

Face Landmarking: Comparative Analysis

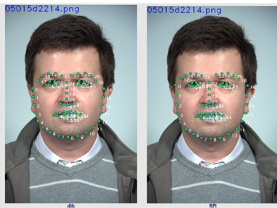
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Abstract

Facial landmarking is defined as the detection and localization of certain key points on the face. Much like a person's ability to recognize other humans by the dimensions of their face, face landmarking software uses algorithms to map the face of the individual(s). Face landmarking software is utilized in various domains ranging from identifying and profiling criminals to recognizing faces on social media networks such as Facebook, to creating interesting and entertaining visual effects such as face swapping.

My research team is comparing the accuracy of three face landmarking software products: dib, vito, and RPI. We used SGE, to run these three landmarking programs on a data set of 1,781 frontal face images and compared the consistency of landmark locations. Preliminary results indicate that facial landmark localizations are inconsistent among the techniques and tend to be unstable along the jawline.



Materials and Methods

1. Data set:

"SREFI" data set assembled at Notre Dame from biometric collections conducted 2004-2012. There are 1,781 high-quality frontally posed face images of humans aged 18-65: all races, male, and female.

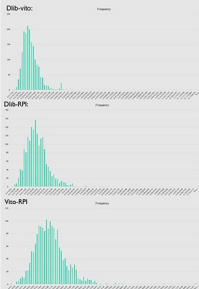
2. Landmarking software:

- "Dib" landmarker - part of the Dib software package (<http://dib.net>). The dib landmarker is an implementation of the technique in Vahid and Sullivan [1].
- "Vito" landmarker - a technique based on a cascaded mixture of regressors, provided by collaborator Prof. Vitomir Struc, University of Ljubljana, Slovenia [unpublished].
- "RPI" landmarker - a probabilistic model based detector provided by Yue Wu and Prof. Qiang Ji of Rensselaer Polytechnic Institute[2].
- SGE: Sun Grid Engine, deployed on CRC computer systems - used to distribute individual independent landmarking jobs to a set of computing systems for efficient execution of large workloads

3. Technique:

- a. Landmarkers were executed on all images, producing files containing 68 landmark locations on the face. Faces for which the landmarker produced no output were ignored.
- b. A comparison program computed the average deviation between corresponding landmark positions for two different techniques applied to the same image. The deviation is reported as a percentage of the inter-ocular distance.
- c. The deviations were computed for each of the three pairs of landmarks (RPI, Vito, and dib), and histogrammed.
- d. Histograms were compared qualitatively.

Results



The figures above depict histograms of landmarker comparisons. The horizontal axis is the average RMS deviation for all landmarks in an image, and the histograms aggregate this value across all images in the SREFI data set. More sharply peaked histograms with a peak location closer to zero indicates better agreement in landmark positions between the two landmarkers involved. The Vito and dib landmarkers illustrate a better result compared to any of the other comparisons. Examination of landmark results also suggests that all techniques experience difficulties consistently labeling the facial boundary (jawline and side of face).

References

- [1] Vahid Kazemi and Jonghwa Sullivan, One-Million-Face Alignment with an Ensemble of Regression Trees, Proc. CVPR 2014
- [2] Yue Wu, Zhong Wang, and Qiang Ji, A Hierarchical Probabilistic Model for Facial Feature Detection, Proc. CVPR 2014