

Augmentation of rPPG Benchmark Datasets: Learning to Remove and Embed rPPG Signals via Double Cycle Consistent Learning from Unpaired Facial Videos

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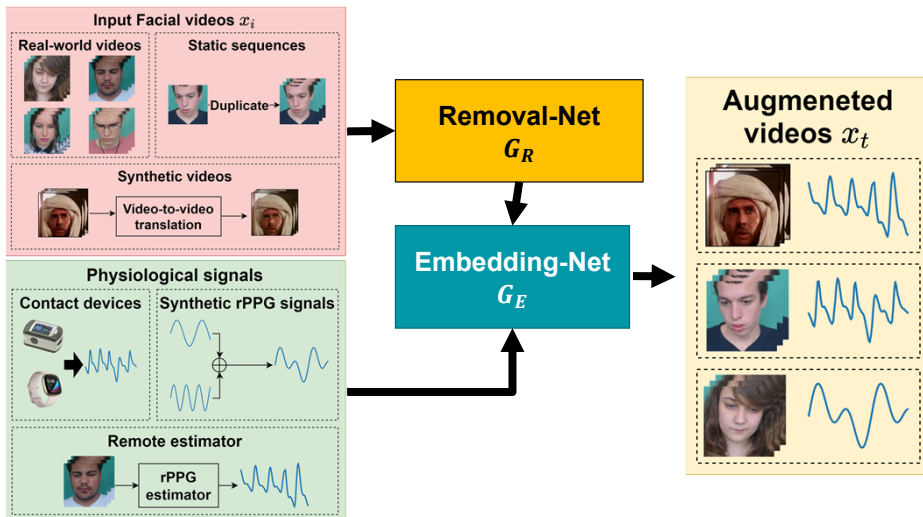
Remote Photoplethysmography (rPPG) Estimation

Robust rPPG estimation

- Lack of large-scale rPPG benchmark

Goal

- Learning to augment rPPG datasets
 - Erasing rPPG signals of the input videos
 - Embedding PPG signals into the resultant videos



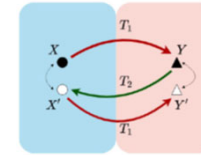
RErPPG-Net: Removal-Net + Embedding-Net

Issue

- Model learning from unpaired videos

Proposed idea

- Double-cycle consistent learning

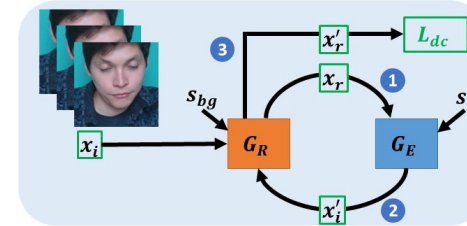


Single cycle consistent: $X \leftrightarrow X'$



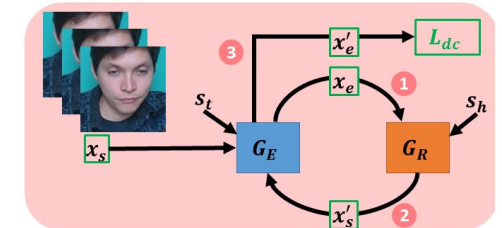
Double cycle consistent: $(X \leftrightarrow X') \wedge (Y \leftrightarrow Y')$

- Learning to Embed: G_E



$$L_{dc}^{embed} = \|x_i - x'_i\|_2 + \|x_r - x'_r\|_2$$

- Learning to Remove: G_R



$$L_{dc}^{remove} = \|x_s - x'_s\|_2 + \|x_e - x'_e\|_2$$

$$L_{total} = L_{rPPG} + \lambda_1 L_{dc} + \lambda_2 L_{perception}$$

Experiments

Datasets

- UBFC-rPPG: 42 subjects
- PURE: 10 subjects x 6 motions
- VIPL-HR: 107 subjects x 9 scenarios x 3 devices

Augmented dataset

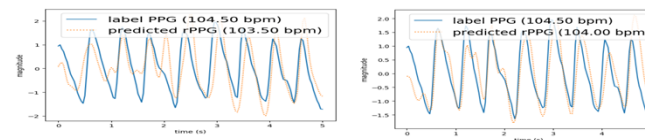
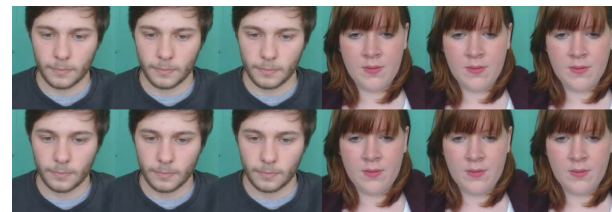
- Aug-rPPG: 5776 videos

Cross-Dataset Testing

Training	Testing	MAE↓	RMSE↓	R↑
UBFC	PURE	14.18	20.20	0.34
UBFC+Aug-U	PURE	4.36	6.69	0.60
PURE	UBFC	3.78	6.69	0.71
PURE+Aug-P	UBFC	2.23	4.66	0.78
UBFC+PURE	VIPL-HR	20.78	21.60	0.64
UBFC+PURE+Aug-rPPG	VIPL-HR	16.93	16.95	0.67

Input

PPG
Embedded



Input Video

Single Cycle
Reconstructed

Double Cycle
Reconstructed

