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A Uniform Approach for Face Segmentation and Coding with Adaptive Region Growing

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Nowadays, it is the goal in visual communication applications, such as in smartphones and in automated video conferencing, to send and store images of faces at a low bitrate, in such a way that the faces are still recognizable. Furthermore, it is essential that the representation is intelligent, so that it can be used for face analysis.

In this work we propose a novel technique to code and segment images of faces by 2-d polynomial surfaces. A face representation with polynomial surfaces is natural and offers a compact and reversible way to preserve the essence of the original face image. In order to have a complete coding, the contours are coded by 1-d polynomial functions. On this manner, we efficiently represent faces in a hundred bytes instead of a hundred kilobytes. Transmitting these face parameters over the network is very efficient, while preserving all the necessary details of the face. Furthermore, at receiver side, these parameters are useful for face analysis.

To segment the intensities of a face according to polynomial surfaces, we propose an intelligent segmentation algorithm, which is a region growing algorithm based on constructive polynomial fitting. This constructive fitting works with a so-called infinity fitting cost, which is preferred over least squares, because it has the advantages of suitability for region growing and capability for handling outliers. We also introduce adaptive thresholding for the constructive surface fitting, which allows a variable polynomial order and a variable segment thickness of the surfaces.

Compression with polynomial surfaces is compared with JPEG. For minor image quality requirements, we achieve higher compression ratios, while presenting faces more recognizable, demonstrated in the results by higher rates for face detection and face recognition.