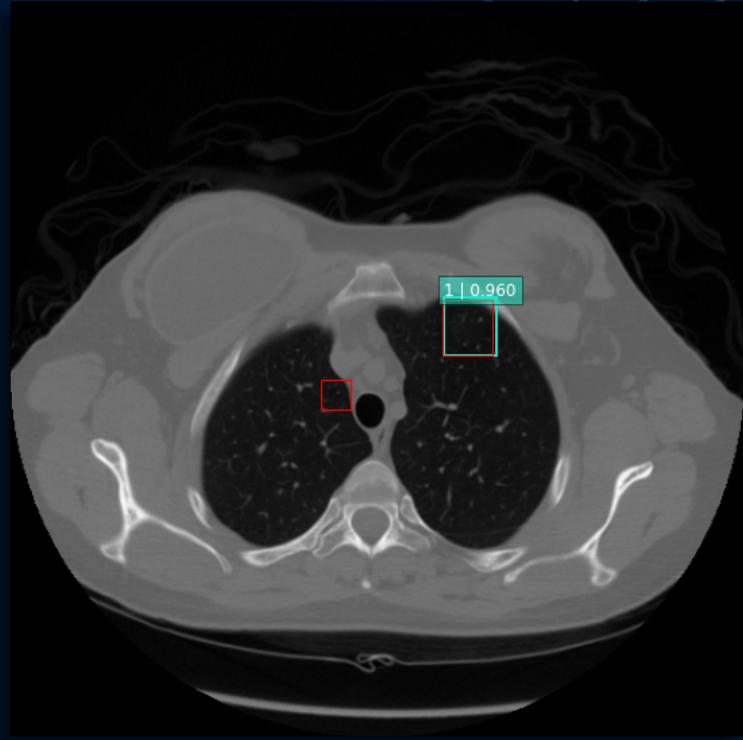
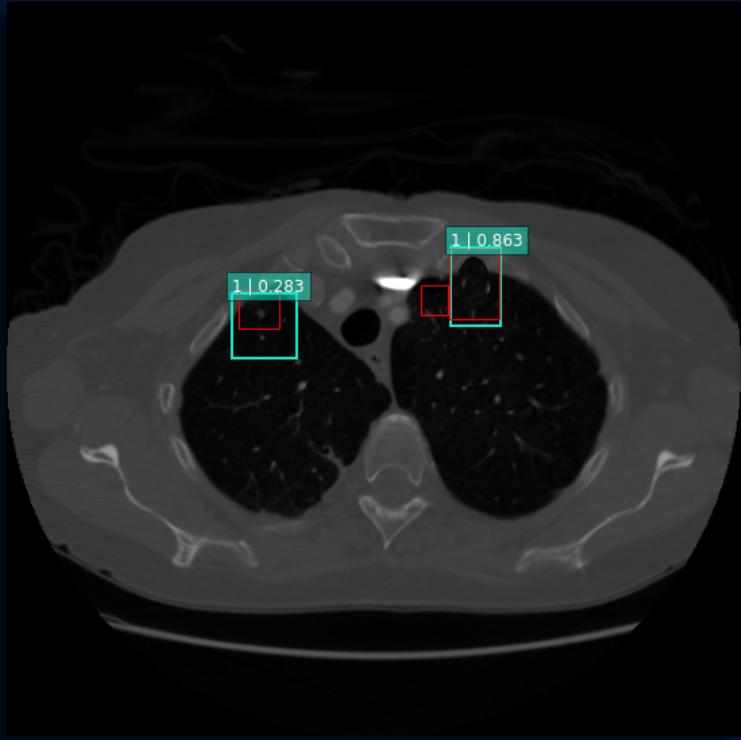


# 04

## RESULTS

Testset

Copy-Move



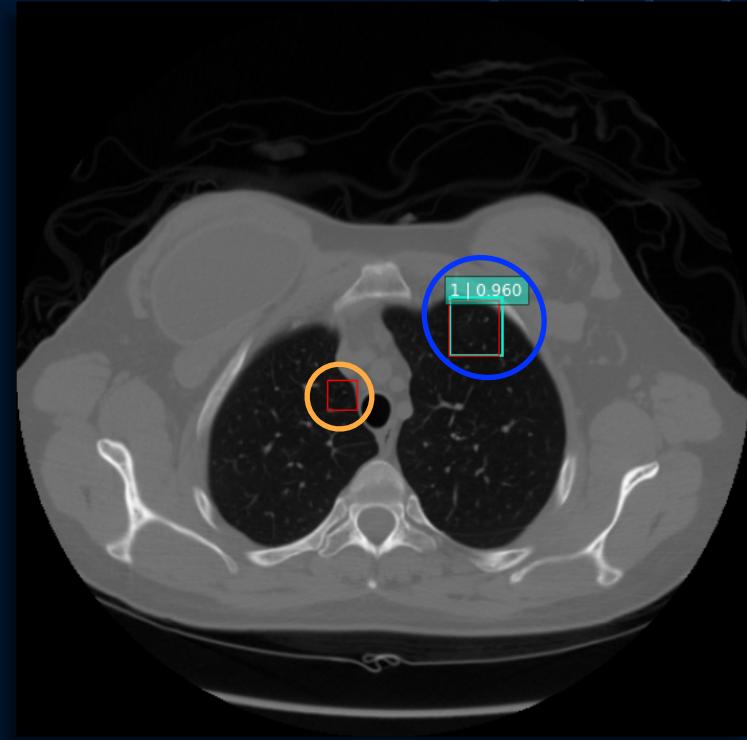
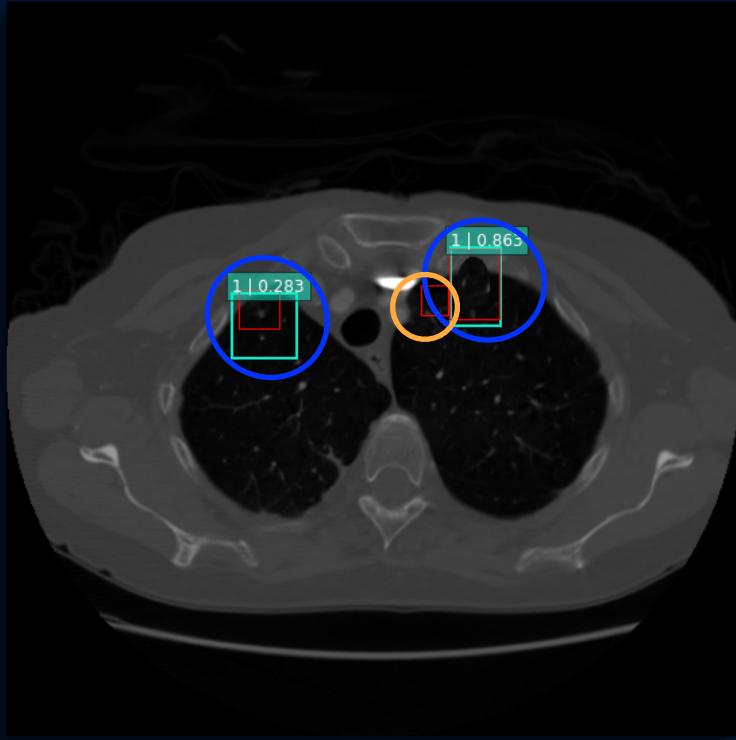
# 04

## RESULTS

Testset

Copy-Move

TP FP  
No detected

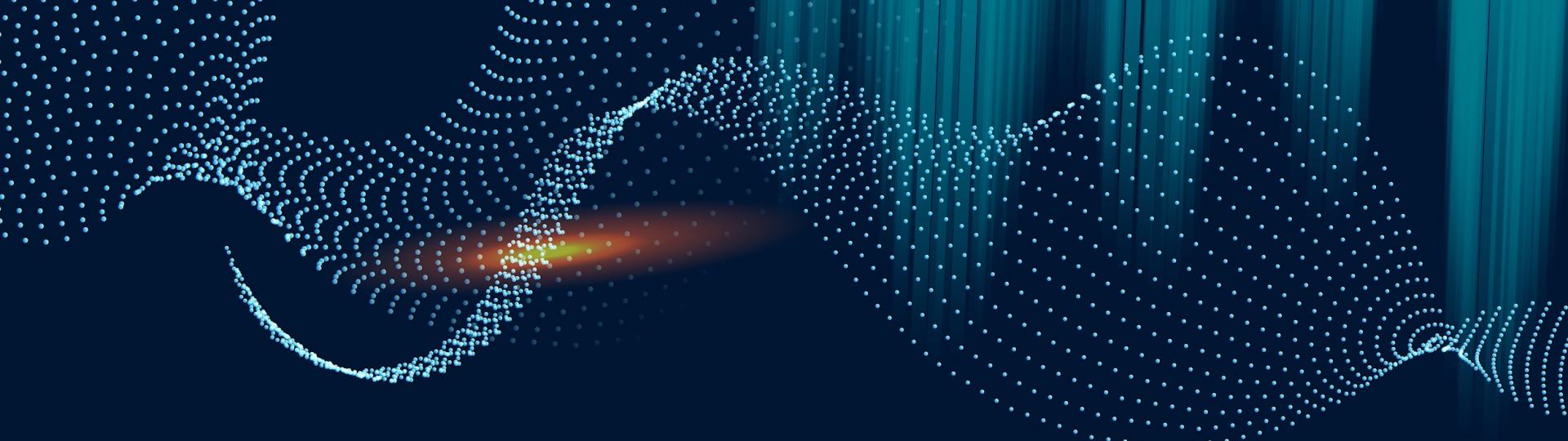


# 05

## FUTURE WORK

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- Try a two steps solution:
  - First step: Training the SSD model
  - Second step: Training of a shallow CNN to classify the bound boxes returned by the SSD model
- Experiment to train each model separately for the types of forgery
- Experiment to do fine-tuning models built to detect fakes in natural images



**Thank you !**