An improvement on estimated landmarks of Beetle's pronotum

Le Van Linh[1,3], Beurton-Aimar Marie[1], Zemmari Akka[1], Parisey Nicolas[2]

[1]LaBRI - CNRS 5800 Bordeaux University, France, van-linh.le/beurton/zemmari@labri.fr
[2]IGEPP - INRA 1349, France, nparisey@rennes.inra.fr
[3]ITDLU - Dalat University, Vietnam, linhlv@dlu.edu.vn

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Abstract

In recent years, deep learning is known as a good solution for the difficult problems in computer vision. It appears in many fields such as classification, recognition, face detection. In this paper, we propose a scenario to predict the landmarks on 2D images, specify beetle's head images. The proposed method includes two stages: firstly, the landmarks are estimated by applying convolutional neural network; then, the estimated landmarks are verified to increase the accuracy. The method experimented on a set of 293 images. The accuracy of the method is evaluated by calculating the distance in pixels between the coordinates of the predicted landmarks and manual landmarks which were provided by the biologists.

1 Introduction

Morphometry landmark (or point of interest) is an important feature in many biological investigations. It was usually used to analyze the forms of whole biological organs or organisms. The analysis is mainly based on the coordinates of the landmarks. The collecting of enough the number of landmarks can help the biologists make a good estimate about organisms. Depending on the problem, the number of landmarks may be more or less; besides, the location of landmarks can be located on the shape (border) or inside the object, *for examples,* the landmarks on Drosophila wings have stayed on the veins of the wings but the landmarks on human ear can be located at the ear hole or inside. Recently, the landmarks were set manually by the biologist. This work is time-consuming and difficult to reproduce. Therefore, a method that proposes automatically the coordinates of landmarks could be a concern.

For segmented images, identification of landmarks on the shape can be finished by applying the image processing techniques such as HOG[], SIFT[], ... But for un-segmented images, defining the landmarks become a challenge and the image processing techniques seem to be inappropriate. This article introduces a scenario for automatic detection of the landmarks on biological images, specific beetle's head images, called pronotum images (Fig.). The method includes 2 stages: 1) the initially predicted landmarks are given by a convolutional neural network (CNN) []; 2) the predicted landmarks which located in the shape of pronotum will be refined the location to increase the accuracy of coordinates. In the first stage, the main idea is design and train a CNN with a set of images and their manual landmarks. The dataset includes 293 pronotum images and their manual landmarks which have been provided by the biologists. The images are presented in two dimensions and RGB color. After training, the trained network will be able to detect the initially predicted landmarks on the pronotum images. In the second stage, the predicted landmarks in the shape will be refined the coordinates by applying a Procrustes analysis[]. A model is generated for the specific manual landmark. Then, it used to refine the corresponding predicted landmarks.

In the next section, we present related works in domain automatically estimation landmarks on 2D images. In section 3, we present an overview about the stage that predict the initial landmarks by applying CNN. The procedure apply to refine the predicted landmarks which provide by CNN will be presented in section 4. In the last section, we show all the experiments and analysing the results.

2 Related works

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3 Convolutional neural network and landmarks detection

3.1 Data processing

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4 Improving the predicted landmarks

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