Slide 1
Hello everybody,
My name is LE Van Linh. I am the first year doctoral student at Bordeaux University. On behaft of my group, today I will present our result about landmarks estimation on beetle mandibles. Our group includes 4 members: Marie, she is my supervisor, an assistant professor of Bordeaux University and work at LaBRI; Adrien, he is a post-doc in LaBRI; Nicolas, he is a collaborative-researcher in France, he work at INRA Rennes.

Slide 2
As we know, to measure the characteristic of animal, we can do directly on its body with many kinds of information. But in other case, when the size of studied object is small, we cannot use the normal way. Instead, we use the devices to extract first (taking the picture), then we apply the techniques to characterize the information such as contours, landmarks.

In our case, we choose landmarks to study. These are the biologically points. They are usually defining by the biologist. For example: the tip of nose and the outer corner of left eye are the landmarks on the face.

//The question is: How to locate the landmark automatically?
//My presentation will solve this question.

Slide 3s
This slide shows the studied objects of our method: the left and right mandibles. For each mandible, a set of 293 images have been collected.
For each mandible, a set of 18 landmarks of right mandible (16 landmarks of left mandible) have been set by biologists (the red points on the images).
The landmarks are set by manual.
In this study, we try to estimate the landmarks on the mandibles and considering to replace the manual landmark by estimated one.

Slide 4
My presentation includes 4 parts: In the first section, I will give to you a general viewer about our method. Then, I will come to the detail of method. In the third section, I want to show to you some result and evaluation. And the last one, we have some conclusion and the future works.

Slide 5
Our method uses an image (called model) and its manual landmarks to estimate the landmarks of another image (called scene). This method is mainly having 3 steps: segmentation, registration between the image contours and the last one is estimating the landmarks on the scene image.
Now, we will enter the details of the method.

Slide 6
The first step of method is extracting the contours of the image. The segmentation is done by applying the Canny algorithm. The keyword of Canny is using the adaptive threshold, the values are set for lower threshold and upper threshold. In our method, the threshold value is detected by analyzing the gray-scale histogram. And the ratio between the thresholds is 1:3. Then, the segmentation is post-process to remove the contours (hole) that not belong to the main shape.

Slide 7
This is an example about the segmentation of a right mandible. The left image is the original one, the center image is the result of Canny algorithm, the right image is the result after post-process overlap the original image.

Slide 8
The next step of our method is registration. The input of this step is the contour of model and scene image. For each contour, the PCA is applied to compute the centroid point and principal axis. To register the contours, the transformation (translation and rotation) between them must be compute. So, the translation is the distance between the centroid points. The rotation angle is determined by computing the angle between the principal axes. Then, the scene is transformed to the model.
However, when we consider the result of segmentation, the tip part is better than the base part. So, to improve the registration step, we sort and extract a subset of contours points following the y-value. Then, the PCA and transformation are executed again. This work will be repeated and stopped when the angle between the model and the scene is less than 1.5 degree.

Slide 9
This is the result of registration. In this image, we can see three contours of mandible. The red contour is the model contour, the black one is scene contour after 1 iteration and the blue one is the last result of registration.

Slide 10, 11
The last step of our method is applying the SIFT descriptor to determine the landmark position. For each manual landmark, a patch around the landmark is extracted and calculated the SIFT descriptor. While, at the same position in scene, a larger (than in manual one) patch is extracted. Then, for each pixel in the patch of scene image, a small patch is extracted with the same size of manual one. The SIFT descriptor is calculated too. An comparison between the manual patch and small patch in the scene is calculated. This work is repeated until all the pixels in the patch of scene are considered. The location of the estimated landmarks is the pixel where has the minimum distance with the manual one.

Slide 12
The images in this slide is the final result of our method. On the left is the result of left mandible, the right image is the result of right mandible. In these images, the red points are represented for the manual landmarks, the yellow points are the estimated landmarks.
As we can see that, the estimated landmarks are really close with the manual ones.

Slide 13s
The method is evaluated on all the image in the dataset. This chart show the proportion on each landmarks or the right mandible. The best accuracy is the first landmark with 98.62%, other landmarks are also having a nice proportion more than 70%.

Slide 14
The result of left mandibles is shown in this chart. We can see that the result of left mandible is not good as the right one, with the highest proportion is 93% of the first landmark.

Slide 15
As we can see, we have proposed an method to estimate the landmark on mandible images based on the manual one from a mandible. The proportion of the estimated landmarks are closest with the manual one (see we present in Result).
In the future, we will to improve the registration step. We also consider the scale parameters among the mandibles (this parameter is more effect on left mandibles). Beside, with the developing of machine learning, we will using CNN to detect the landmark and integration with automatic classification.

Slide 16, 17, 18

There are the references that we have used.

Slide 17: Thank you for listening !