THE PHYSICS OF PHOTOPLETHYSMOGRAPHY: FROM OPTICAL PRINCIPLES TO SIGNAL ANALYSIS

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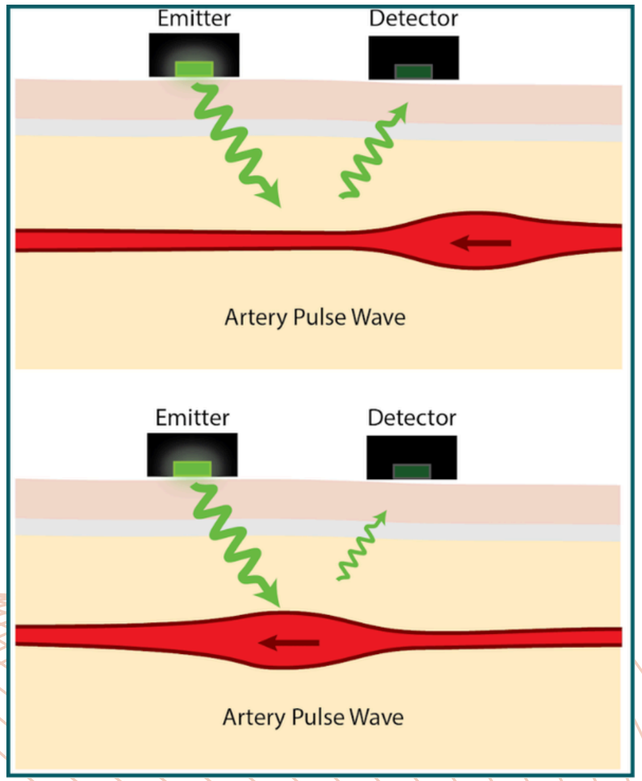
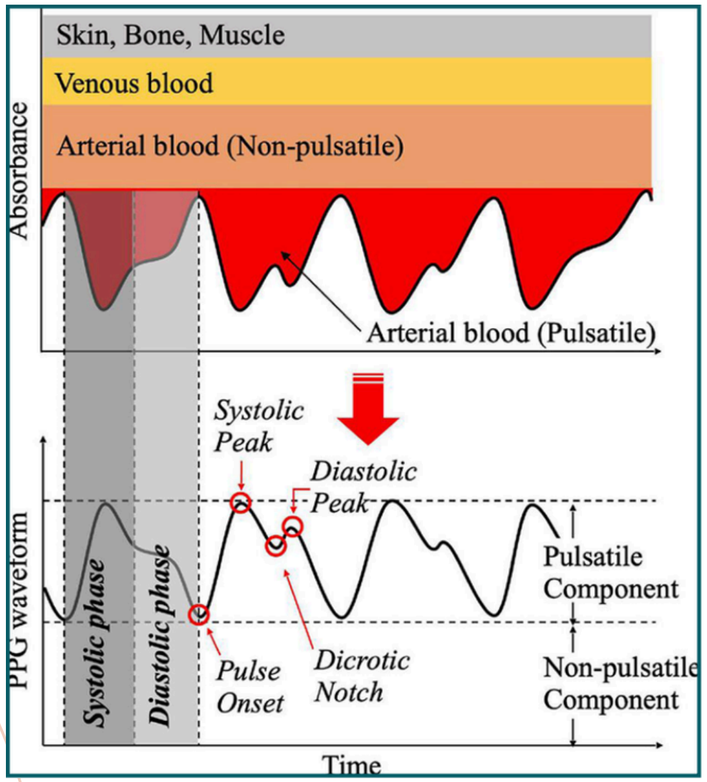
PHOTOPLETHYSMOGRAPHY (PPG)

AN OPTICAL METHOD OF MONITORING BLOOD VOLUME CHANGES IN TISSURE





WHAT IS ASSOCIATED WITH INACCURATE HEART-RATE ESTIMATION FROM WRIST PPG?

PULSE VARIABILITY

DOES VARIABILITY IN DETECTED INTERVALS CORRESPOND TO ESTIMATION ERROR?

WRIST MOTION

IS MOVEMENT ASSOCIATED WITH REDUCED MEASUREMENT ACCURACY?

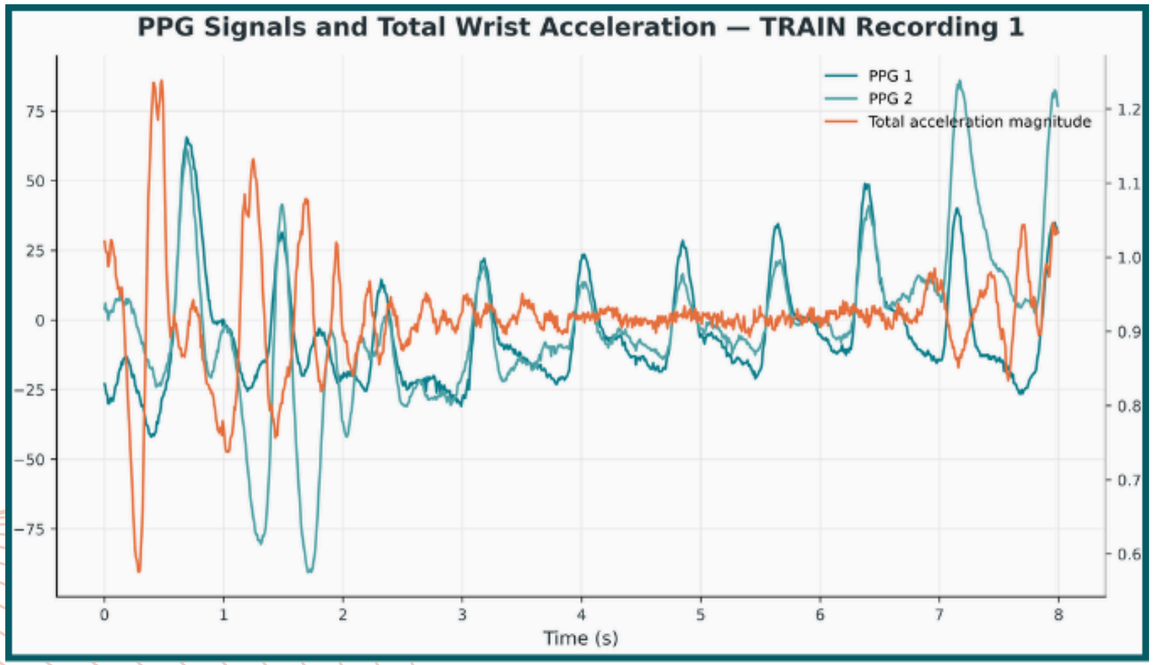
WHAT WE INVESTIGATED?

3096
RECORDINGS

125 HZ
SAMPLING FREQ.

8 SECS
RECORDING LENGTH

IEEEPPG DATASET | 5 CHANNELS
1768 TRAIN | 1328 TEST



HOW WE INVESTIGATED?

PPG FILTERING → PEAK DETECTION

PULSE PEAKS → IBI→ COEFFICIENT OF VARIATION

WELCH PSD →
HR ESTIMATE

ACCELEROMETER
→ MOTION LEVEL

ABSOLUTE HR ERROR → SPEARMAN CORRELATION

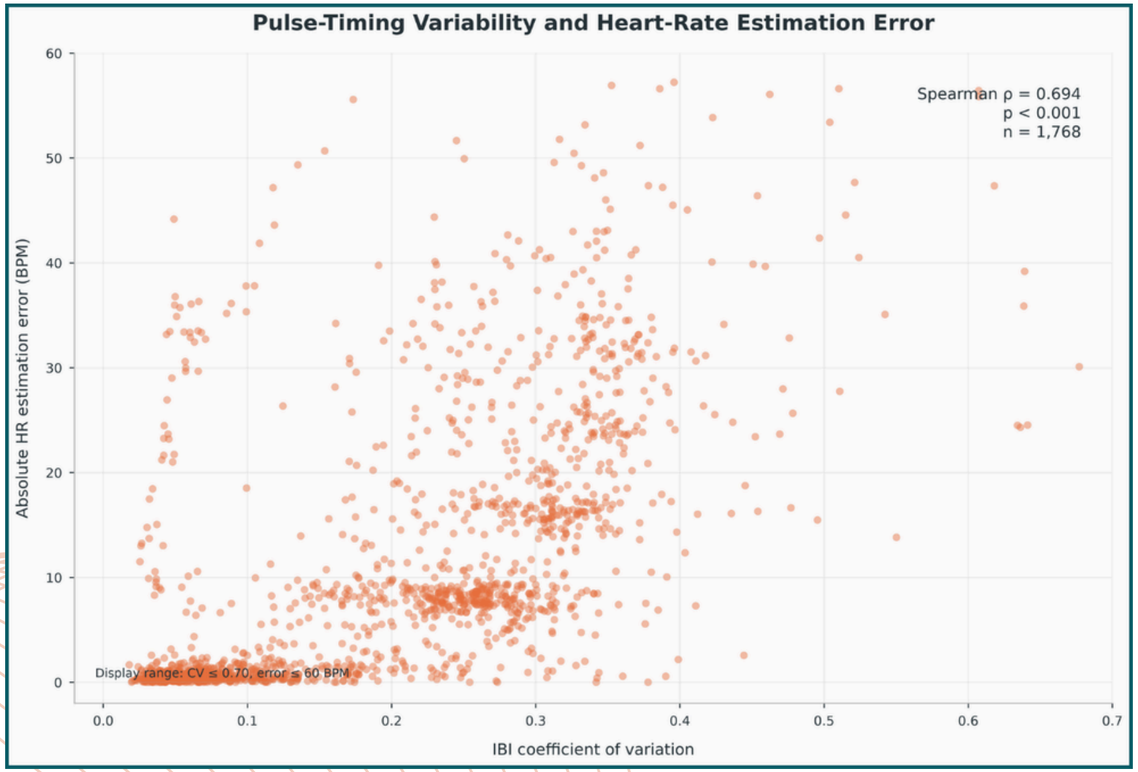
PULSE TIMING VARIABILITY

P (RHO) = 0.694

P < 0.001

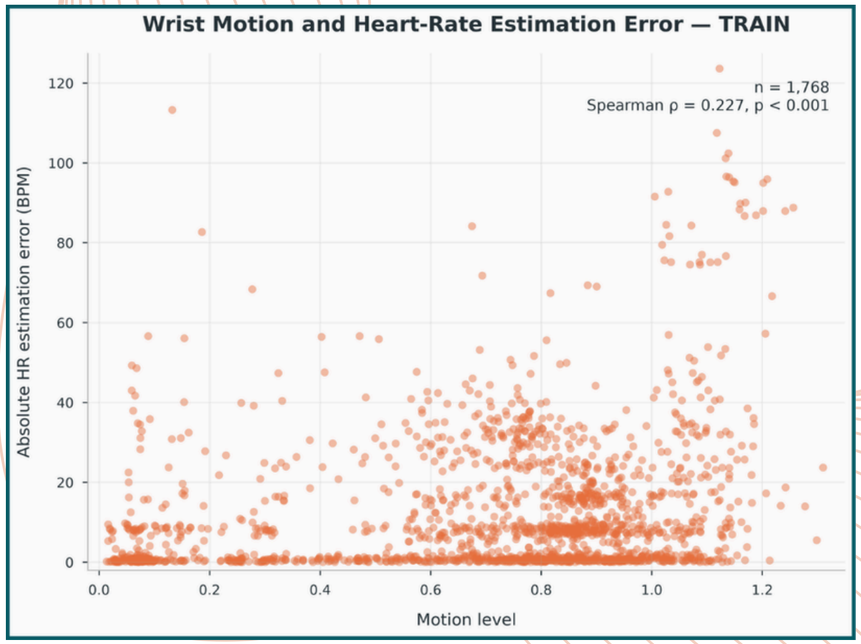
STRONG POSITIVE

GREATER PULSE-TIMING VARIABILITY ↔ GREATER ESTIMATION ERROR

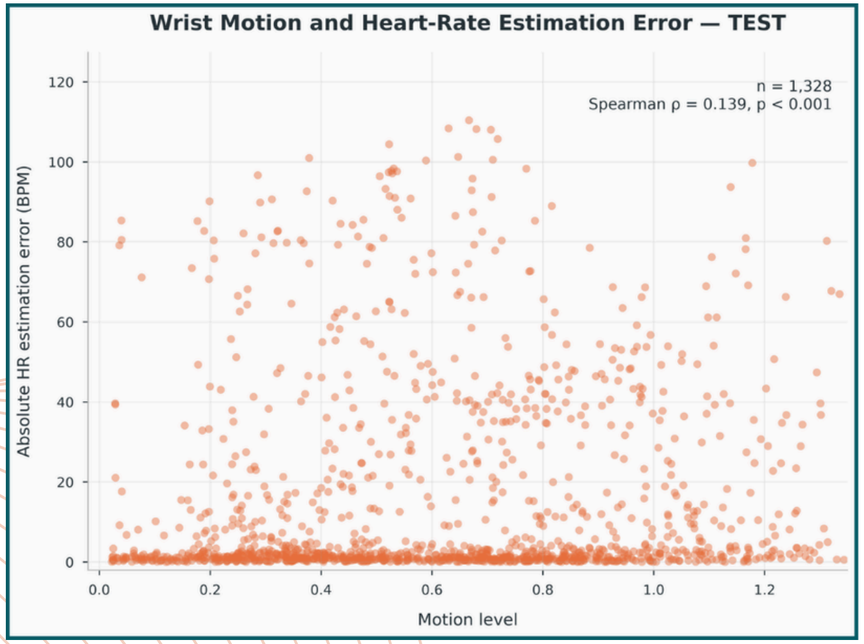


MOTION VS HEART RATE ERROR

TRAIN: P (RHO) = 0.227



TEST: P (RHO) = 0.139



CONCLUSION

PPG RELIABILITY IS CLOSELY LINKED TO THE CONSISTENCY OF PULSE DETECTION, WHILE WRIST MOTION PRESENTS AN ADDITIONAL SOURCE OF ESTIMATION ERROR.

FUTURE DIRECTIONS

→ MACHINE LEARNING
→ MULTI MODAL ANALYSIS
→ IMPROVED SENSING

LIMITATIONS

→ SHORT RECORDINGS
→ SIGNAL-DETECTION ERRORS
→ CORRELATIONAL ANALYSIS.

THANKYOU

A SPECIAL THANKS TO MY TEAMMATES, ZOYA AHMED AND SARA MIRZA, WITHOUT WHOM THIS PROJECT WOULDN'T HAVE BEEN POSSIBLE; AND TO DR KAMRAN UL HAQ KHAN, WHO SUPERVISED THIS RESEARCH.