

A 3D geometric approach to face detection and facial expression recognition

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Abstract

Face detection and facial expression recognition are research areas with important application possibilities. Although the two problems are usually dealt with different approaches, we show in this paper how the same recognition process can be used to recognize both a generic “class-face” in a given, possibly complex image, and a specific facial expression.

The approach we propose is based on two steps. In the former we use *alignment* techniques in order to overlap the 3D representations of the main face components with the 2D image elements. In the latter we compare the candidate groups of localized components with a set of structural models, each of which representing a facial expression. Expression-independent face detection is achieved using the same approach with a model built generalizing over a set of face examples with different expressions.

Keywords : Face detection, facial expression recognition.

1. Motivations and goals

The rapidly growing interest in application fields such as automatic video surveillance, “intelligent” Human-Computer Interaction (HCI), automatic or semi-automatic video summarization/annotation, etc., has brought in the last ten years to an increasing effort of the Computer Vision and Pattern Recognition communities in studying face and face expression recognition problems for digital images.

The task of identifying the face of a given individual in an image is usually split in two main steps: the localization of candidate regions in the image in which likely there is a face (the *face detection* problem) and the comparison of such regions with a data base of known faces (*face recognition*). The former phase is necessary in order to select the patch of the image containing a face which is then used by the latter phase for identification issues. Moreover, face detection has other important motivations in itself. For instance, detecting human people in video sequences is usually performed by detecting faces (when visible) [11]. As observed by Yang et al. [22], face detection is a interesting challenge for Computer Vision because it well summarizes in a real domain all the main issues related to one of the most important and difficult problem of Computer Vision: *object recognition*. In fact, the “objects” of the face class have a great within-class variability, a face is a non-rigid object, there are segmentation problems related to the unknown position(s) of the (possibly