Paper Review in the field – State of the art

Iphys: Open source toolbox- Matlab

- Introduction
- Impact of video Parameters:
  - video compression (x.264, x265) has the majority impact. Frame rate and resolution has lower impact – Solution Super resolution
  - Multi Image performance is better
  - Distance depends on the camera sensor type
  - Light wavelength – Green most effective
- Covered methods: Using ROI
  - Green Channel: Filter based approach for green channel
  - ICA: DeTrended, z-transform, Normalized, ICA, FFT
  - CHROM: Combination of chrominance, Spacial average
  - POS: Plane orthogonal to the skin tone
  - BCG: Filter, PCAvi

Fusing Partial Camera Signals Pulse rate

- Face Detection and Segmentation
- Camera Signal Processing!!
- Signal Separation
- Filter
- Auto Regressive

Deep Super resolution to recover Physiological information from videos

- Preprocess video frame by super resolution techniques
  - Bilenear & Bicubic
  - Deep recurrent convolutional network (this paper applied)
- Extract HR from the frames
- Dataset: Recovering pulse rate with a multi-imager array Estepp et. al. 2014

DeepPhys: Convolutional Attention Networks (CAN)

- Outperforms all methods in RGB and infrared video dataset
- Visualization via attention mechanism
- DRM: Model for skin and image
  - $C_t = I(t).(v_s(t) + v_d(t) + v_n(t))$
  - Non linearity between $p(t)$ and C_t
- Approach
  - Model Representation input: $\frac{c_l(t+\Delta t) - c_l(t)}{c_l(t+\Delta t) + c_l(t)}$
  - CNN
- Datasets:
  - Estepp et al. Recovering PR during motion Artifact with multi imager array for non-contact IPPG, 2014
  - Chen et al. Eliminate info from video
  - MAHNOB-HCI https://mahnob-db.eu/hci-tagging/pages/supplementary/ (Request)
  - Chen et al. Non contact physio. From neck NIR video

Spectral Estimation Methods for iPPG

- Dataset: Estepp et. Al 2014

InPhysible: Camouflage against VB Physiological Measurement

- Proposed a glass based system to disrupt the Heart rate measurement.

Cardiolens: Physiological monitoring in mixed environment

- System to measure PPG using glass

DeepMag: Source specific Motion Magnification using GD

Supervised Learning approach to remote HR estimation from Facial Videos

- Datasets: Own data collection (Rana et al.)
- Method
  - Feature extraction
  - Signal sync: Red and green channel
  - Feature Representation
  - SVM

SparsePPG: Drivers monitoring using NIR

- Dataset: RGB and NIR (collected own)
- Method
  - Signal Modeling - Sparse PPG
  - RPCA denoise
  - Spectral estimation
  - Fusion of time window
  - Facial tracking

HR extraction based on NIR: Driver state monitoring

- Dataset: Own collected
- Method
  - Face tracking KLT
  - EMD and FFT
- Multiple people option

Infrared based video HR

- Dataset: Own collected
- Method:
  - Feature Extration KTL
  - Channel separation, normalization, Detrending
  - EMD, FFT

NonContact Monitoring of RR in Newborn using IR

- Dataset: 12 subject and study of infant
- Method
  - ROI channel
  - Filtering
  - SQI
  - Information Fusion

Waveform analysis for camera based PPG

- Own dataset collection
- processing
- Information about the PPG data

Monitoring cardiorespiratory signals using Thermal imaging: Pilot study

- Data: Frontal view and side view, own collected dataset, 20 subjects
- Vertical head movement to measure RR
  - Cold air from nose in and hot air out.
- HR estimation
  - Image preprocess, region selection, Shi-Tomasi corner detection, Temporal filter, PCA

Local Group invariance for HR estimation from Face video in wild

- **Public data** available: (https://github.com/partofthestars/LGI-PPGI-DB) Heusch et. al. And Bobbia et. al.
- Feature invariance under motion
- Mathematical modeling
- Methodology

Non-Contact Remote measurement of the HRV using NIR

- Multiple camera sensors

Diffusion Process for HR estimation from face videos under realistic Conditions

- Problem formulation
- Feature representation under varying pixel intensity

Estimation of RR from thermal videos of preterm infants

- Methodology
  - Region tracking
  - Signal Processing
    - Mean temporal value
    - Adaptive window autocorrelation
    - Adaptive window avg magnitude diff func
    - Adaptive maximum amplitudes pairs

Multisensor data fusion for enhanced RR estimation in thermal videos

- Methodology
  - ROI detection
  - Tracking
  - Breathing waveform
  - SQI
  - Signal fusion

A ppg Smartphone based Method for HRV assessment: Device model and breathing influences

- SPPG: 23 persons : No more description

Non-Contact IR camera based respiratory rhythm measurement while driving

- Infrared frame
- Depth point-cloud
- normalization
- opportunistic piece selection

Comparison of video based methods for respiratory rhythm measurement

- 21 subjects
- RGB videos
- Depth point cloud
- thermal video
- Signal processing

VitaMon: Measuring HRV using smartphone front camera

- Datatset: 30 participants
- Low resolution
  - Multiple ppg reading from different face portion to overcome low resolution
- Methodology
  - CNN to learn correlation between ECG and recontruct
  - Multiple facial region
  - Two-phase ML

Single-Element Remote-PPG

- SoftSig (soft signature based extraction)

- Methodology
  - Projection
  - Selection Step
  - Dataset: own dataset

Analysis of CNN-based remote-PPG to understand limitation and sensitivities.

- HNU and PURE pulse rate detection dataset.
- PPG extraction
  - Input preprocessing normalization difference
  - CNN network
  - Post processing

Attacks on Heartbeat-Based security using Remote photoplethysmography

- Heartbeat based security

Illumination Robust HR extraction from single-wavelength IR camera using spatial channel expansion.

- Dataset: Own collected
- Methodology
  - Sub-window
  - Decomposition
  - Component selection

IR thermography-based monitoring of respiratory phase without image segmentation.

- Pixel time series to avoid nose tracking

Discriminative signature for remote-PPG

- PPG strength lower in NIR spectrum
- Discriminative signature based extraction (DIS) in NIR

NN based luminance variation resistant remote PPG for driver HR monitoring

- Facial motion and luminance concerns
- Personalized ANN
- HCI driver dataset

Remote PPG enhancement with ML methods

- Convolutional auto encoder and Multi-channel CAE
- PCA-SS

Motion resistant IPPG based on Spectral peak tracking algorithm

- MRSPT
- Multi-channel spectral matrix decomposition
- Dominant Motion Signal
- Kalman filter and verification

Remote PPG with constrained ICA using periodicity and Chrominance Constraints

- cICAt
- Dataset:
  - UBFC-RPPG (This Paper) https://sites.google.com/view/ybenezeth/ubfcrppg
  - MMSE-HR (Public database) http://www.cs.binghamton.edu/~lijun/Research/3DFE/3DFE_Analysis.html

VIPL-HR: A multi-modal database for pulse estimation from less-constrained face video

- Database: http://vipl.ict.ac.cn/database.php
  - MAHNOB
  - MMSE-HR
  - PURE (https://www.tu-ilmenau.de/en/neurob/data-sets-code/pulse/) - request
  - PFF
  - OBF

Self-adaptive matrix completion for HR Estimation from face videos under realistic conditions

- Dynamically select face regions
- Chrominance Features
  - $C = X_f - \alpha Y_f$
  - $\alpha = SD(X_f)/SD(Y_f)$
  - X_f and Y_f are filtered signal of X and Y
  - $X = 3R_n - 2G_n$, $Y = 1.5R_n + G_n - 1.5B_n$; (normalized version of R, G, B)
- Self-adaptive Matrix Completion

New insights into the origin fo rPPG signals in visible light and infrared

- mathematical modeling

Noldus information technology Research

- Skin Reflection model – Wang et al. Algo. Principle of remote PPG
- Facereader

Remote Detection of PPG systolic and diastolic Peaks using a Digital camera

- Face ROI
- Color channel
- ICA
- Source signal separated and rescaled

HR estimation using remote PPG with multi-objective optimization

- Semi blind source extraction method – Optimizing method
- Face ROI and Spatial avg
- Pulse and feature extraction
- MAICA (Multi-objective Opt. With Autocorrelation as a periodicity measurement and ICA)

Exploring the usage of time-of-flight cameras for contact and remote PPG

- ToF camera type – Pico Flexx ToF
- Own Data!!

RPPG using nonlinear mode decomposition

- PURE dataset
- NonLinear Mode Decomposition

Non-Contact PPG and Instantaneous HR estimation from infrared face video

- Principle signal extraction method
- Code: https://github. com/natalialmg/IR_iHR

3D CNN for remote pulse HR measurement and mapping from facial video

- COHFACE Dataset: https://www.idiap.ch/dataset/cohface/download-proc
- 3D CNN

Might check later

- https://www.jimmynewland.com/wp/

A novel framework for rPPG pulse extraction on compressed videos

- Benchmark dataset – own!
- Video compression artifacts
  - Amplitude deterioration
  - High-freq. Noise
  - trace discontinuity
- Methodology
  - Singular spectrum analysis (SSA)
  - Reconstruction component (RC)

A comparative Survey of Methods for remote HR detection from frontal face videos

- MAHNOB-HCI dataset
- Survey paper

Algorithmic principles of remote PPG

- Own dataset of 60 people
- Comparison between existing methods
- rPPG model: Specular and Diffuse reflection: [rPPG methods extract the diffuse reflection from the input video]

Amplitude selective filtering for remote PPG

- Own dataset
- R channel AS and band pass filter

Remote HR measurement from highly compressed facial videos: An End-to-end Deep learning solution with video enhancement. (https://arxiv.org/pdf/1907.11921v1.pdf**)**

- Two stage – Enhancement and Attenuation network
- STVEN and rPPGNet

RhythmNet: End-to-end HR estimation from face via spatio-temporal representation

- VIPL-HR databases.

Non-contact heart rate monitoring by combining convolutional neural network skin detection and remote photoplethysmography via a low-cost camera

- CNN to get skin (ROI),
- then rppg methods (ICA or PCA)

Vision-Based Heart Rate Estimation Via A Two-Stream CNN

- COHFACE databaset

Real-time rPPG monitoring

A Real-Time Contactless Pulse Rate and Motion Status Monitoring System Based on Complexion Tracking

- NIR camera on FPGA
- Transfer to mobile for processing
- BPM detection.
- Motion/skin detection

Remote heart rate monitoring - Assessment of the Facereader rPPg by Noldus

- Facereader app
- BPM only

Optimizing Remote Photoplethysmography Using Adaptive Skin Segmentation for Real-Time Heart Rate Monitoring

- Proper ROI selection

Remote heart rate measurement using low-cost RGB face video: a technical literature review

- A review itself.

HeartTrack: Convolutional neural network for remote video-based heart rate monitoring

- Synthetic dataset
- CNN based 3D architecture

Github Links: Dataset, Database, Code

- Dataset: https://github.com/partofthestars/LGI-PPGI-DB
- Code: https://github.com/pi-null-mezon/vpglib
- https://github.com/partofthestars/PPGI-Toolbox
- https://github.com/ymonno/RemotePPG
- https://github.com/habom2310/Heart-rate-measurement-using-camera
- https://github.com/danmcduff/iphys-toolbox
- https://github.com/vladostan/Dataset-for-video-based-pulse-detection
- Dataset: ftp://ftp.merl.com/pub/tmarks/MR_NIRP_dataset/

IR Fever Detection:

http://www.infrared.avio.co.jp/en/products/ir-thermo/lineup/tvs200is_tvs500is/index.html
https://www.photonics.com/Articles/Demand_for_FLIR_Temperature_Screening_Devices/a65632
https://satir.com/application/thermal-imaging-and-fever-detection
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0203302
https://iopscience.iop.org/book/978-0-7503-1143-4/chapter/bk978-0-7503-1143-4ch5
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https://www.optotherm.com/ts-advantages.htm
https://www.hikvision.com/en/products/Thermal-Products/Thermography-thermal-cameras/fever-screening-series/
https://athena-security.com/