

Non-Contrastive Unsupervised Learning of Physiological Signals From Video

Highlight Paper

WED-PM-202

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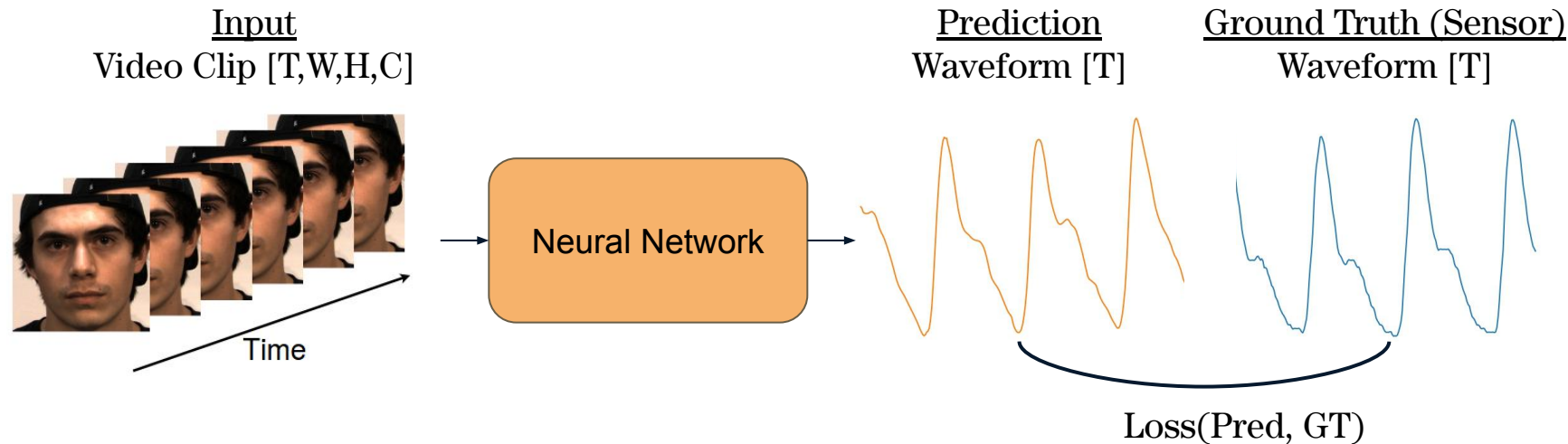


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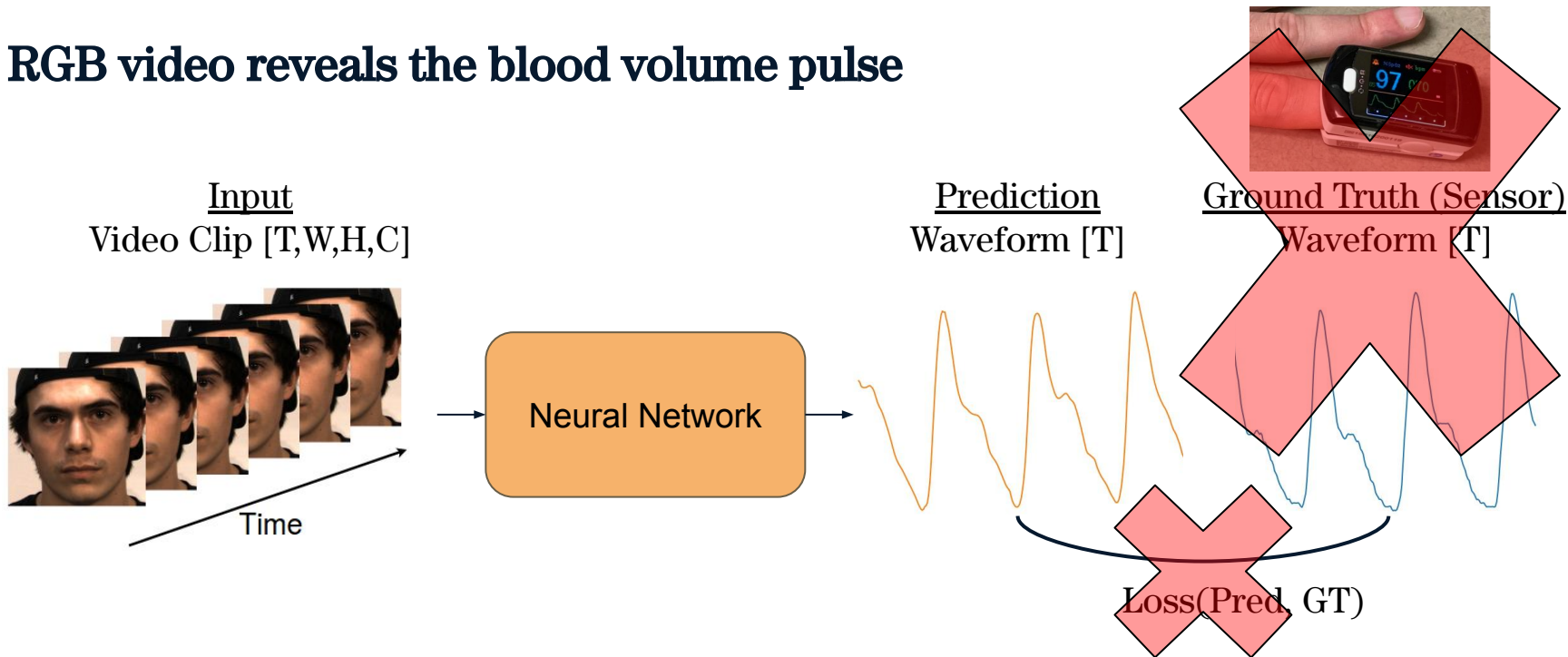
Overview

RGB video reveals the blood volume pulse



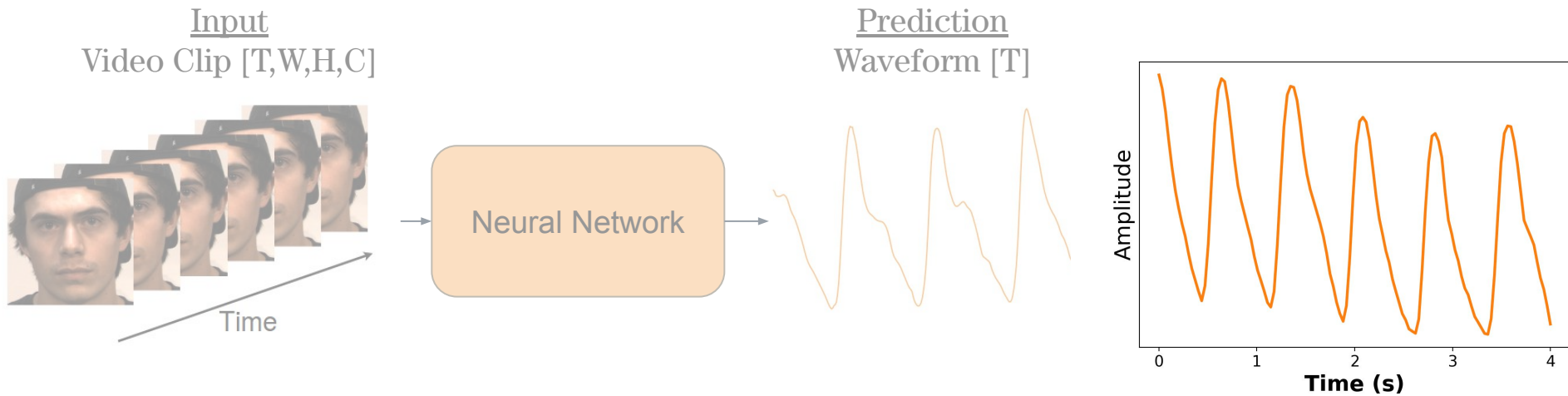
Overview

RGB video reveals the blood volume pulse



Collecting ground truth is challenging!

Overview



The pulse has a **sparse** frequency domain (periodic) with energy in a known **bandwidth (40-180 bpm)**.

Our non-contrastive method (SiNC) successfully trains models without ground truth!

Why Camera-Based Vitals?

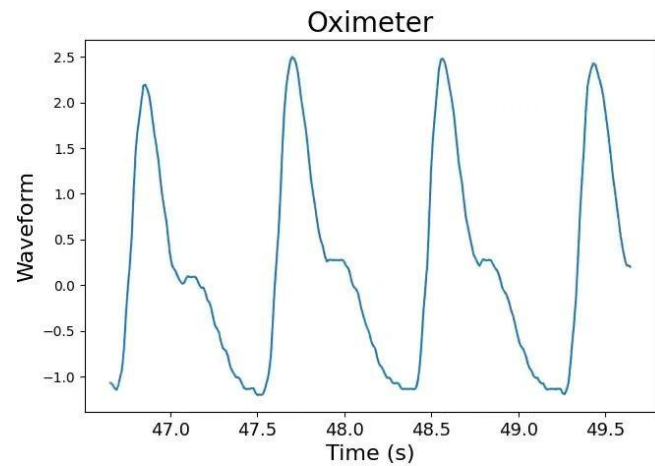
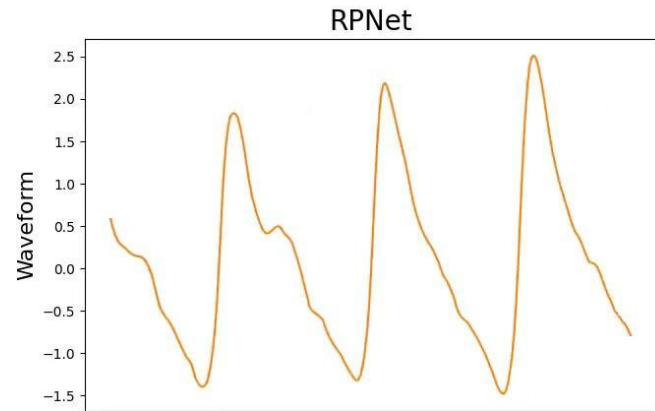


Contact Devices

- Expensive
- Specialized
- Uncomfortable
- Infrequent

Cameras

- Cheap
- Ubiquitous
- Multiple Vitals



Supervised Learning for rPPG

How: Regress waveforms from PPG

- Predict a real value for each frame

Challenge: Simultaneous video + PPG

- Data limited to lab

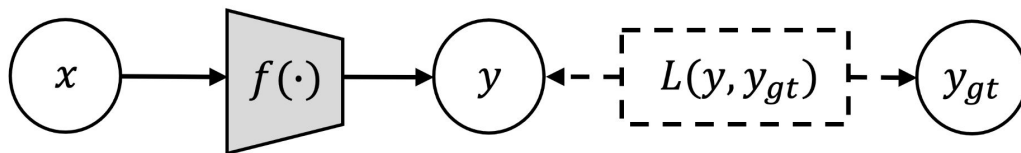
Solution: Unsupervised learning



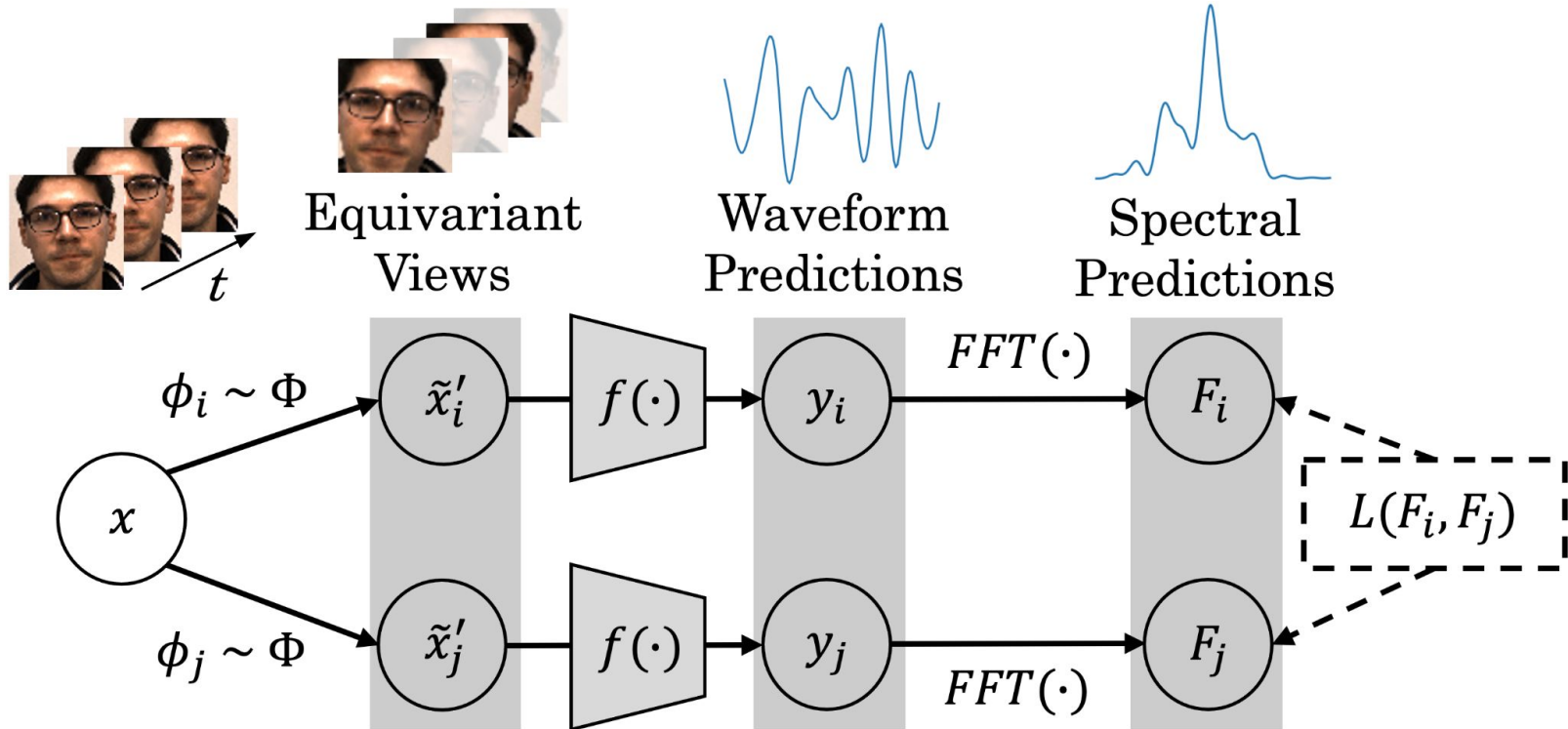
Waveform Prediction



Waveform Ground-Truth



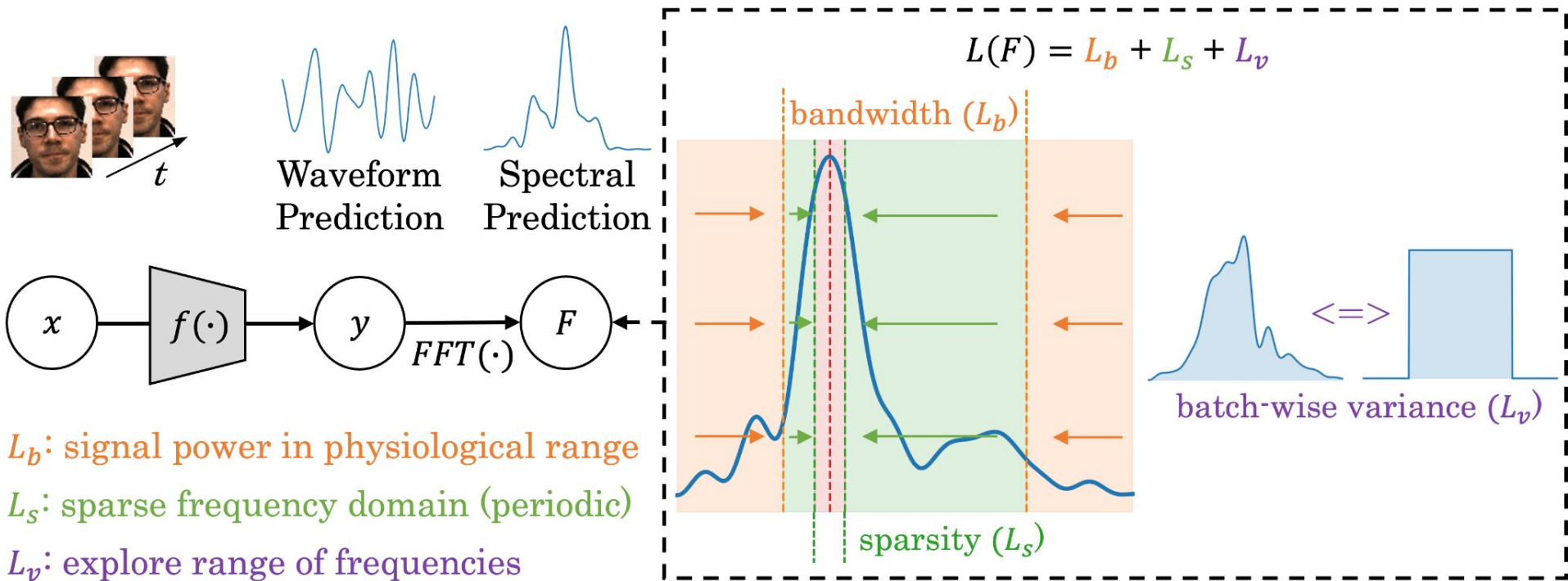
Contrastive Unsupervised Learning

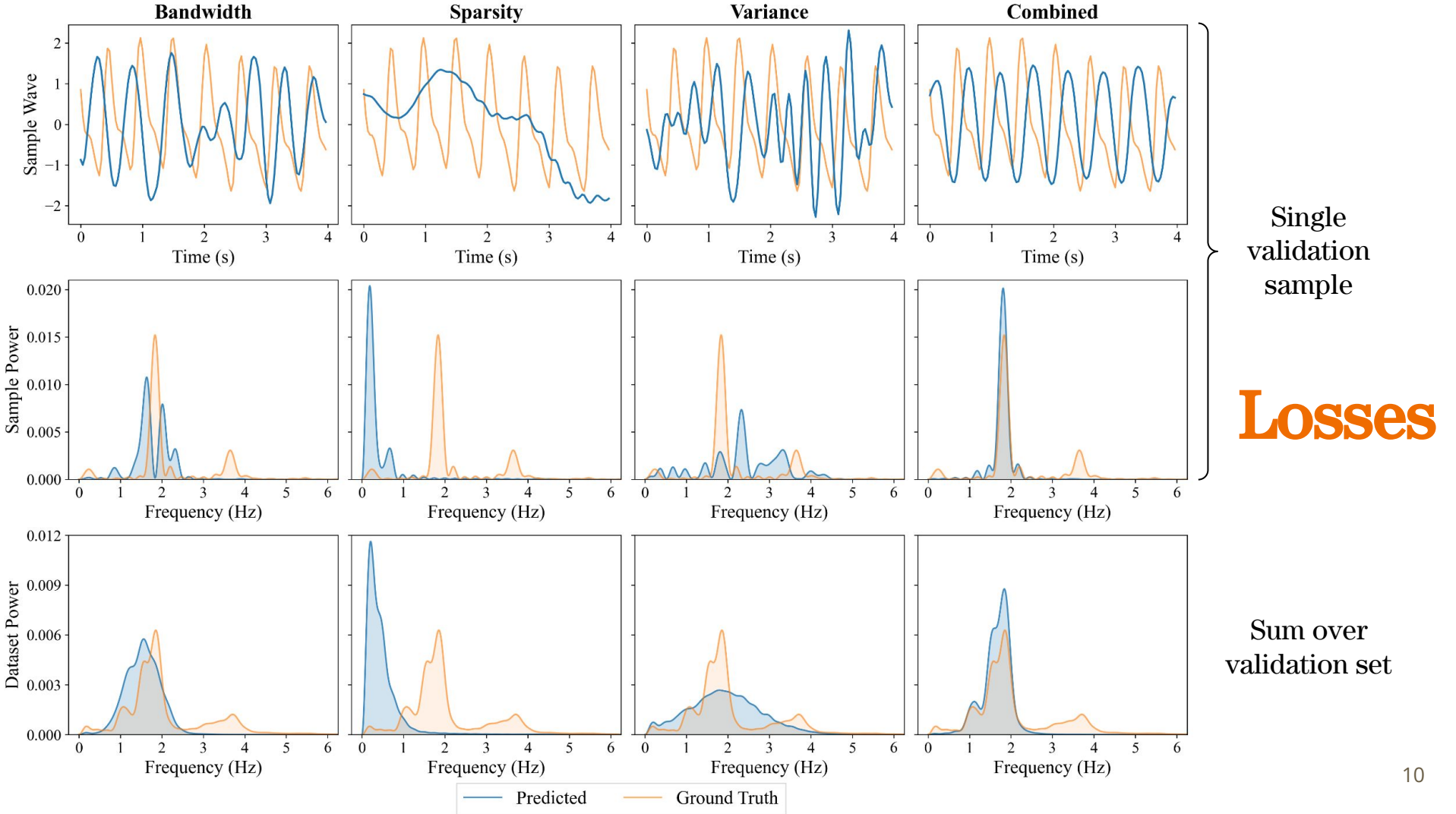


- Attract similar pairs
- Repel dissimilar pairs

SiNC: Signal estimation via Non-Contrastive Learning

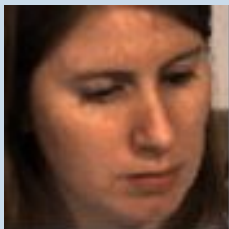
Idea: The pulse has a **sparse** frequency domain (periodic) with energy in a known **bandwidth (40-180 bpm)**.





Datasets

rPPG Datasets



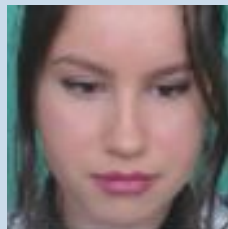
DDPM

- High heart rates
- 86 subjects
- Strong movement
- Challenging



PURE

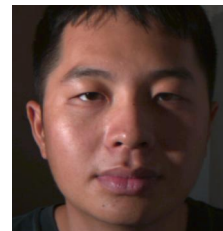
- Low heart rates
- 10 subjects
- Controlled movement



UBFC-rPPG

- High heart rates
- 43 subjects
- Minor movement

Non-rPPG Data

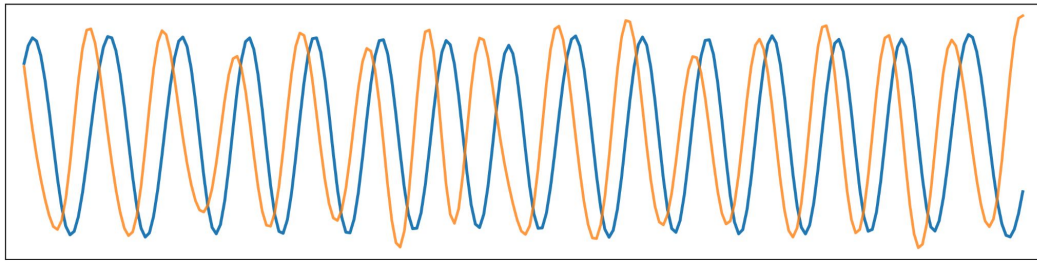


HKBU-MARs

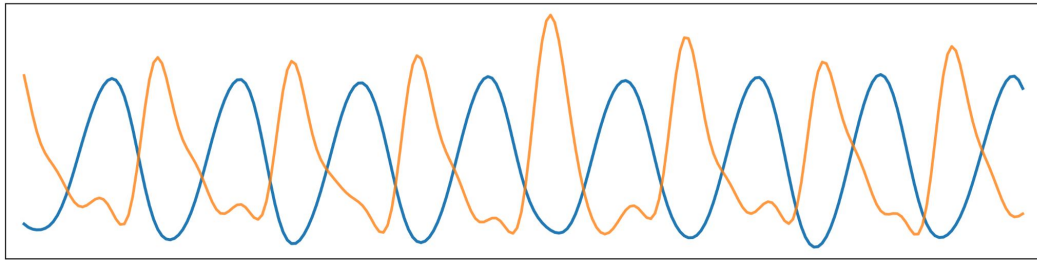
- Meant for face PAD
- **No ground truth**
- 7 cameras
- 6 lighting conditions

Results

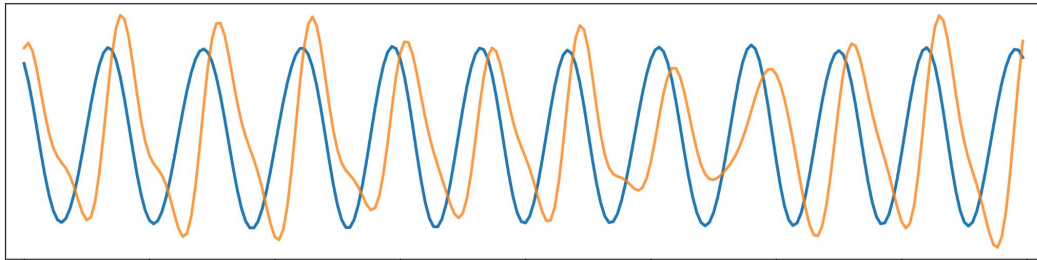
UBFC-rPPG



PURE



DDPM



Time (s)



- <1 bpm MAE on UBFC and PURE!
- Competes with supervised methods
- Removes dicrotic notch
- Learns own phase

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<https://github.com/CVRL/SiNC-rPPG>

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