

# Real-time Face Detection and Motion Analysis with Application in “Liveness” Assessment

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## Abstract

A robust face detection technique along with mouth localization, processing every frame in real-time (video-rate) is presented. Moreover, it is exploited for motion analysis on-site, to verify “liveness” as well as to achieve lip-reading of digits. A methodological novelty are the suggested quantized angle features (“quangles”), being designed for illumination invariance without the need for pre-processing, e.g. histogram equalization. This is achieved by using both the gradient direction and the double angle direction (the structure tensor angle), and by ignoring the magnitude of the gradient. Boosting techniques are applied in a quantized feature space. A major benefit is reduced processing time, i.e. that the training of effective cascaded classifiers is feasible in very short time, less than 1 hour for data sets of order  $10^4$ . Scale invariance is implemented through the use of an image scale-pyramid. We propose “liveness” verification barriers as applications, for which a significant amount of computations is avoided when estimating motion. Novel strategies to avert advanced spoofing attempts, e.g. replayed videos which include person utterances are demonstrated. We present favorable results on face detection for the YALE face test set and competitive results for the CMU-MIT frontal face test set, as well as on “liveness” verification barriers.

## Index Terms

Object detection, face detection, landmark detection, quantized angles, real-time processing, Optical Flow of Lines, liveness, anti-spoofing, lip reading, AdaBoost, SVM

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