1. Introduction

Goal: Remote vital signs estimation to improve driver safety

Challenges for Remote Photoplethysmogram (rPPG*) in the car:
* rPPG = Subtle intensity variations in skin appearance due to blood flow
  - Outside illumination variations
  - Head and car motion
  - Low SNR, especially in near-infrared (NIR)

Contributions
- Study feasibility of camera-based rPPG in the car + released dataset
- Narrow-beam 940 nm to reduce outside light variations
- SparsePPG algorithm using low-rankness across facial regions and sparsity in frequency of rPPG signals

2. Lighting Variations
- Narrow-band NIR illumination reduces light variations, and needed at night.
- Sunlight effects are reduced at 940 nm due to atmospheric moisture.
- Strength of rPPG signals is reduced in NIR and in narrow-band light.

Sunlight at earth’s surface

Lower SNR of rPPG in NIR

3. SparsePPG Algorithm

A. Recovering low-rank signal
- Each facial region contains the same cardiac signal (plus noise) → model rPPG signals as low rank across facial regions

B. Sparse spectrum estimation
- rPPG signals are quasiperiodic → should be sparse in frequency
- We pose this as an optimization problem with mixed L2,1 norms constraints:

\[ Z = Y + E \]

4. Datasets

Controlled indoor light dataset
- 9 subjects with varying skin tones, facial hair
- Varying indoor illumination dataset (2 subjects)
- Oscillated overhead lights to simulate lighting variations while driving

5. Results

Heart Rate error measures

Controlled indoor light dataset

Varying indoor illumination dataset

6. References


