Breast Cancer Detection Contest

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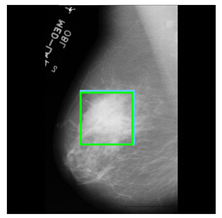
Overview & Contribution

- 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

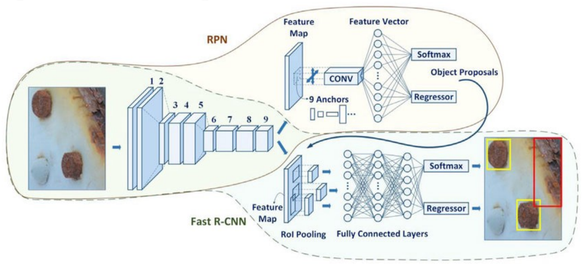
- 325 images from **MIAS [4] database**.
- **6** different tumor classes.
- **20x augmenting** using Horizontal flipping, Blurring, Adding some noise, ...



Object detection algorithms

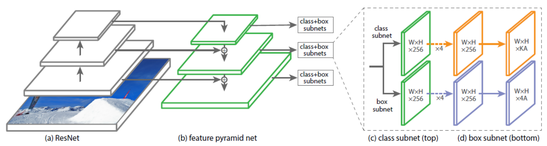
Faster-RCNN [2] :

- **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**).

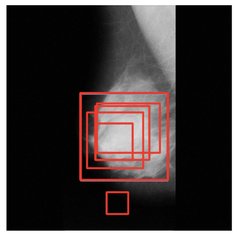


FCOS Object Detector [1] :

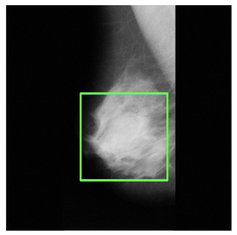
- **One-Stage** detector **without** anchor boxes
- **3 sub-networks**: BBox regression, classification and centerness.
- Focal Loss.

Outputs

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



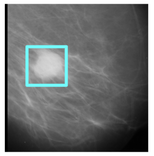
Raw



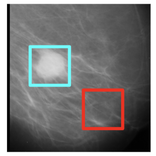
Filtered

Results

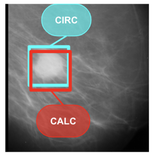
Prediction Cases



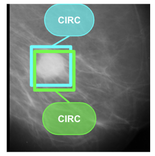
FN - No prediction



FP - Wrong position

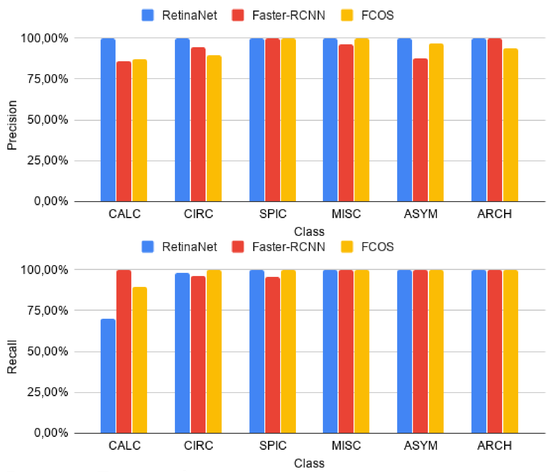


FP - Wrong class



TP - All correct

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%	**98,47%**	98,05%

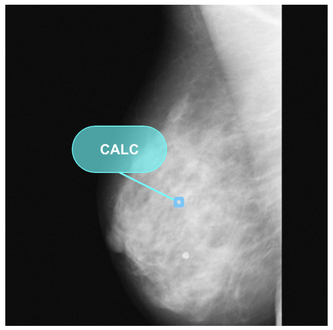
Results & Error Analysis

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 tumors
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 - **GAN**s 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.