EB-Net for landmarking on pronotum images

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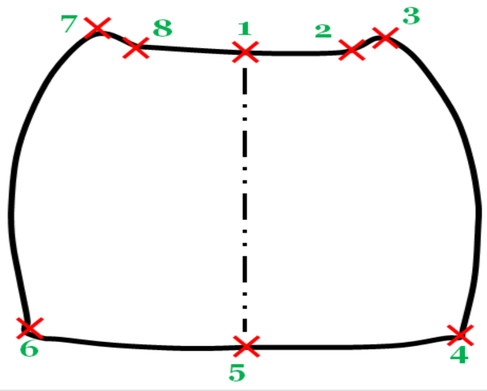
Context

- **Deep learning**[1]: methods to learn the representations of data
- Key points (**landmarks**): the points on the image that are invariant when the image changes
- *Key points detection*: to find the key points through images (video)
- 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.



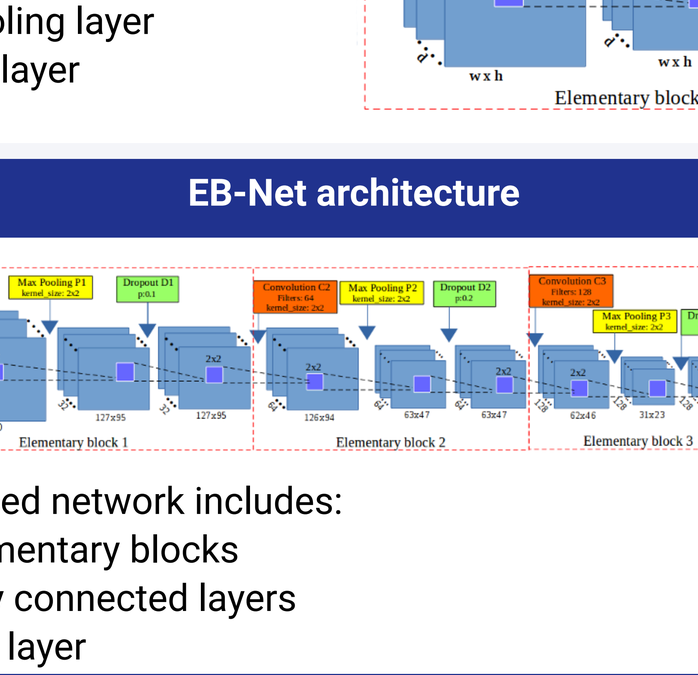
How to locate the landmarks automatically?

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

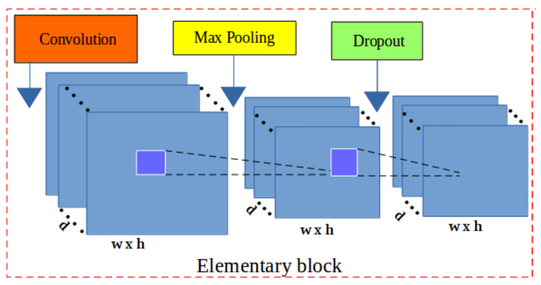
In total: $293 \times 7 = \mathbf{2051}$ images



Elementary block

An elementary block (EB) is consists of:

- A Convolutional layer
- A Max-Pooling layer
- A Dropout layer



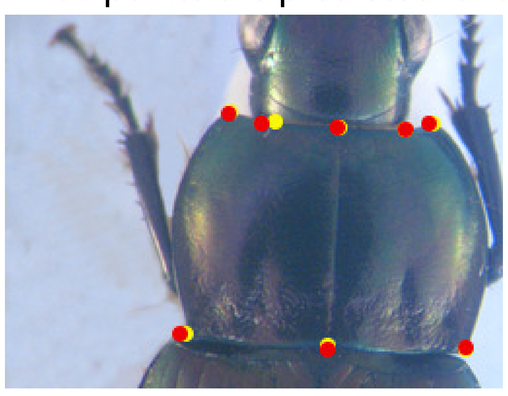
EB-Net architecture

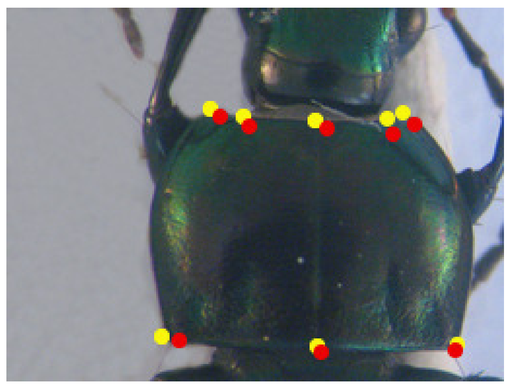
The proposed network includes:

- 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 progresses

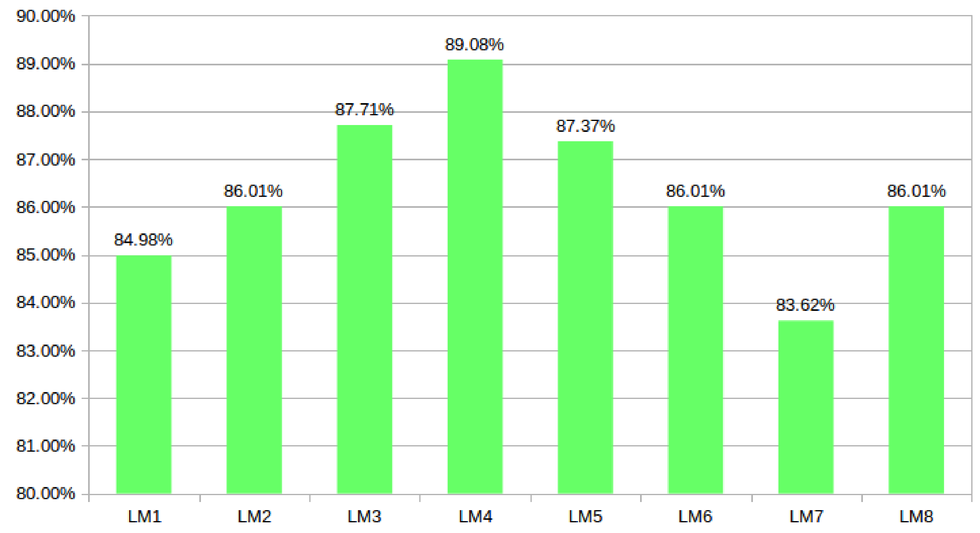
On **quality metrics** for regression problems.

Metric[1]	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** by landmarks

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 has been proposed to predict the landmarks on pronotum images which are difficult to apply image processing techniques.
2. A new 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

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