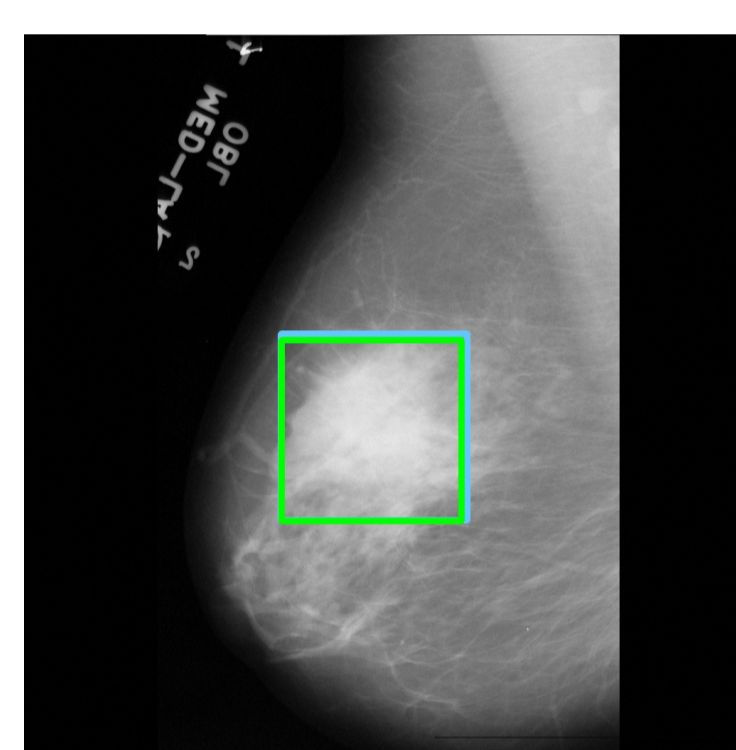


## Overview & Contribution

- Automatic **Breast Cancer Detection and Classification** to assist radiologists on the task.
- **Goal:** Achieve **radiologist expertise** using **few data samples**.
- **Contribution :** Benchmark **3 state-of-the-art** algorithms.

## Data

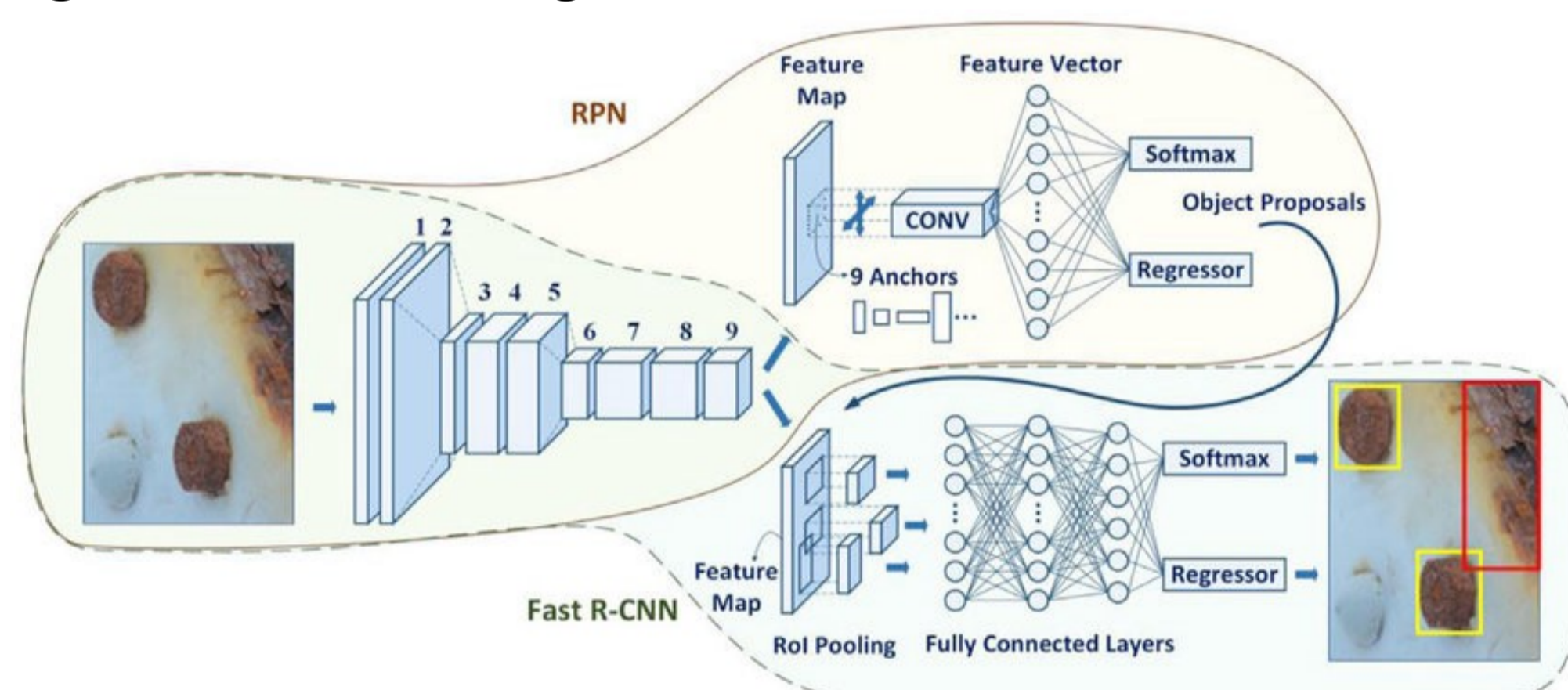
- 325 images from **MIAS [4]** database.
- **6** different tumour classes.
- **20x augmenting** using Horizontal flipping, Blurring, Adding some noise, ...



## Object detection algorithms

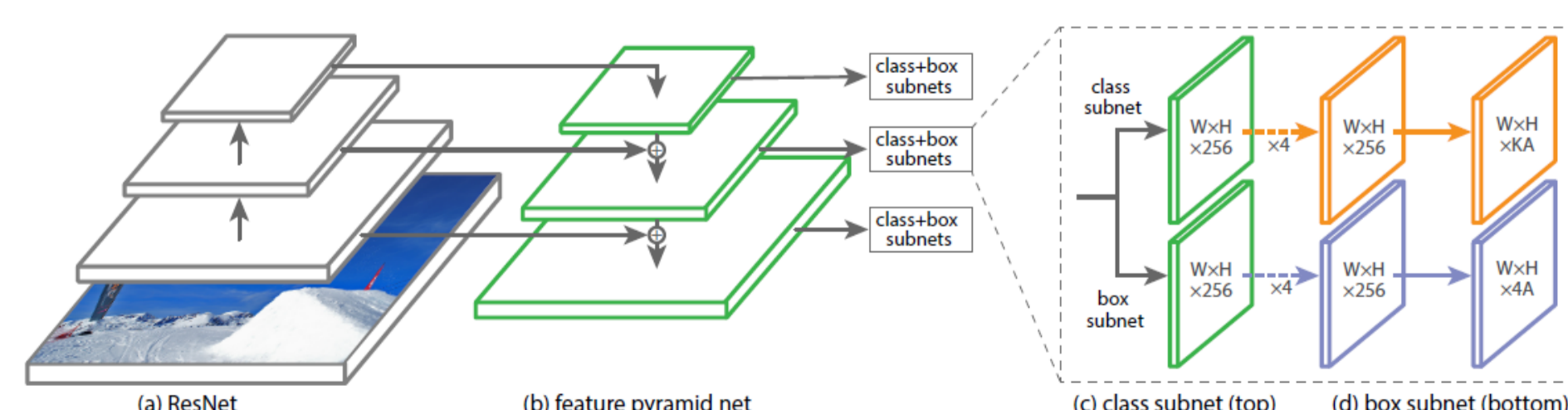
### Faster-RCNN [2] :

- **Two-stage** detector using Anchor boxes.



### RetinaNet [3] :

- **One-Stage** detector using Anchor boxes
- **2 sub-networks:** BBox regression and classification.
- Focal Loss (learns on **few examples** and handles **class imbalance**).

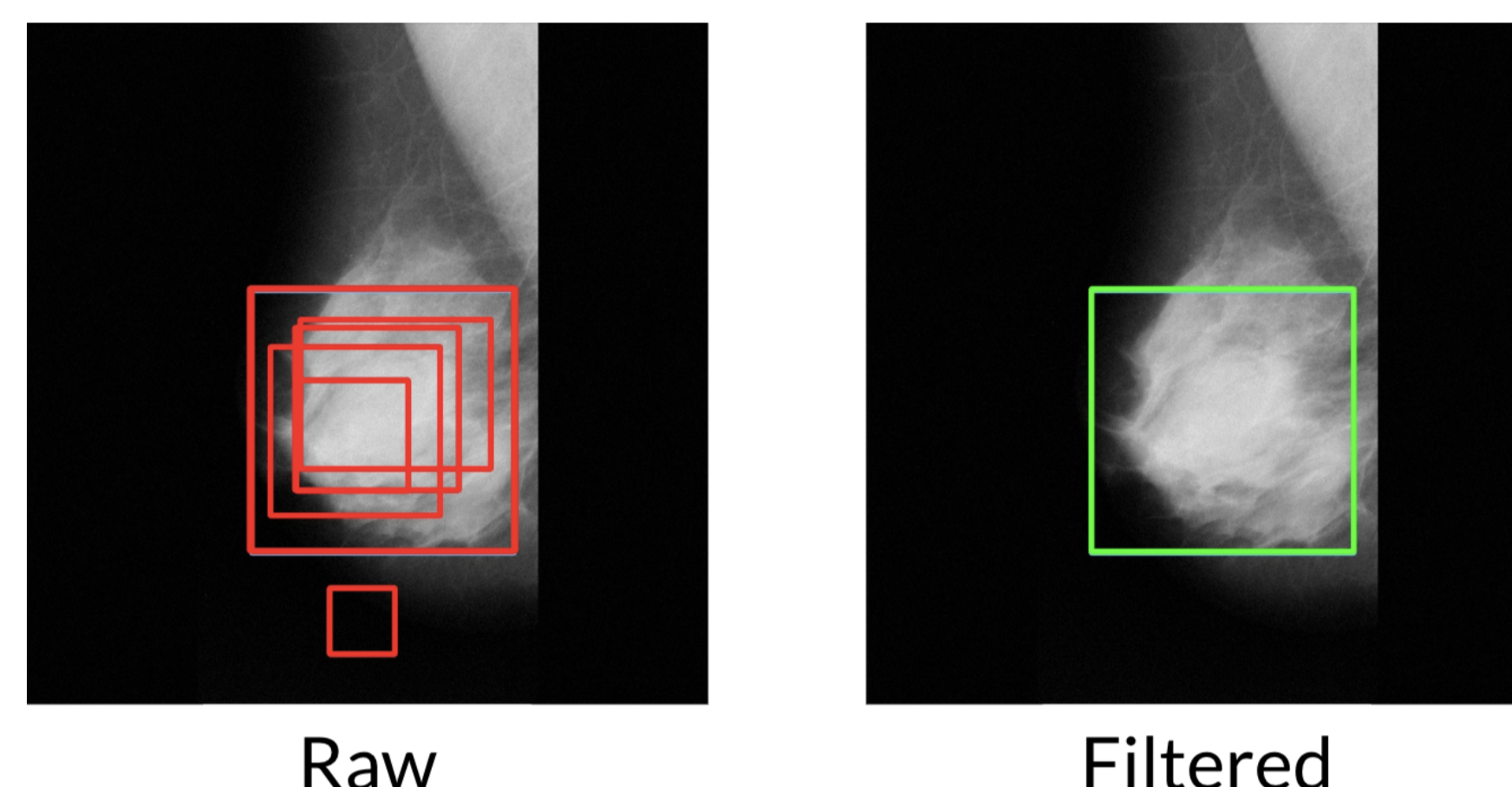


### FCOS Object Detector [1] :

- **One-Stage** detector **without** anchor boxes
- **3 sub-networks:** BBox regression, classification and centerness.
- Focal Loss.

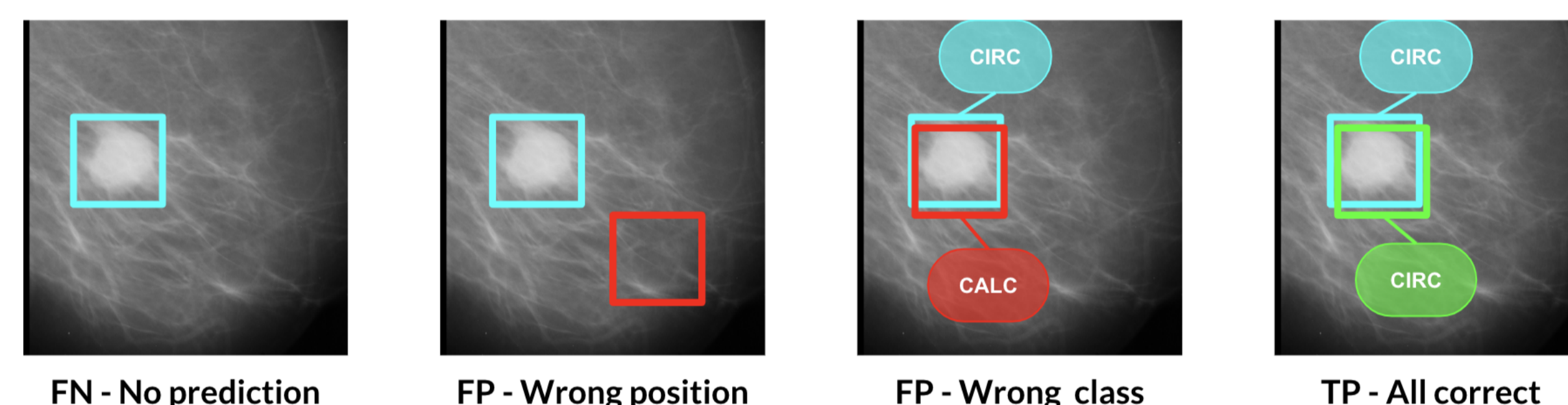
## Outputs

- **8K bounding boxes** prediction, along with their predicted class and confidence score
- **Thresholding** on confidence scores & **Non-Maximum-Suppression**

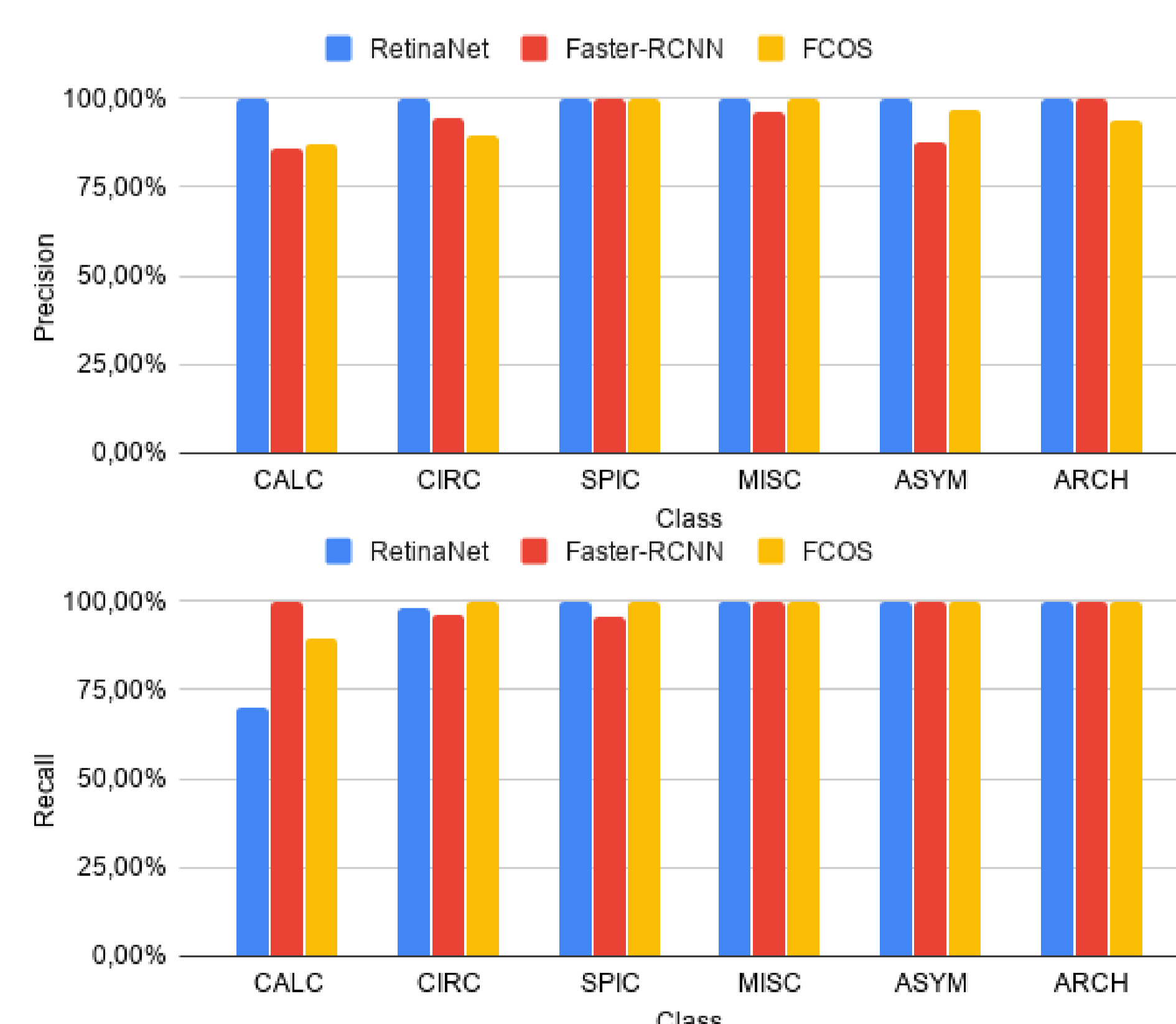


## Results

### Prediction Cases



### Per-class Precision & Recall



High precision  
 ⇒ Low FP rate

High recall  
 ⇒ Low FN rate

### Results Evaluation

Metrics	RetinaNet	Faster R-CNN	FCOS
Precision	100,00%	94,12%	94,44%
Recall	94,72%	98,65%	98,20%
F5-score	94,91%	<b>98,47%</b>	98,05%

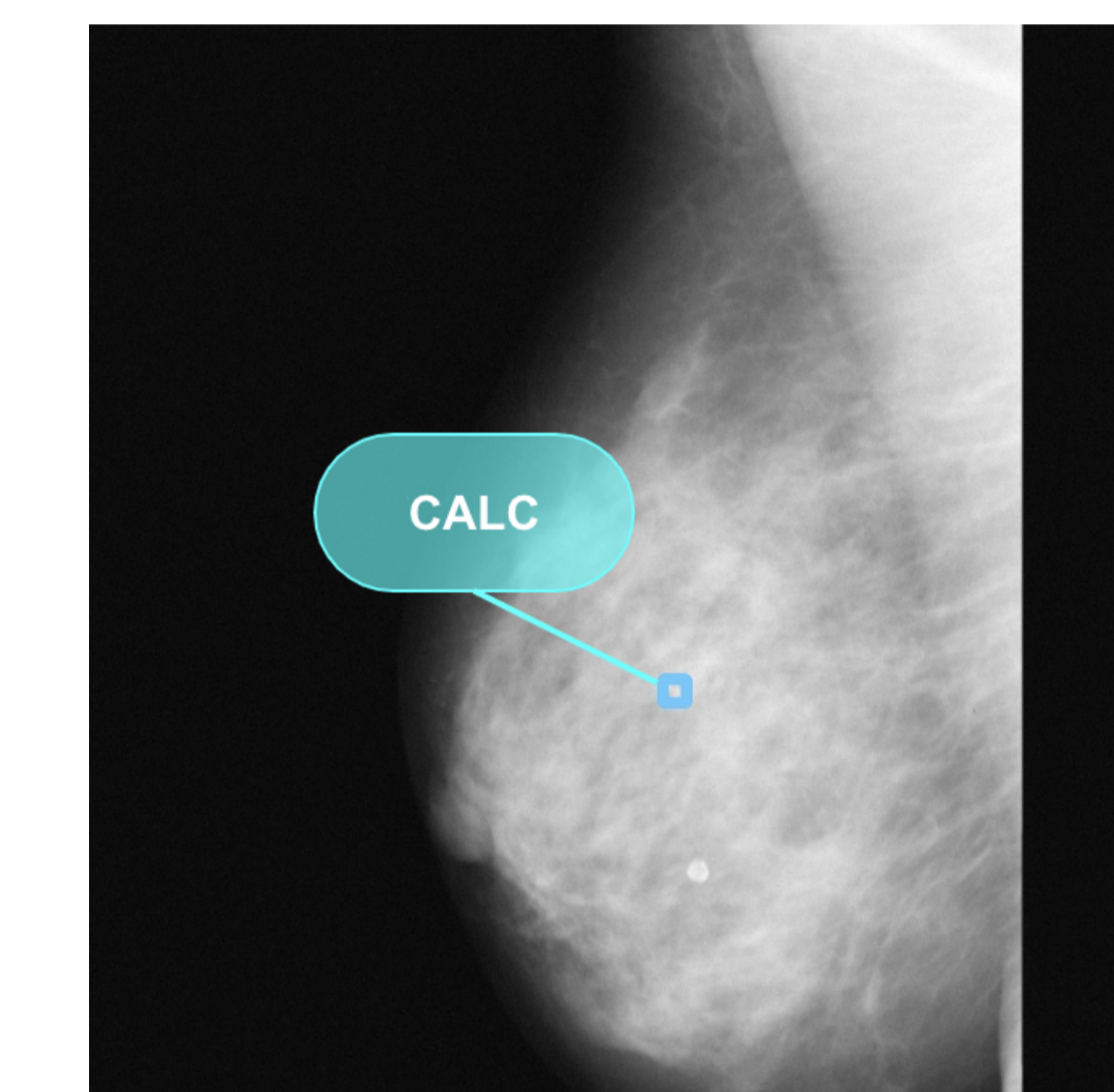
## Results & Error Analysis

### Overall metrics analysis

- RetinaNet: **100%** precision | Lowest recall - **Serious Issue**.
- Faster-RCNN outperforms slightly FCOS.

### Per-class metrics analysis

- All algorithms: **100%** recall on **MISC, ASYM** and **ARCH** classes.
- Faster-RCNN:  
 Outperforms on **CALC** class -  
 Better detection on small tumor.
- FCOS: Outperforms  
 on **CIRC** and **SPIC** classes.



Model	Pros	Cons
RetinaNet	100% right predictions	Miss some tumours
Faster-RCNN	High recall ~98%	Wrong predictions (mostly on CALC)
FCOS	High recall ~98%	Less efficient than Faster-RCNN

## Next Steps

- Try ensemble learning.
- Improve data augmentation - **GANs** or **AutoAugment**.
- Train on larger datasets.
- Deeper classification based on **background tissue type** or the **severity** of tumor (B:Benign or M:Malignant).

## References

- [1] C. Shen et. al. "FCOS: Fully Convolutional One-Stage Object Detection". In: (Aug. 2019).
- [2] K. He et. al. "Faster R-CNN: Towards Real-Time Object Detection". In: (Jan. 2016).
- [3] T.-Y. Lin et. al. "Focal Loss for Dense Object Detection". In: (Feb. 2018).
- [4] MIAS Database. <https://tinyurl.com/y6elv5dr>.
- [5] Project github repository. <https://tinyurl.com/y5fpyt9y>.