

# Comparing inter beat and inter pulse intervals from ECG and PPG signals

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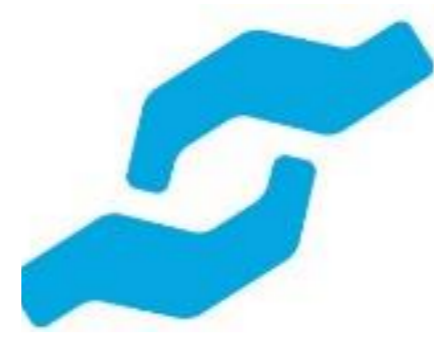
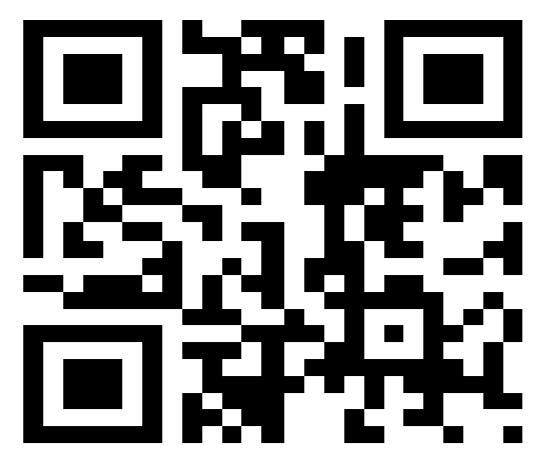
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# COMPARING INTER BEAT AND INTER PULSE INTERVALS FROM ECG AND PPG SIGNALS

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## Introduction

Heart rate (HR) monitoring is crucial in several clinical fields. The gold standard technique for measuring HR dynamics is electrocardiography (ECG). However, photoplethysmography (PPG) is becoming a reliable alternative to ECG for long-term monitoring, because of its unobtrusiveness. Studies have shown that cardiac features, such as HR variability, can be accurately calculated both from ECG and wrist-worn PPG measurements [1], [2]. However, the correspondence of beat-to-beat intervals (RR) from ECG and PPG pulse-to-pulse intervals (PP) has not been widely studied, especially during sleep where lower number of body movement artifacts are present.

Our research investigates the correspondence between RR and PP for three landmarks on the PPG waveform.

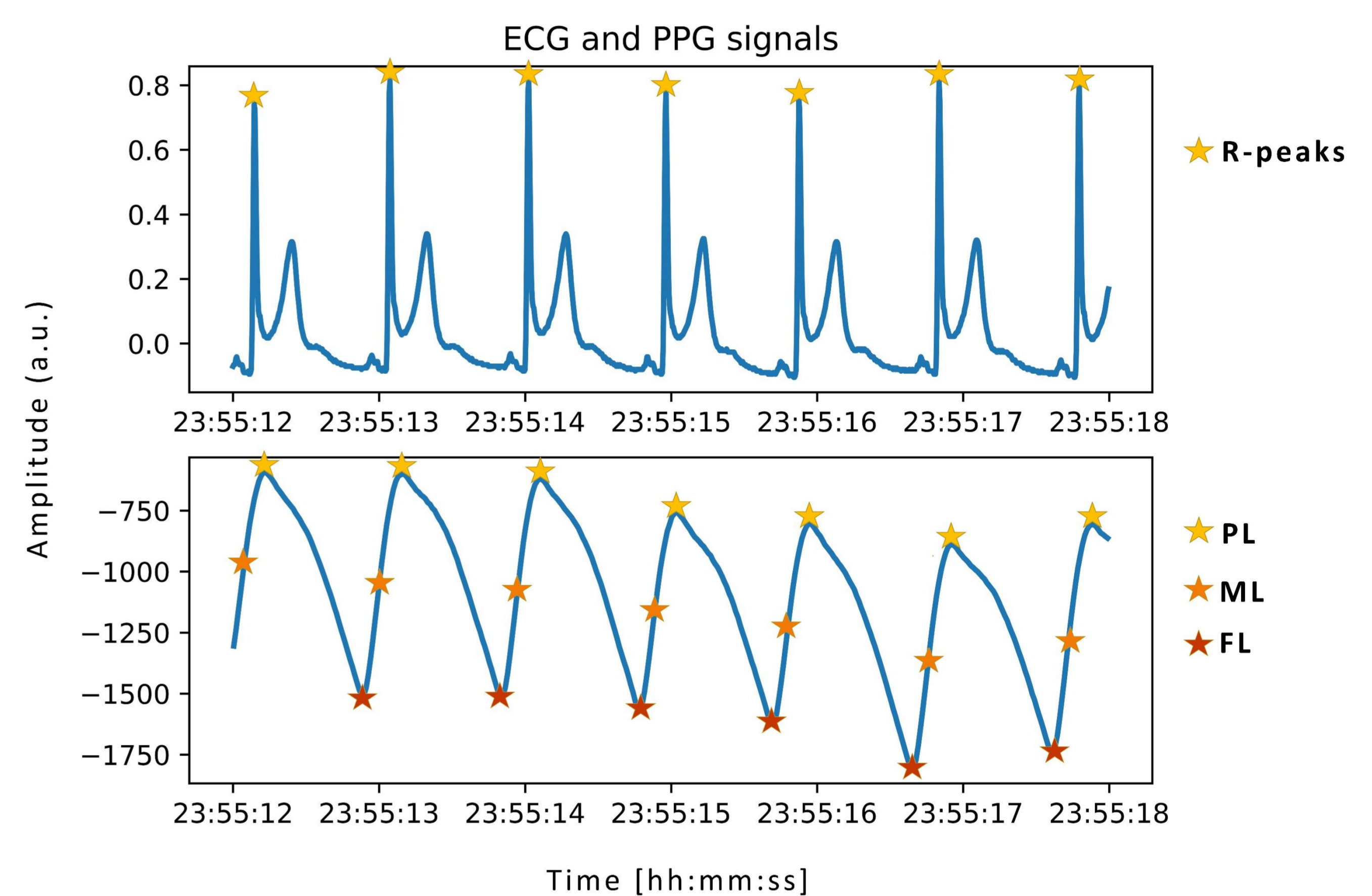
## Methods

### Data

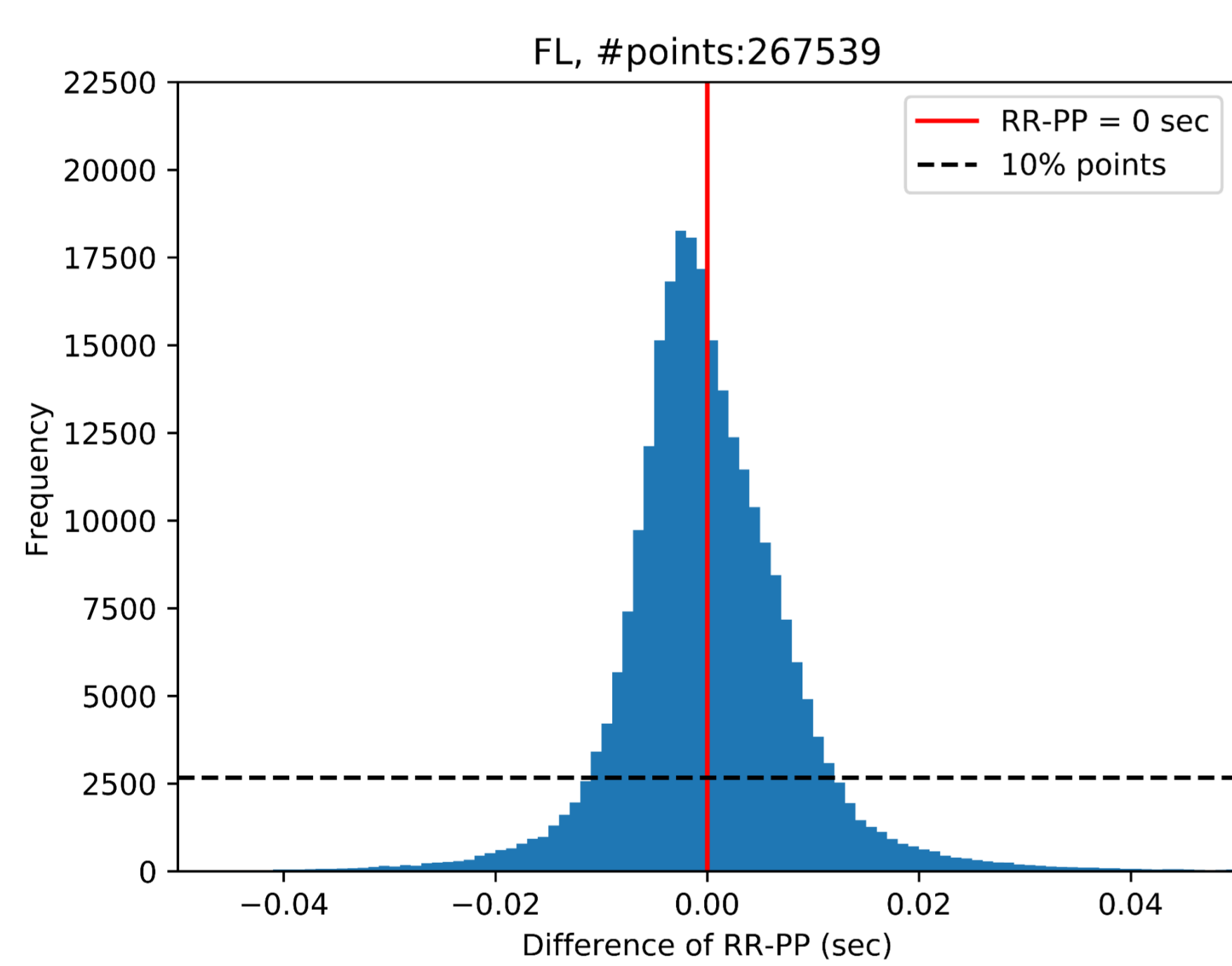
10 overnight sleep recording of 6 healthy subjects (age:  $50.5 \pm 8.46$  y, 2 males) using ambulatory PSG for lead II ECG recordings and wrist-worn PPG sensor

### Analysis

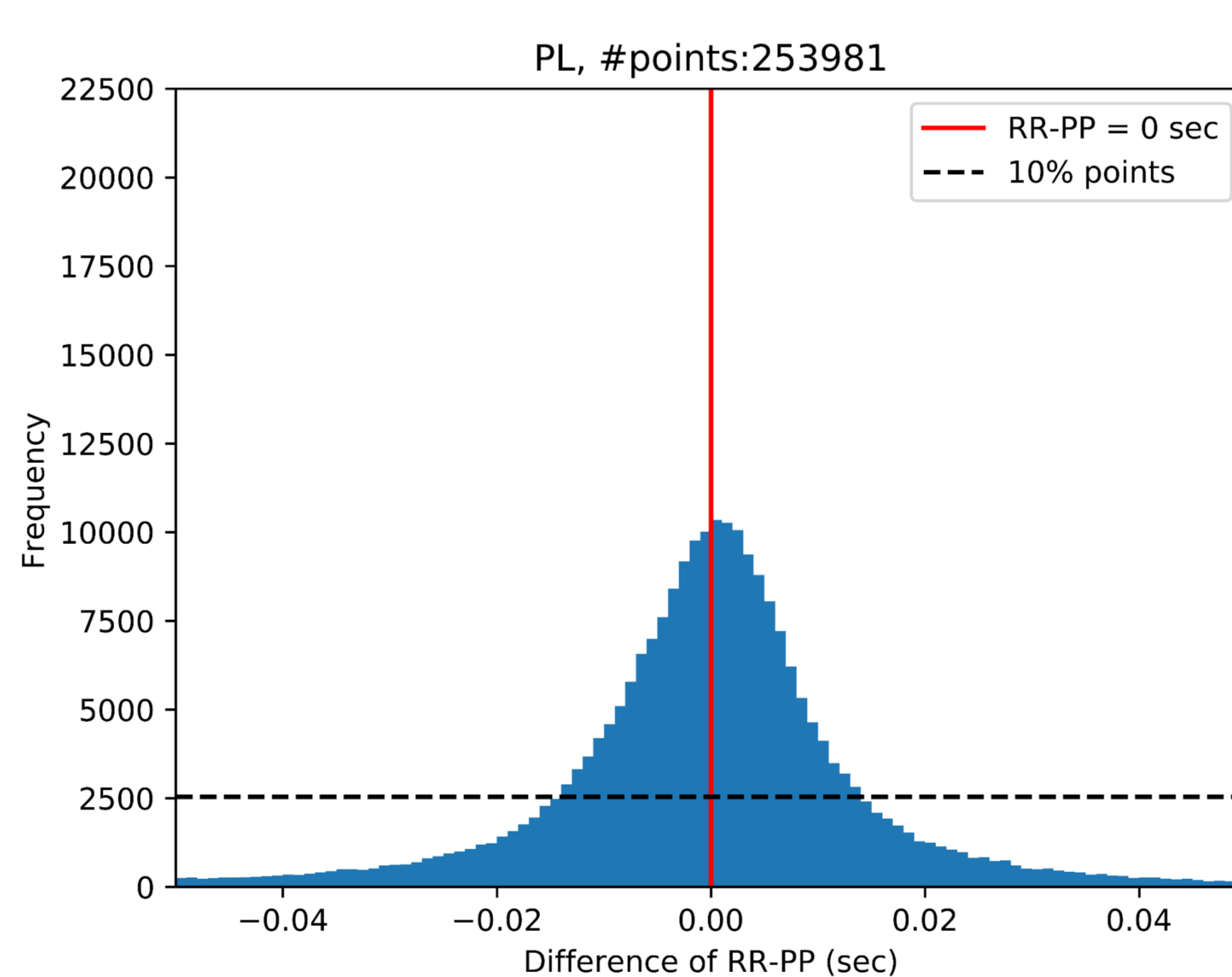
- ECG and PPG synchronization (time and frequency offset)
- R-peaks detection
- Pulse-landmarks (foot (FL), peak (PL), maximum gradient of the rising slope (ML)) detection
- R-peaks and pulse-landmarks considered a match when detected within a 125ms window in order to account for pulse transmit time (PTT) changes
- Comparison of the distributions of the RR-PP differences



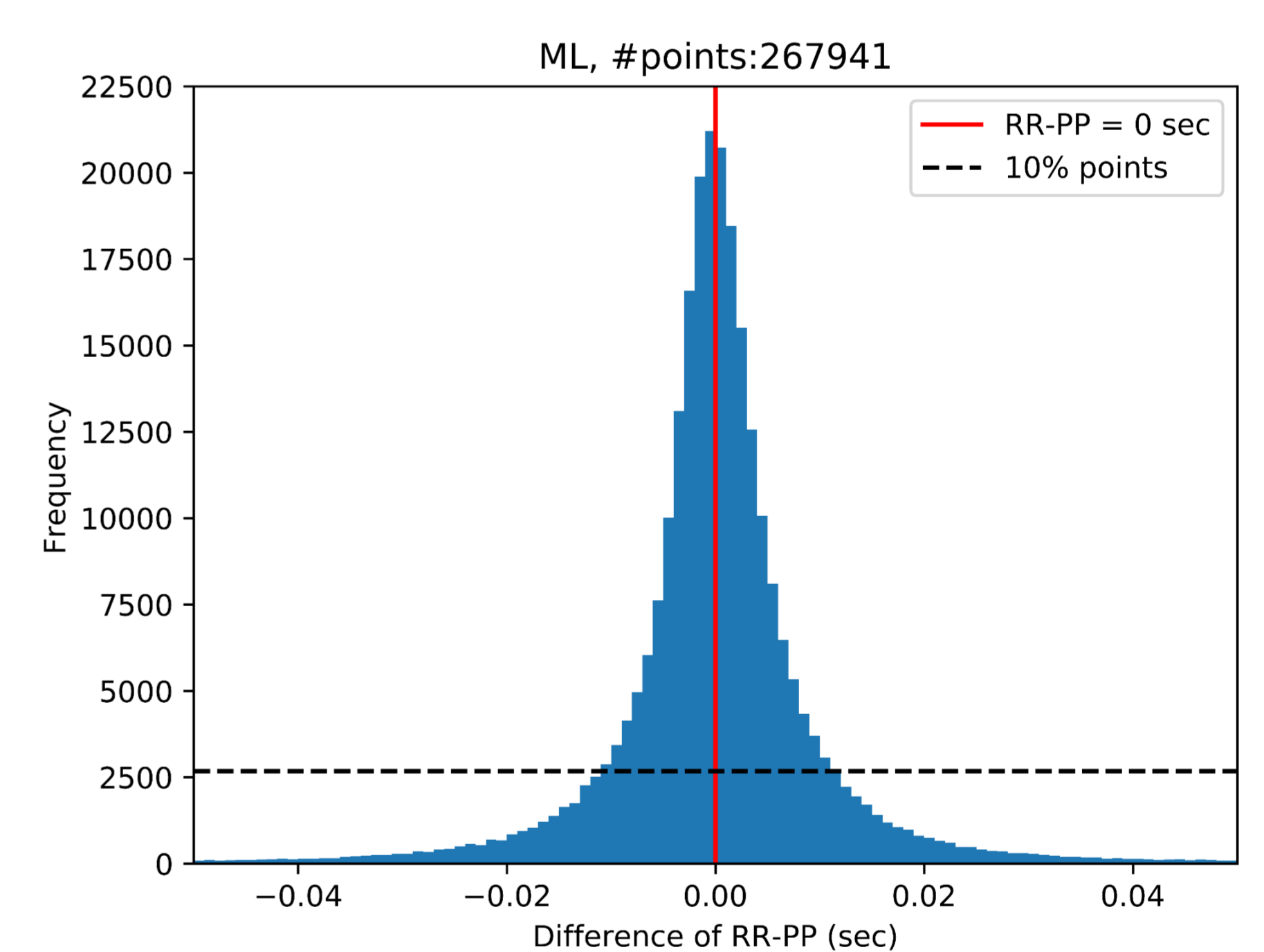
## Results



mean  $\pm$  sd:  $0.3 \pm 19$  ms  
skewness: 0.048



mean  $\pm$  sd:  $1.8 \pm 39$  ms  
skewness: -0.046



mean  $\pm$  sd:  $0.3 \pm 18$  ms  
skewness: -0.014

## Conclusion

Maximum gradient of the rising slope landmarks deliver the lowest average difference to R-peaks, and the lowest trigger jitter and skewness

## References

- [1] A. Schäfer and J. Vagedes, "How accurate is pulse rate variability as an estimate of heart rate variability?: A review on studies comparing photoplethysmographic technology with an electrocardiogram," *Int. J. Cardiol.*, vol. 166, no. 1, pp. 15–29, 2013.
- [2] J. van An del, C. Ungureanu, R. Aarts, F. Leijten, and J. Arends, "Using photoplethysmography in heart rate monitoring of patients with epilepsy," *Epilepsy Behav.*, vol. 45, pp. 142–145, 2015.