

# Skull R-CNN: A CNN-based network for the skull fracture detection

MIDL 2020

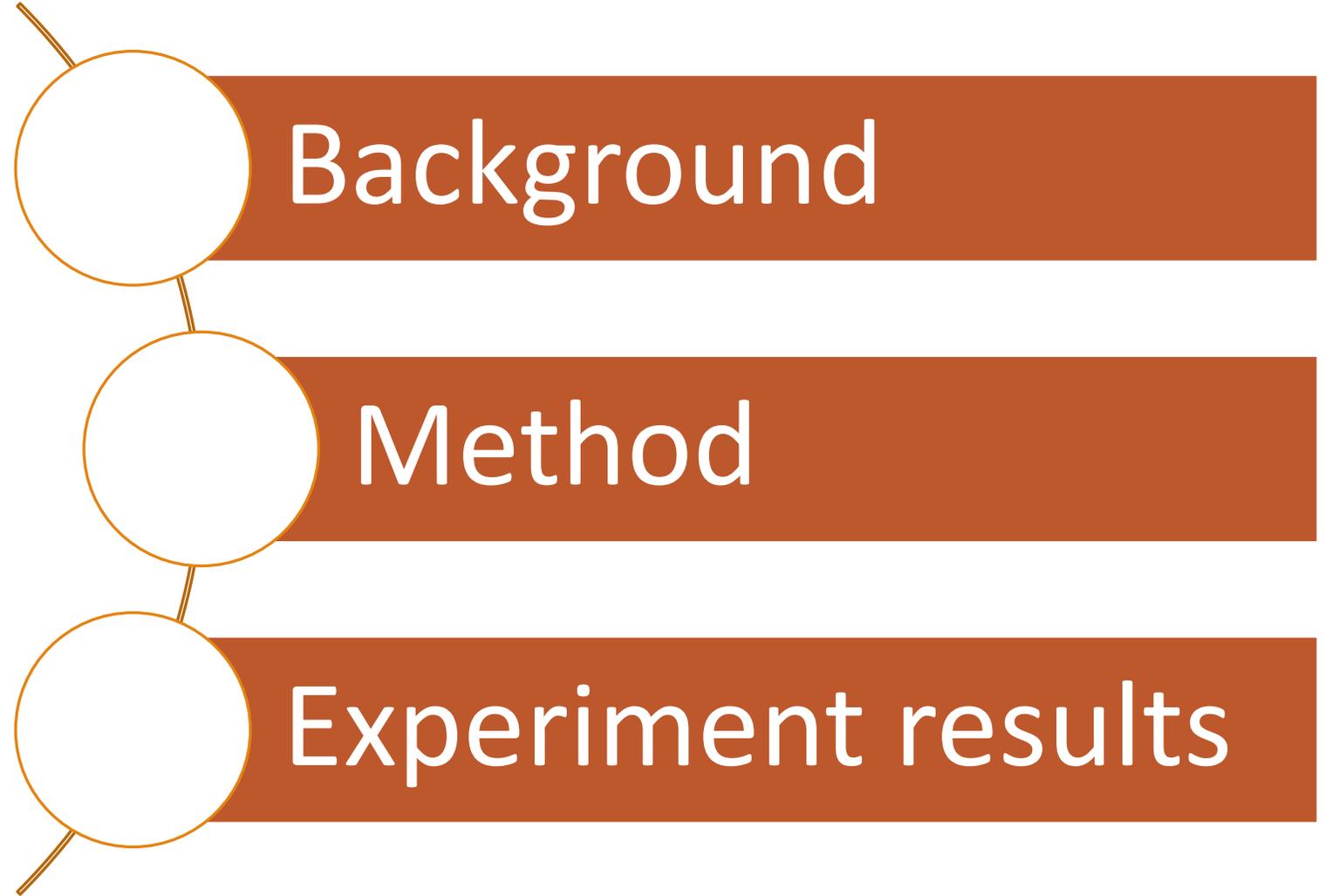
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ZHUO KUANG<sup>1</sup>; XIANBO DENG<sup>2</sup>; LI YU<sup>1</sup>; HANG ZHANG<sup>2</sup>; XIAN LIN<sup>1</sup>; HUI MA<sup>2</sup>

<sup>1</sup> HUAZHONG UNIVERSITY OF SCIENCE AND TECHNOLOGY, CHINA

<sup>2</sup> UNION HOSPITAL AFFILIATED WITH TONGJI MEDICAL COLLEGE OF HUAZHONG UNIVERSITY OF SCIENCE AND TECHNOLOGY, CHINA

# Content

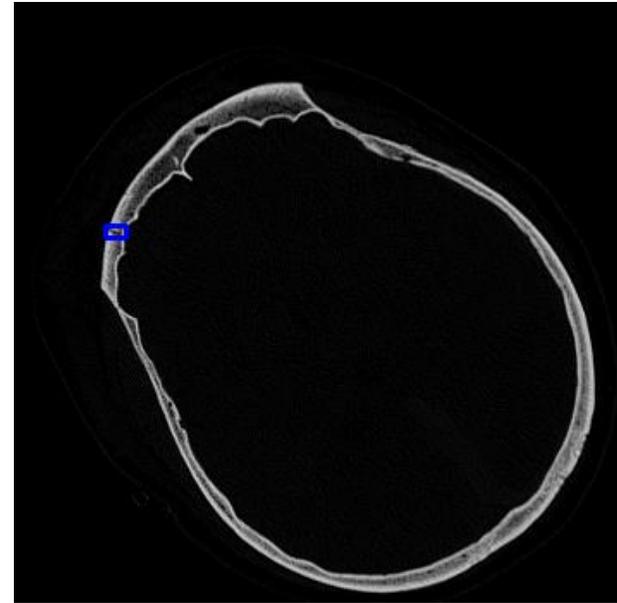
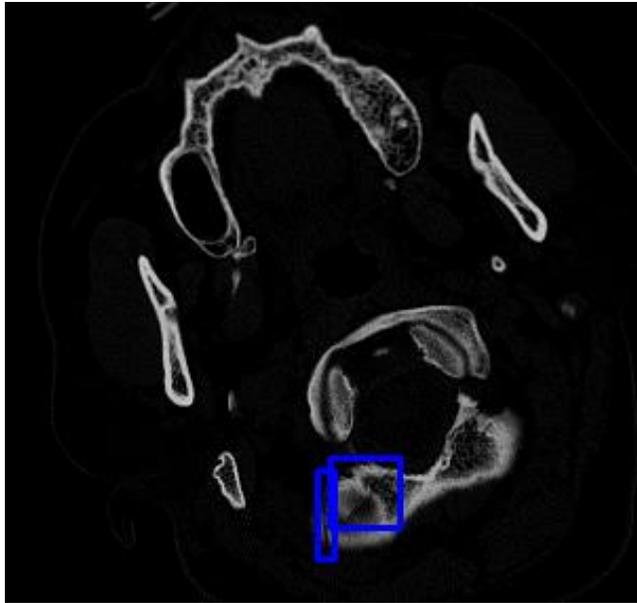


# Background

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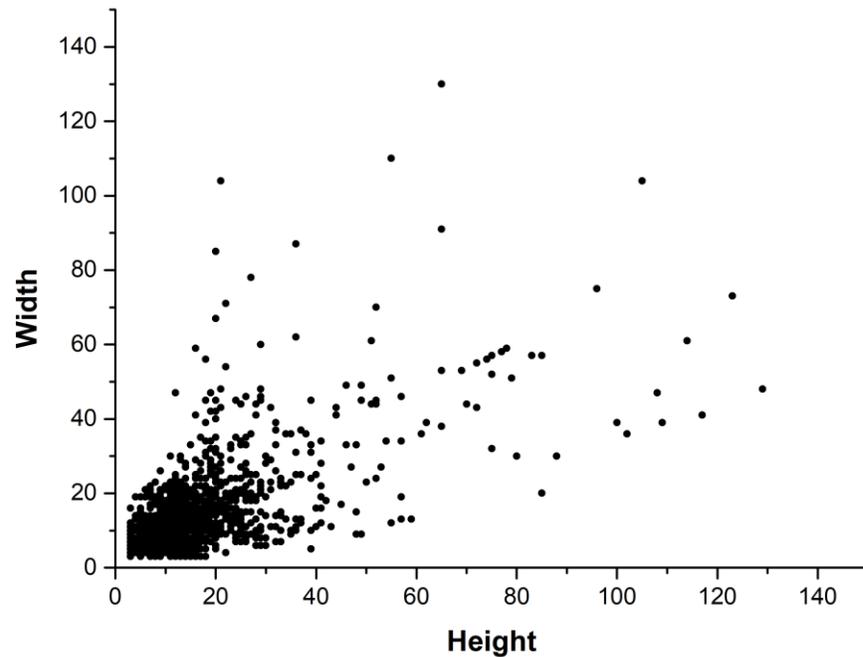
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**Figure. 1.** The skull fractures annotated by the radiologist. The blue boxes are the ground truth annotated by the radiologists, which contain the fractures.

# Background

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The fractures usually present as narrow slits;

The locations and the length of fractures are diverse;

A considerable percentage of the fractures have very small sizes;

Figure. 2. The distribution of the width and length of the object boxes.

# Method

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# Skull R-CNN

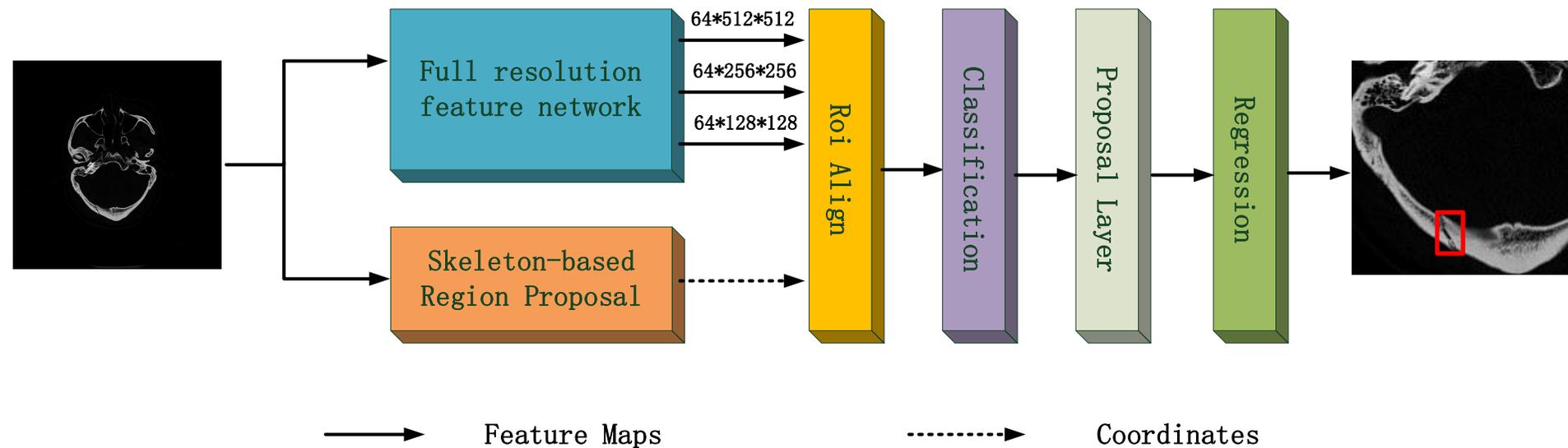
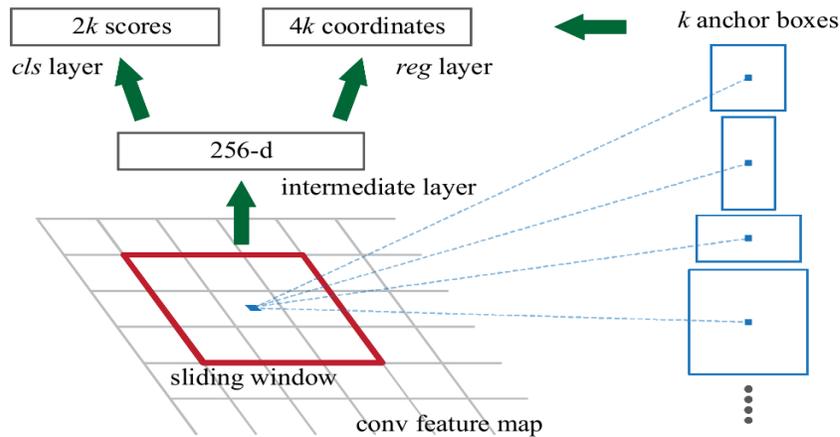


Figure. 3. The architecture of the Skull R-CNN

# Skeleton-based region proposal

Based on the feature map with low resolution



Based on the origin CT image

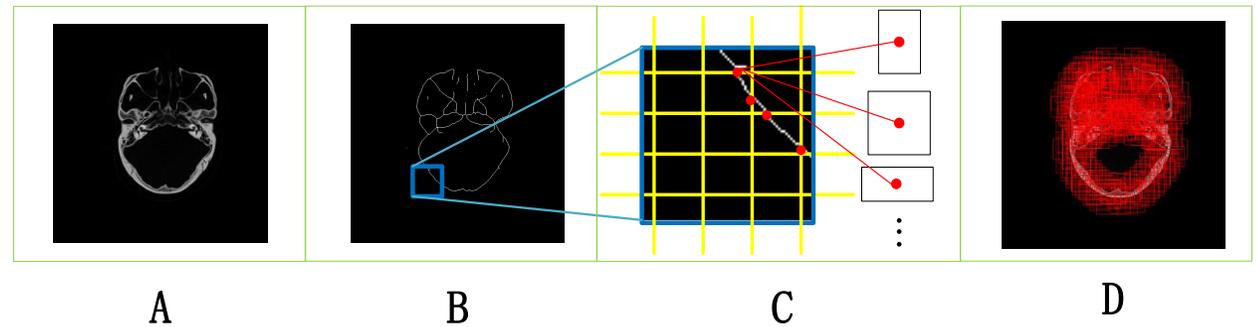


Figure 4. Left: Region proposal network(RPN)[1]; Right: Skeleton-based region proposal

The candidate boxes are much less than RPN, while keeping enough boxes containing fractures.

Compared to RPN, there is no need to be trained and it just costs small amount of computation.



# Experiment results

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# Objective indices

Table. 1. The performance of the models.

Methods	AP( $\times 0.01$ )				Detection time(s\slice)	
	val	test	val(<16*16)	test(<16*16)	val	test
Faster R-CNN + FPN	55.7	54.2	59.4	49.3	0.088	0.087
Skull R-CNN + FPN	62.6	57.9	64.7	58.6	0.058	0.058
Skull R-CNN	65.1	60.0	67.3	63.3	0.035	0.036

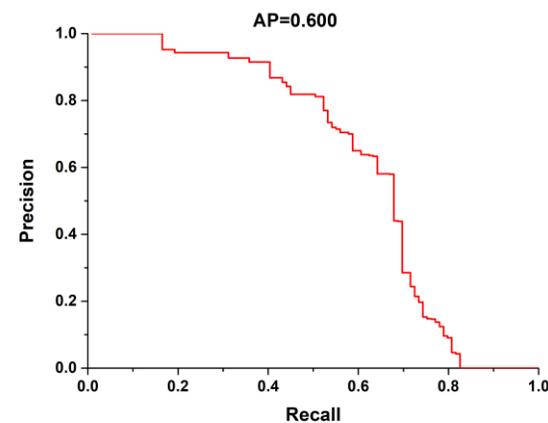
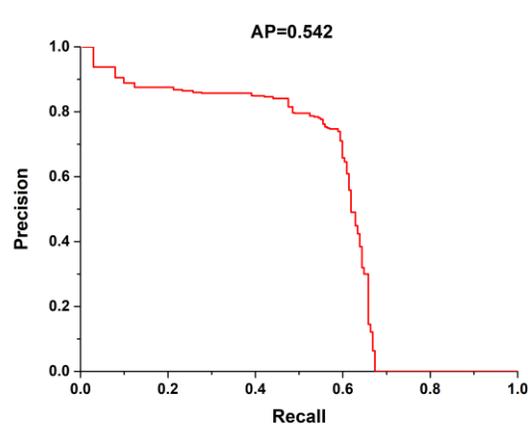
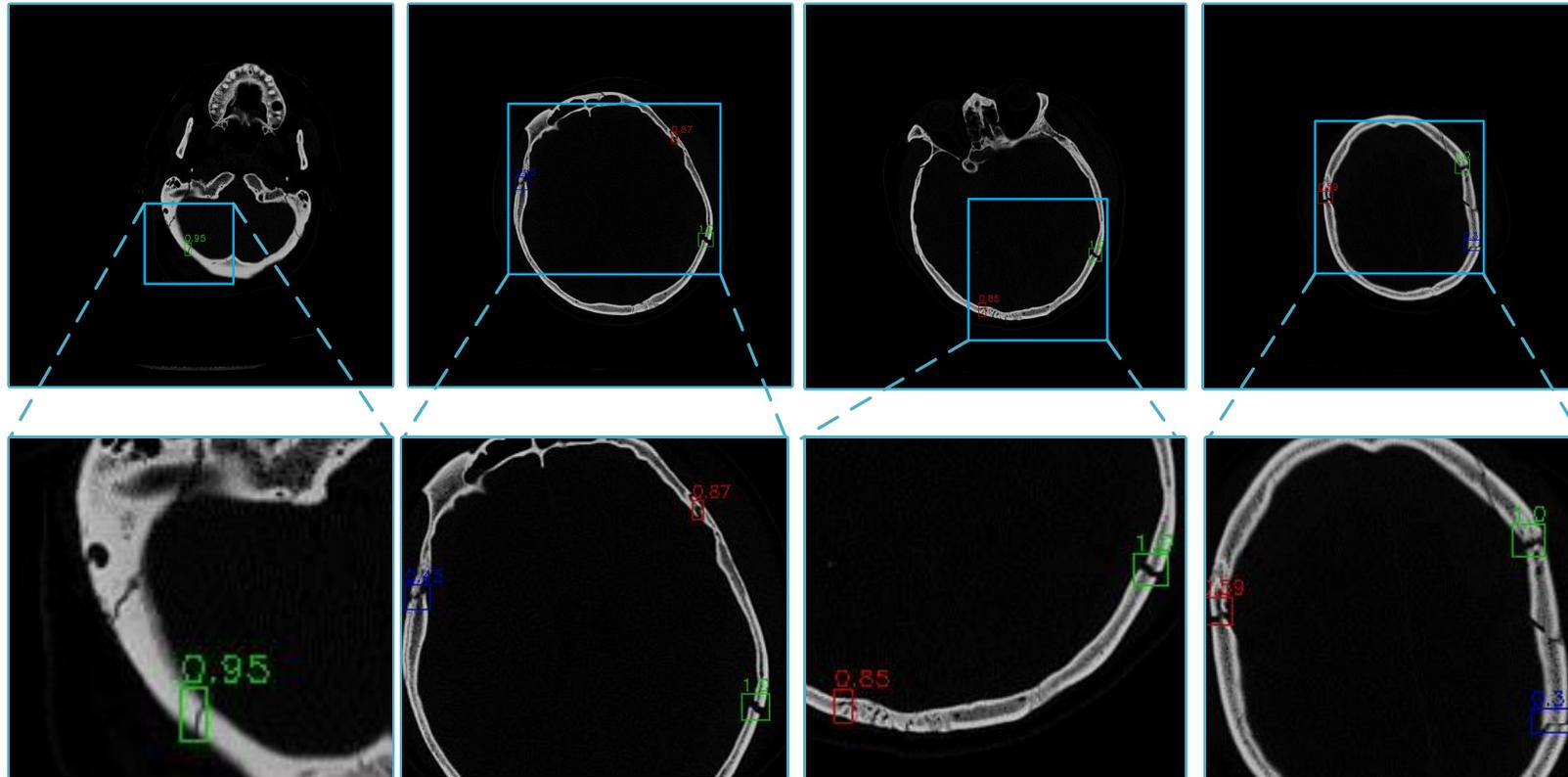


Figure. 6. The PR curves on the test set. **Left:** Faster R-CNN+FPN; **Right:** Skull R-CNN

# Subjective results

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**Figure. 7.** The detection results of the Skull R-CNN. The images in the second row are the partial magnifications of images in the first row. In which, the green boxes are TP predictions, the red boxes are FP predictions, and the blue boxes are the FN predictions

Thank you for listening !

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