# EB-Net for landmarking on pronotum images

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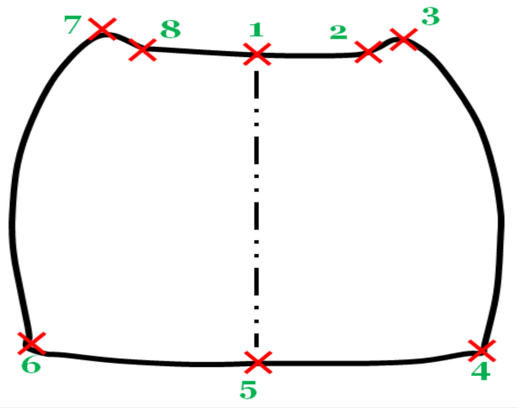
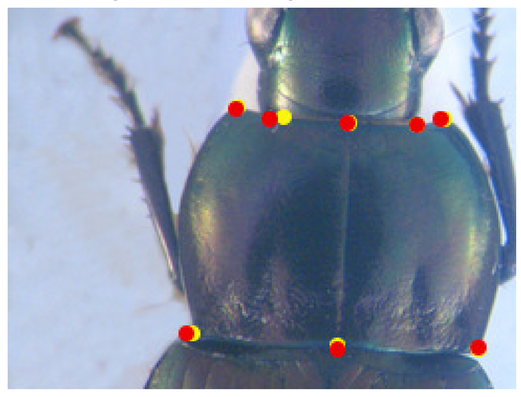
## Pronotum and landmarks

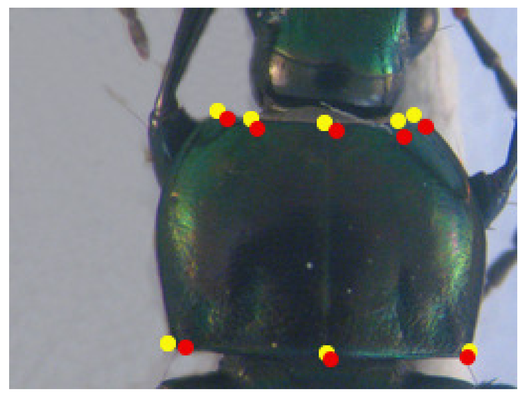



**How to locate the landmarks automatically?**

## Predicted landmarks on images

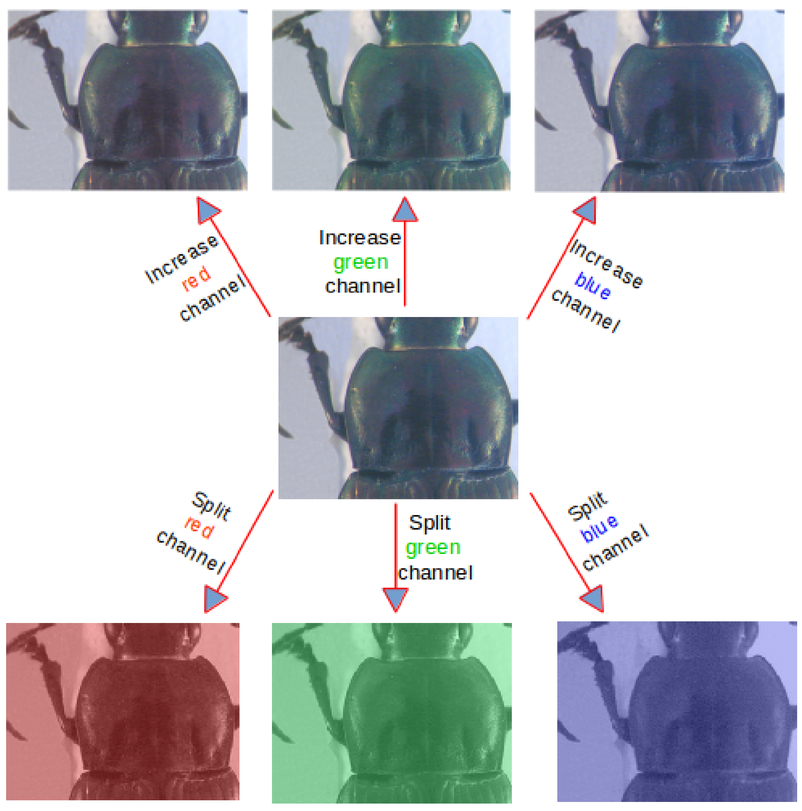
- **Yellow** points are manual landmarks
- **Red** points are predicted landmarks





## Dataset augmentation

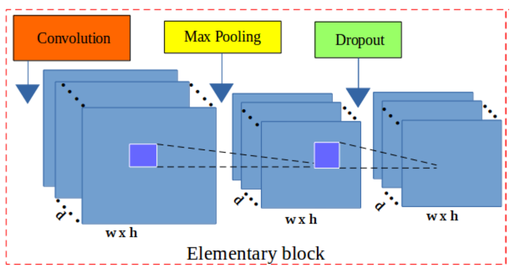
1. Changing the value of one color channel in the original image
2. Separating the channels of original image
3. In total: $293 \times 7 = 2051$ images



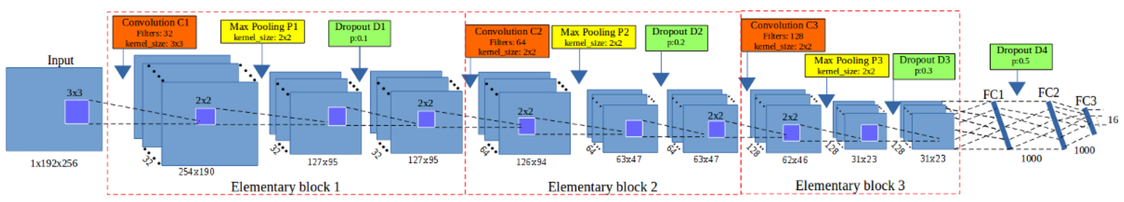

## Elementary block

An elementary block (EB) is consists of:

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




## Network architecture




The proposed network includes:

- Three elementary blocks
- Three fully connected layers
- A Dropout layer

## Evaluation progresses

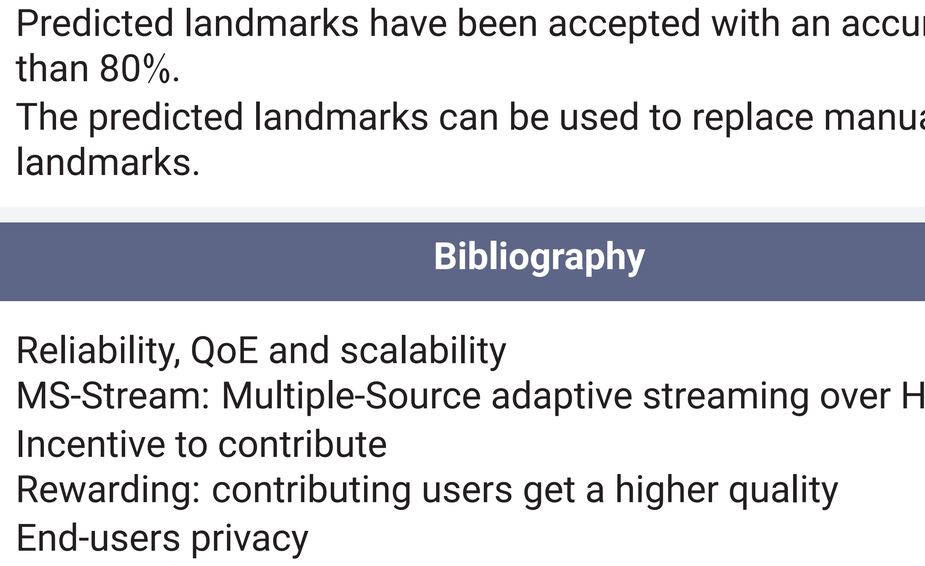
On **quality metrics** for regression problems.

| Metric[1] | $r^2$ | EV | Pearson |
|---|---|---|---|
| Cintas et al. | 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.
4. Predicted landmarks have been accepted with an accuracy greater than 80%.
5. The predicted landmarks can be used to replace manual landmarks.

## Bibliography

- Reliability, QoE and scalability
  MS-Stream: Multiple-Source adaptive streaming over HTTP
- Incentive to contribute
  Rewarding: contributing users get a higher quality
- End-users privacy
  TEE (SGX): encryption, NAT and anonymity