EB-Net for landmarking on pronotum images

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Context

► **Deep learning**[1]: methods to learn the representations of data.
► **Landmarks** (key points): the points on the image that are invariant when the image changes.
► *Key points detection*: to find the key points through images.
► Landmarks in biology: most often provided manually by biologists.

Beetle's pronotum and landmarks

► Pronotum: an external morphology part of beetle
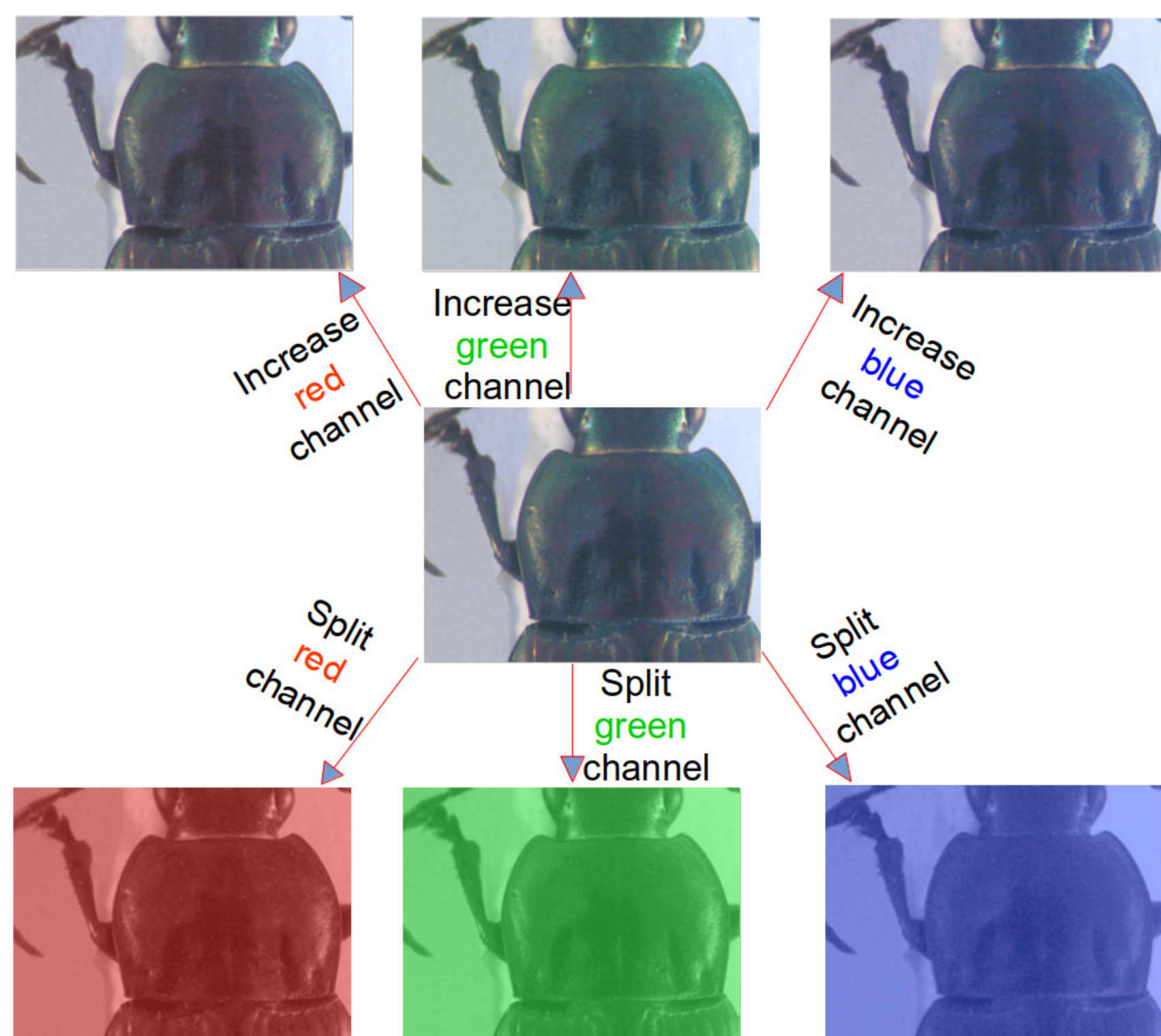► Eight-manual landmarks: provided by biologists and used as ground truth.
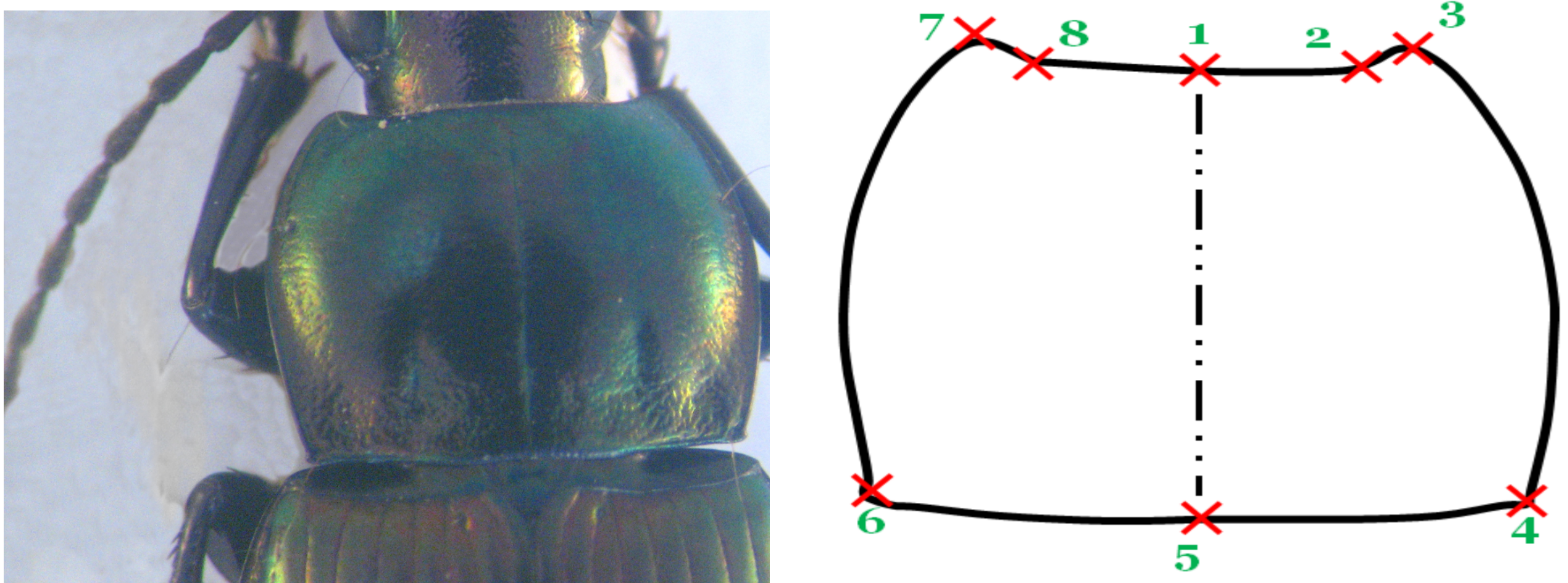
How to locate the landmarks automatically?

Dataset augmentation

The augmentation includes two procedures:
1. Changing the value of one color channel in the original image
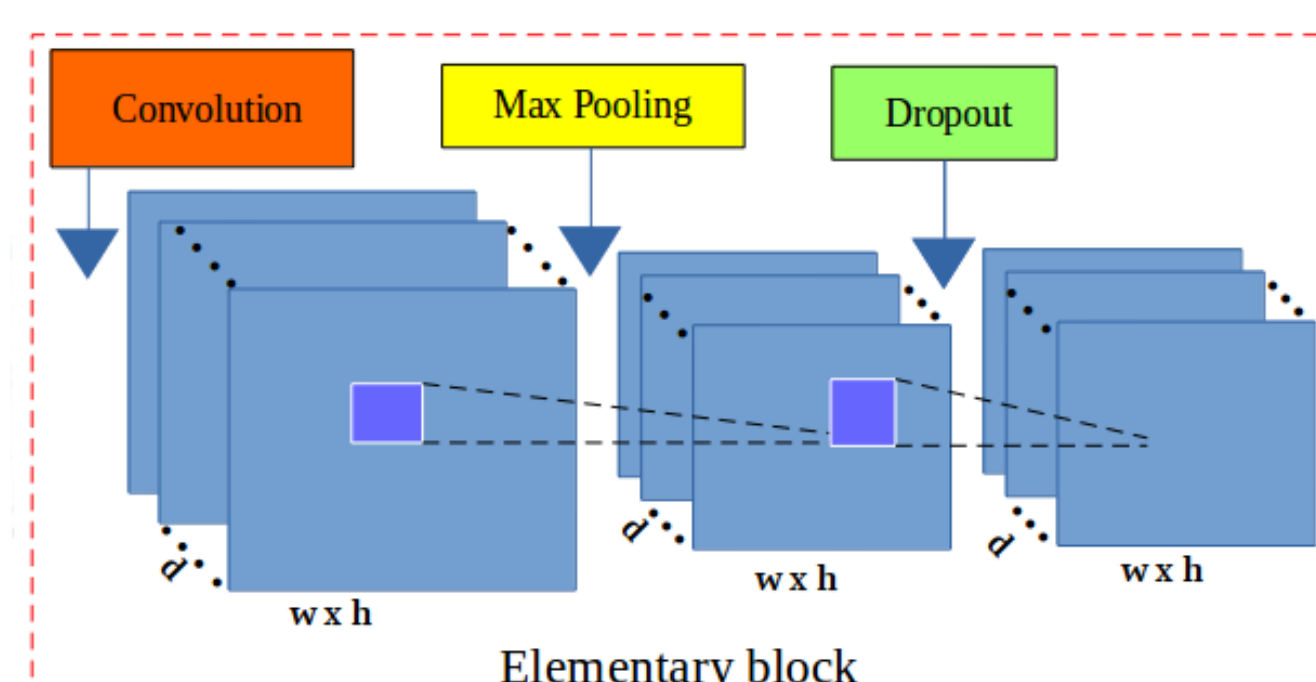2. Separating the channels of original image
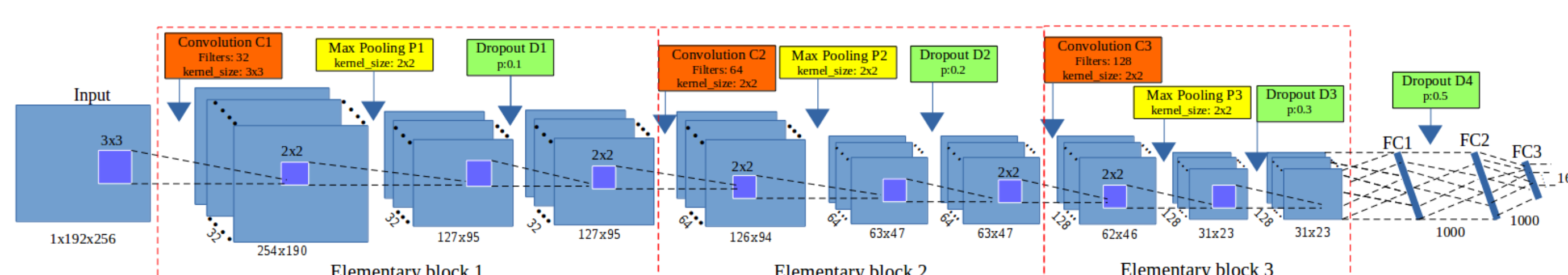In total: $293 \times 7 = $ **2051** images

Elementary block

An elementary block (EB) is consists of:
► A Convolutional layer
► A Max-Pooling layer
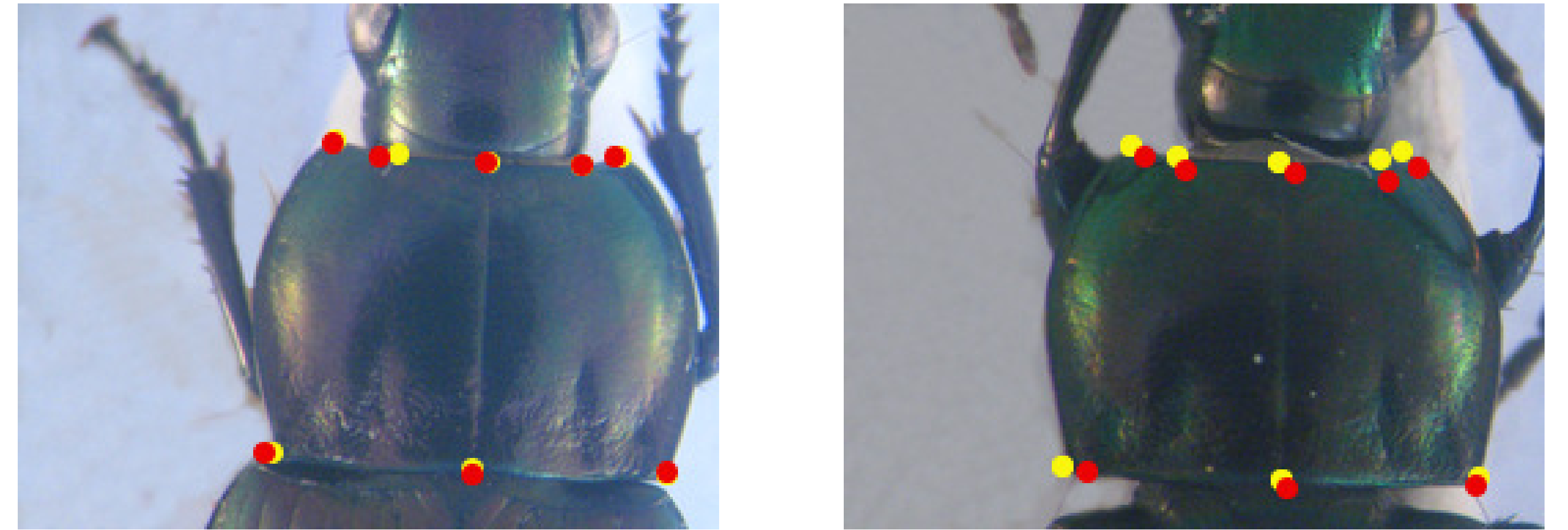► A Dropout layer

New model: EB-Net

The proposed network includes:
► Three elementary blocks
► Three fully connected layers
► A Dropout layer

Predicted landmarks on images

► **Yellow** points are manual landmarks
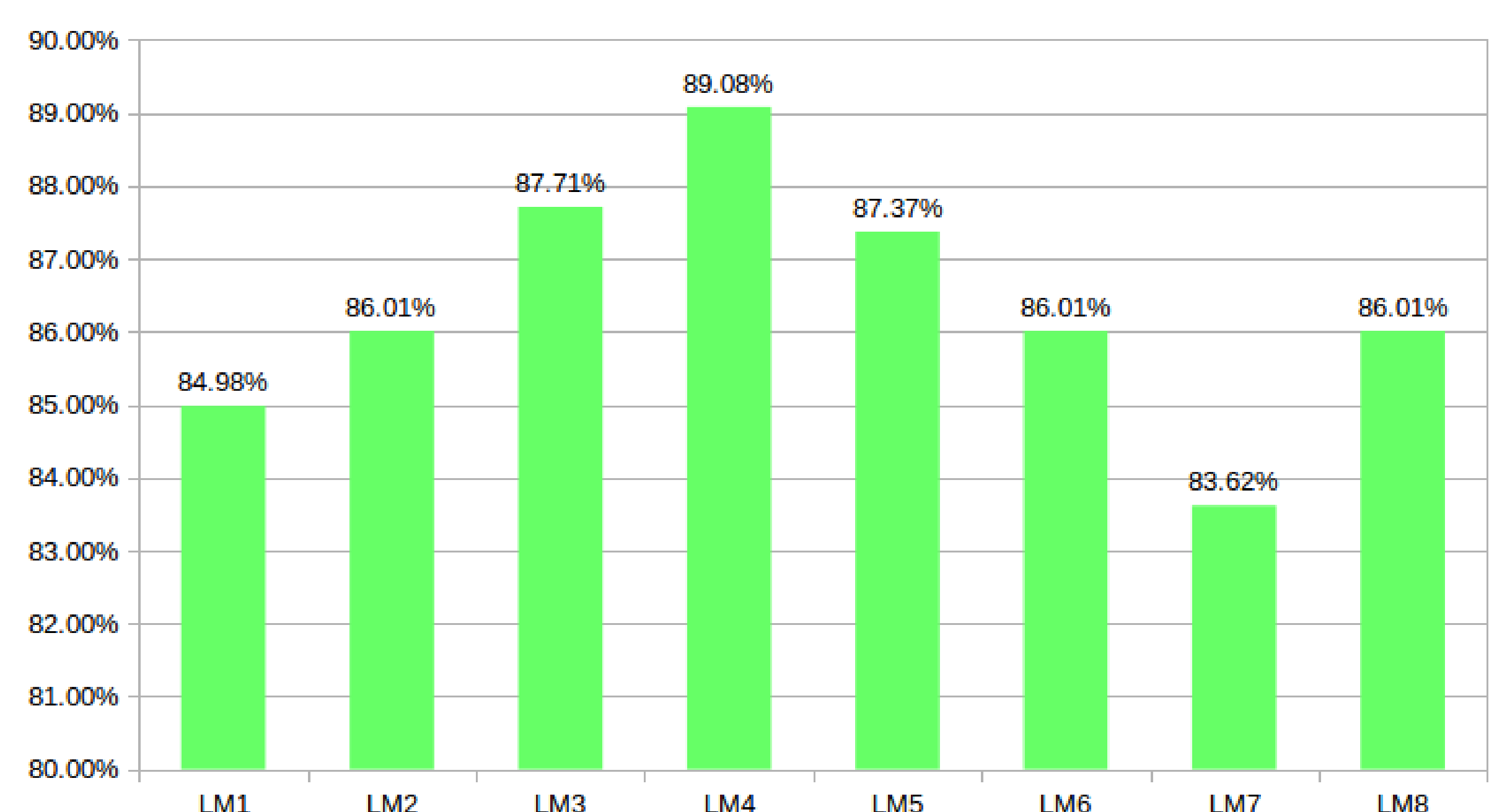► **Red** points are predicted landmarks

Evaluation

On **quality metrics** for regression problems.

Metric	r^2	EV	Pearson
Cintas et al.[2]	0.884	0.951	0.976
Our model	**0.9952**	**0.9951**	**0.9974**

On **average distances** between landmarks (manual & predicted)

Landmark	Distance (in pixels)
1	4.002
2	4.483
3	4.296
4	4.387
5	4.293
6	5.363
7	4.636
8	4.936

The proportion of acceptable predicted landmarks

Conclusion

1. A CNN model has been proposed to predict the landmarks on pronotum images.
2. An original method has been applied to augment dataset.
3. The quality of predicted landmarks have been evaluated by average distances with an accuracy greater than 80%.
4. The predicted landmarks can be used to replace manual landmarks.

Bibliography

[1] Yann LeCun, Yoshua Bengio, and Geoffrey Hinton.
Deep learning.
Nature, 521(7553):436−444, 2015.

[2] Celia Cintas et al.
Automatic ear detection and feature extraction using geometric morphometrics and convolutional neural networks.