

## Doctoral thesis review

Michal Uříčář

### Multi-view Facial Landmark Detection

Proposed doctoral thesis addresses detection of facial landmarks in the multi-view scenario. Such task attracts growing attention in the scientific literature due to its importance in applications like person recognition, facial expression estimation and other often security related areas. The accuracy and time complexity are crucial in such applications.

The student's approach is using the tree based Deformable Part Model (DPM). He implemented modified local binary patterns - sparse pyramid of LBPs as feature descriptors for an appearance model and proposed speed-up of their computation utilizing their pre-computed forms in the MIPMAP representation. The effect of the loss function was studied. The detector weights are learned using the Structured Output SVM (SOSVM). The student applied Stochastic Gradient Descent and Bundle Method for Regularized Risk Minimization (BMRM) as solvers in SOSVM learning. He proposed two improvements for the latter – multiple cutting plane model and the addition of the quadratic proxy term, both leading to lower number of iteration.

To improve the performance of the multi-view DPM detector the student proposed to work in two stages. Firstly he applies the single view detector for each view and in the second stage estimates the best fitting viewing angle for given data. The author proposes to even further minimize computational costs by utilizing two resolution levels during the DPM detecting phase.

The time-wise and quality-wise effect of the proposed improvements is demonstrated in the Experiments. The method performance is tested on several publicly available datasets and is compared to several state of the art methods using described metrics. The author addressed separately single view and multi view cases. Finally, the student lists several possible directions of his future research.

The work is based on combination of methods, motivated by existing approaches which are improved and modified in order to fulfil conditions of time consuming detection of facial landmarks in real environment. There is clear evidence that this topic is clearly understood, and well handled. The motivation for the improvements is mainly to lower the computational time and thus making the method applicable in real time mode even for dense sets of landmarks, which is crucial. Implementation of the described tool was released in an open-source library, which was already many times applied in various areas.

The collection of the author's publications with citations clearly demonstrates the respect Michal Uříčář's work has got already during his PhD studies. Thanks to publicly available open source library the outcome of the thesis has been already used by numerous projects. The length of the work is appropriate and the work is well presented. Images play an important role and are well selected, too.

Michal Uříčář proved to be able to generate creative research hypotheses. His work is underpinned by existing literature. He pays attention to thoughtful validation of his ideas. The list of his publications demonstrates his ability to finalize what he has started.

Questions:

- The LBPs were used as descriptors for landmarks. They can be vulnerable to noise, especially in regions with low contrast. Have you tested the sensitivity of the method with respect to the light condition? How would the performance change in the case of noise increase/contrast decrease?
- In the literature often the Gabor filters are applied in such situations, have you considered some other types of descriptors?
- The image dataset have variable resolution of the data (LFW 250x250 only), which can influence the performance in the case of coarse to fine search strategy. Have you perceived any impact?
- Have you considered the coarse to fine search apply on the landmark set only (cascade DPM), while preserving the image resolution?
- Figure 5.4 demonstrates the exemplary images with highest localization error. Are there any typical constellations which lead to the failure?

I recommend the thesis for the defense since the thesis fulfils conditions for the PhD work.

Doporučuji tuto disertační práci k obhajobě.



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