Welcome to the remote photoplethysmography (rPPG) wiki!

The rPPG github repository is created to improve rPPG algorithms that allow the extraction of average heart rate and the timing of heart pulses from skin surfaces as recorded with cameras that filmed people's faces and other body parts. The surface of the skin and the light it reflects tends to change rhythmically as a function of heart pulsations. Each heart pulsation widens the blood vessels, inducing texture changes (due to physical and color changes) at the skin’s surface. These changes are not detectable with the human eye but a digital camera (e.g., a webcam) is able to capture such small fluctuations in texture.

The extraction of the heart rate signal from the skin surface recorded with videos requires several image processing steps. The description and the implementation of these steps are published here (link follows soon). The current code includes these image processing steps. However, there are several remaining challenges that need to be solved by changing the current algorithm. Below you can find a list of future code requirements and invite you to help me to further develop the current algorithms. Please contact me if you would like to become a contributor to this rPPG project.

* Phase invariant pulse detection

Each recorded pixel or block of pixels may display a pulse signal pattern with a different phase as compared to other pixels. The current code averages the signals for each time point across all pixel, therewith filtering out the signal from pixels that are in counter phase (i.e., a pixel with peak pulsatility at a certain time point will be filtered away when another pixel has trough pulsatility at the same time point). An improved algorithm should either not average across all pixels or align the phases of all pixels before averaging.

* Noise filtering

The heart’s pulse signal as represented in the changes in pixel values of the recorded skin is typically noisy, especially when videos are recorded in either a dark environment and when the skin surface is placed at a large distance (i.e., consists of few video pixels). The algorithms that filter or “clean up” the signals to remove noise should be improved by applying new signal processing methods. One way to do this is by looking at pulse frequency changes within a 3D color space as a function of time.

* Body part tracking

When the object of interest moves, the pulse signal is distorted. The tracking of skin surface by following the movement of individual pixels (or blocks of pixels) from frame to frame is required to prevent motion distortion. An improved algorithm should be able to track objects (horizontal displacement, vertical displacement, and rotation) based on either skin color detection or other sophisticated object tracking methods (e.g., face detection). Setting parameters per video for accurate object detection (e.g., a certain range of colors to look for) may be required but it is preferred to develop an algorithm that is context invariant. This means that the algorithm should accurately detect heart rates independent of the skin color, body part, and image background without the requirement to specify certain parameters per recorded video.

* Physiologically impossible changes in HR

Sometimes the detected heart rate suddenly jumps to a higher heart rate due to noise. Such random and implausible changes to HR should be filtered from the HR traces as a function of time.