



Automatic morphology: landmarks estimation in biological images

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LaBRI

LaBRI

LaBRI^a is a research unit associated with the CNRS, the University of Bordeaux and the Bordeaux INP.

Missions: research, technology application and transfer and training.

^a<http://www.labri.fr/>

Staffs

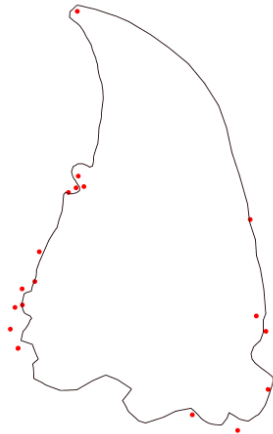
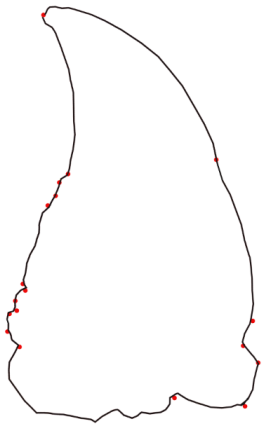
- ▶ 150 teaching/research staff
- ▶ 22 administrative and technical
- ▶ More than 140 doctoral student and post-docs.

Introduction

- ▶ A collaborative project between LaBRI and INRA Rennes
- ▶ Objectives: tracking, collecting and classifying the insects based on morphometry.
- ▶ Programming of automatic identification of landmarks in biological images: Implementation based on article “*Automatic identification of landmarks in digital images*”¹

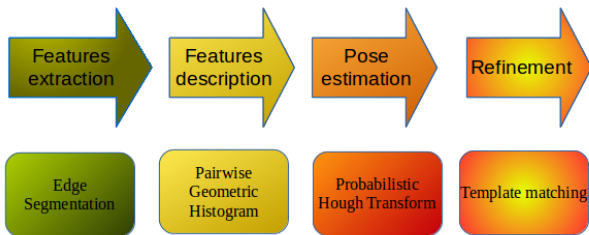
¹ Palaniswamy, Sasirekha, Neil A. Thacker, and Christian Peter Klingenberg. “Automatic identification of landmarks in digital images.” IET Computer Vision 4.4 (2010): 247-260.

Example



Edge extraction method

- ▶ The implementation based on "**Automatic identification of landmarks in digital images**", *Palaniswamy, Sasirekha, Neil A. Thacker, and Christian Peter Klingenberg*
- ▶ It includes four steps:



Method - Edge segmentation

Purpose:

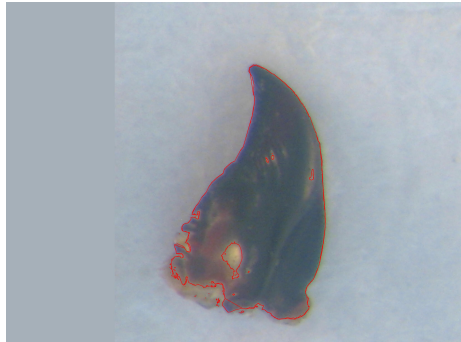
- ▶ Extract the features (edge) from images
- ▶ Get the approximate segment lines

Method:

- ▶ Indicate the threshold value by analysis histogram of image
- ▶ Canny algorithm
- ▶ Break edge algorithm²

²Thacker, Neil A., P. A. Riocreux, and R. B. Yates. "Assessing the completeness properties of pairwise geometric histograms." Image and Vision Computing 13.5 (1995): 423-429.

Method - Edge segmentation



Method - Pairwise geometric histogram

Purpose: detecting the present of scene image in model image

- Method³:**
- ▶ Construct the **local PGH** for each line
 - ▶ Construct the **shape PGH**, it is a set of local PGH
 - ▶ Matching shape's PGH by Bhattacharyya metric

PGH information: angle between two lines and perpendicular distance from two endpoints of scene line to reference line.

³Thacker, Neil A., P. A. Riocreux, and R. B. Yates. "Assessing the completeness properties of pairwise geometric histograms." Image and Vision Computing 13.5 (1995): 423-429.

Method - Probabilistic Hough Transform

Purpose: ▶ Determine the presence and location of model image in scene image

▶ Estimate the landmarks in the scene image

Method: ▶ Build the reference table

▶ Find the pair of scene lines have the best “vote” with pair of model lines

▶ Estimate the “reference point” in scene image

▶ Estimate the landmarks

Method - PHT parameters (Building the reference table)

1. Choose an arbitrary **reference point**
2. Compute the **perpendicular distance and angle** from each closet pair of model lines to *reference point*.

Example:

Pair lines	space 1	space 2
(l1, l2)	(30; 110.33)	(23.5; 855)
(l1, l3)	(15; 121.5)	(5.5; 200)

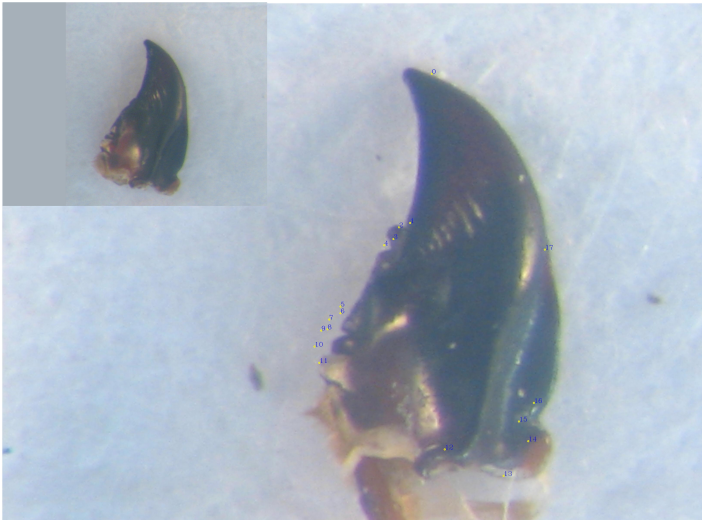
Method - PHT Parameters (Estimate the reference point in scene image)

The process to find the best vote are followed:

- ▶ Create an accumulator
- ▶ Find the pair of model line reasonable agreement about the **position, orientation and scale** and have the best “vote”
- ▶ Estimate the reference point in scene image⁴

⁴ Ashbrook, Anthony, et al. “Robust Recognition of Scaled Shapes Using Pairwise Geometric Histograms.” BMVC. Vol. 95. 1995.

Method - Probabilistic Hough Transform

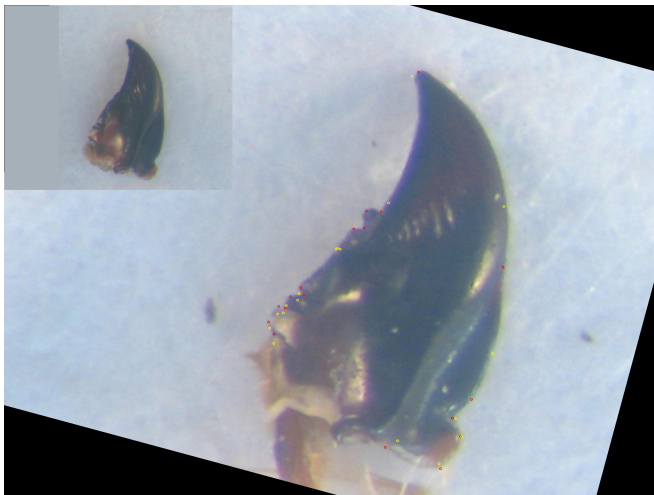


Method - Template matching

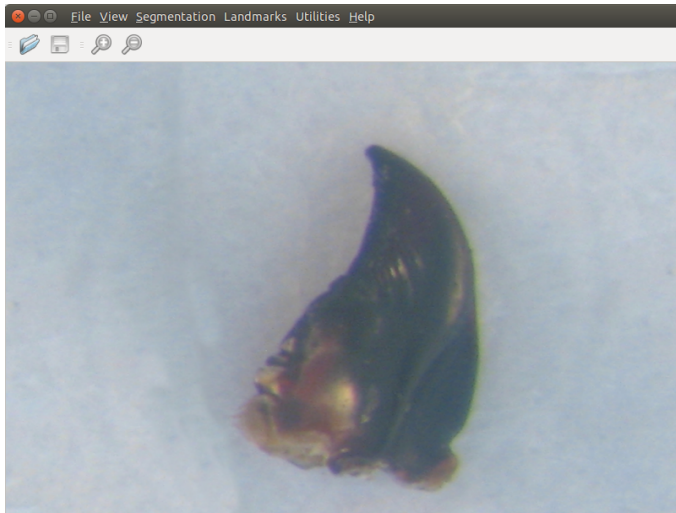
Purpose: Refine the estimated landmarks on the scene image

- Method:**
- ▶ Create a box around each model landmarks on model image
 - ▶ Rotate scene image to match with model
 - ▶ Create a box around each estimated landmarks on scene image
 - ▶ Using Cross-Correlation to refine the estimated landmarks

Method - Template matching



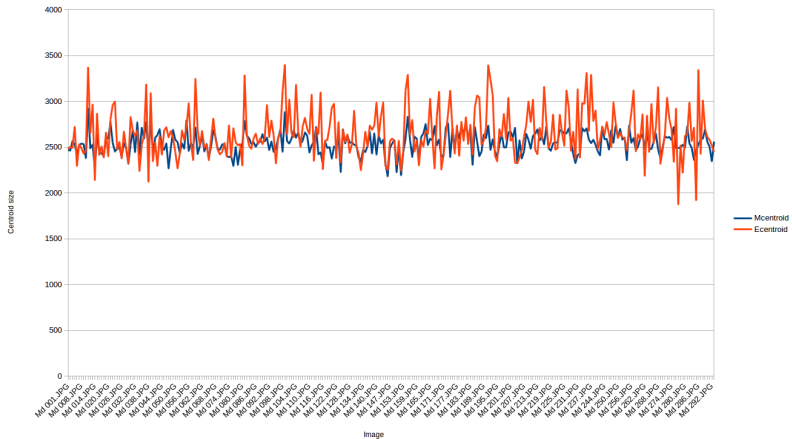
MAELab



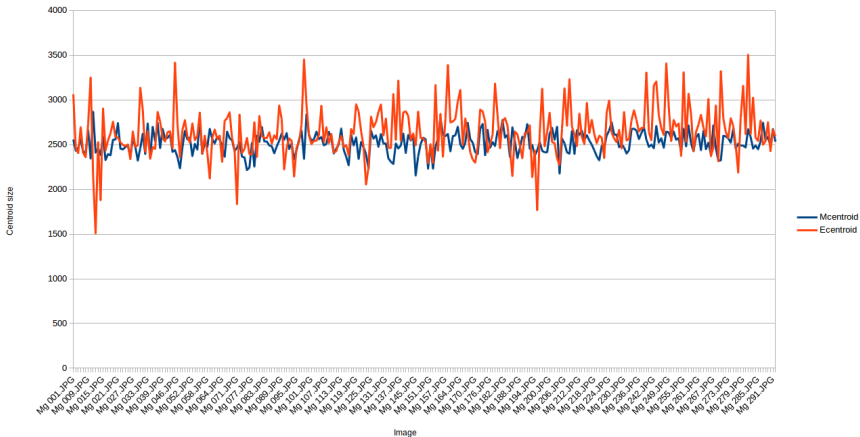
Result

- ▶ Dataset: **290** images of right mandible and **286** images of left mandible.
- ▶ Landmarks are extracted: **18 landmarks** for each *right mandible* and **16 landmarks** for each *left mandible*.

Result



Result



Conclusion and future works

Conclusion:

- ▶ This method (*proposed by the article*) can be used to identify the landmarks. But, in some cases, the estimated landmarks are not close with manual landmarks.
- ▶ Method includes 4 steps. The result of each step can effect to next step.

Future works:

- ▶ Optimize the program based on each process
- ▶ Apply the method on other datasets: *elytre*, *head* or *prnotum*

Thank you !