UNIVERSITY OF BORDEAUX

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LaBRI

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Automatic morphology: landmarks estimation in biological images

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Contents

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.

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[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:

  - ▷ Cross-correlation

  - ▷ 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.**
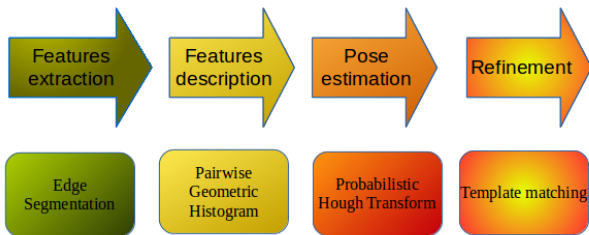
Cross-Correlation method

- Estimate the presentation of a template in an image.
- Formula:

$$R_{ccorr}(x, y) = \sum_{x', y'} [T(x'.y').I(x + x', y + y')] \tag{1}$$

  ▷ **T**: template, (x', y') is coordinate in template
  ▷ **I**: image, $(x + x', y + y')$ is coordinate on image, where we get the value to compute while template T sliding.

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:

| Features extraction	Features description	Pose estimation	Refinement
Edge Segmentation	Pairwise Geometric Histogram	Probabilistic Hough Transform	Template matching

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 algorithm[2]

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[2]**Thacker, 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
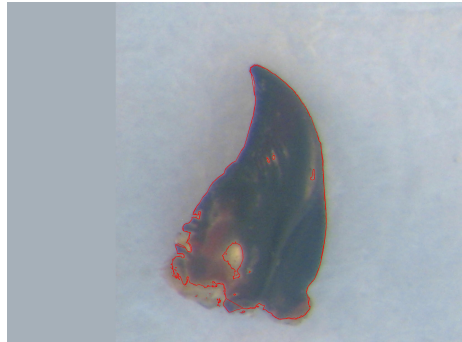
Method - Pairwise geometric histogram

Purpose: detecting the present of scene image in model image

Method[3] : ▸ 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.

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[3]**Thacker, 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 image[4]

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[4] **Ashbrook, Anthony, et al. "Robust Recognition of Scaled Shapes Using Pairwise Geometric Histograms." BMVC. Vol. 95. 1995.**

Method - Probabilistic Hough Transform
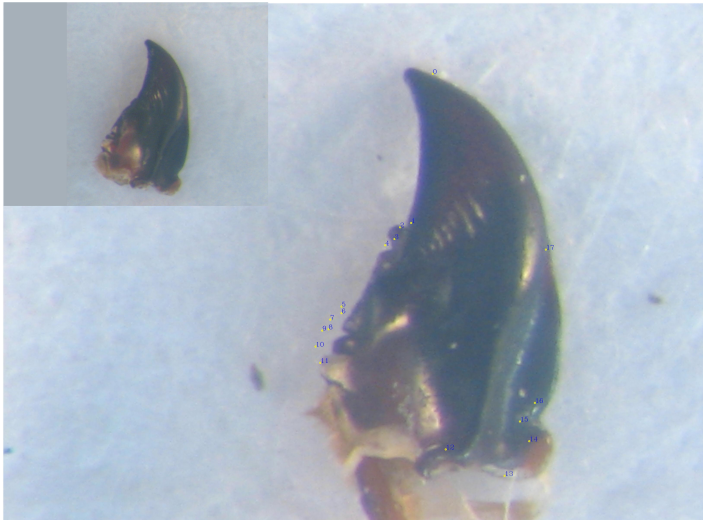
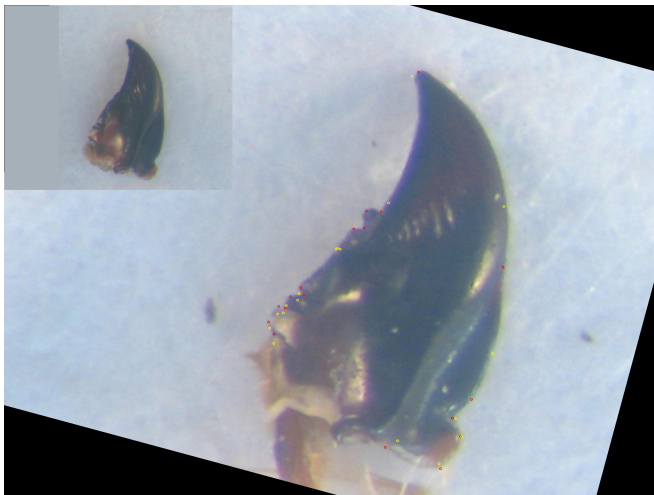# Method - Template matching

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

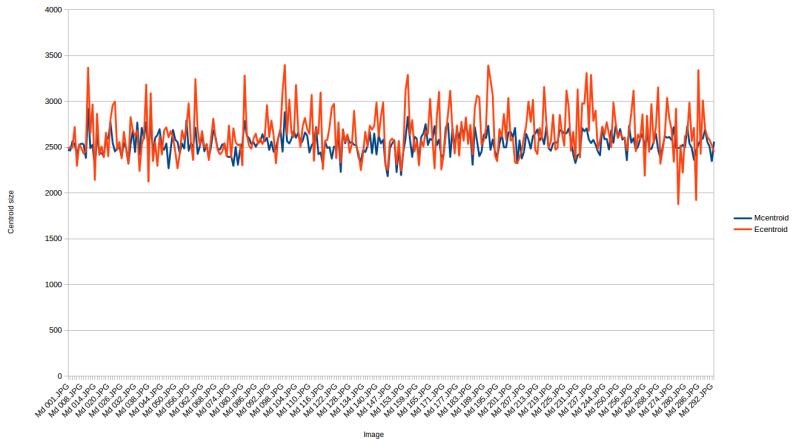▸ Using Cross-Correlation to refine the estimated landmarks
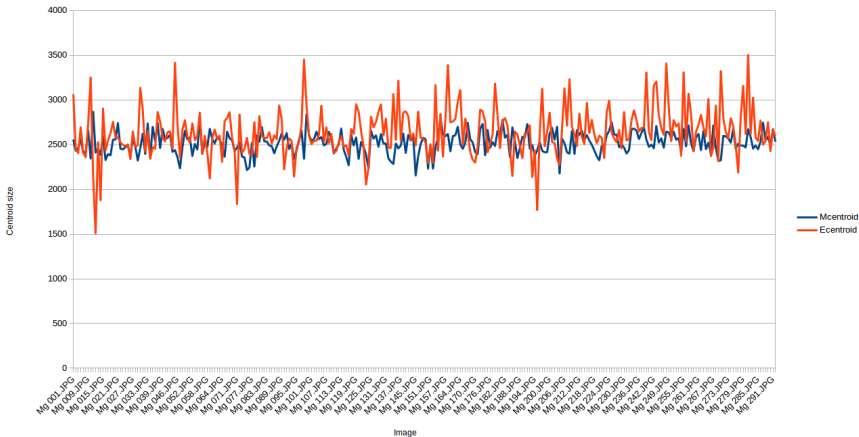
Method - Template matching

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 pronotum*

Thank you !