## B8 Heart Beat Detection in Snuff Movies

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After attending this presentation, attendees will have an insight into the forensic possibilities for the determination of the presence and rate of a heart beat from video.

This presentation will impact the forensic science community by investigating snuff movies and determining if a heartbeat is measurable from the veins in the face with ordinary webcams or video to help determine if a person is dead or alive.

Experiments are conducted to obtain the heart rate from a movie for forensic use in, for example, snuff movies. The approach is based on the principle of photoplethysmography. This means that volumetric changes are measured with the aid of a light source. Here, the changes of interest are the volumetric changes of the blood vessels and the light source used is ambient light.

The heart rate obtained from a movie is compared with the heart rate measured with a finger pulse oximeter and the two methods are used for the comparison. The first method is the root mean squared error and the second is based on the, so-called, Bland-Altman statistics.

Results are obtained from movies of the facial area (recorded with a digital camera and a webcam), an arm (inside and outside, digital camera), a hand (inside and outside, digital camera), and a leg (outside, digital camera).

The maximum obtained root mean squared error is 2.69 beats per minute (hand inside) and the maximum Bland-Altman standard deviation is 2.44 beats per minute (hand inside). Therefore, it can be concluded that the heart rate determined from movies as well as the heart rate measured with the finger pulse oximeter do not differ significantly.

In the experiments that examine the facial area, a face tracker is used. The region of interest is a centered rectangle. The agreement, between video and finger pulse oximeter, might be further improved by using a different region of interest, e.g., the forehead or cheek area. No tracker is used in the experiments with the arm, hand, or leg. Introducing a tracker in these experiments will likely reduce errors caused by motion artifacts.

The parameters used to analyze the photoplethysmographic signal extracted from a movie are determined with a genetic algorithm. Changing the parameters from their optimal values has a great impact on the determined heart rate. This aspect seemed not present in the results reported by Poh of MIT.[1] It is assumed that the difference is caused by the presence of an additional light source. Extra experiments have been performed to validate this assumption.

Additional experiments showed that decreasing the resolution of the movie as well as compression of the movie both increase the root mean squared error and the Bland-Altman standard deviation.

In current implementation, the algorithm always selects a frequency in the range of interest (0.75-4.00 Hz). Therefore, the implementation needs to be modified in order to apply it to snuff movies. A possible approach is to examine the photoplethysmographic signal obtained from the video) for typical photoplethysmographic features. A good feature could be the standard deviation and a standard deviation lower than normal could indicate a subject without a pulse. Validation of the method is necessary before it is applied in casework.

**Reference:**

[1.] M.Z. Poh, D. J. McDuff and R.W. Picard, "Non-contact, automated cardiac pulse measurements using video imaging and blind source separation," Optics Express, vol. 18, no. 10, pp. 10762-10774, 2010.

**Heart Beat, Measurement, Video**

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