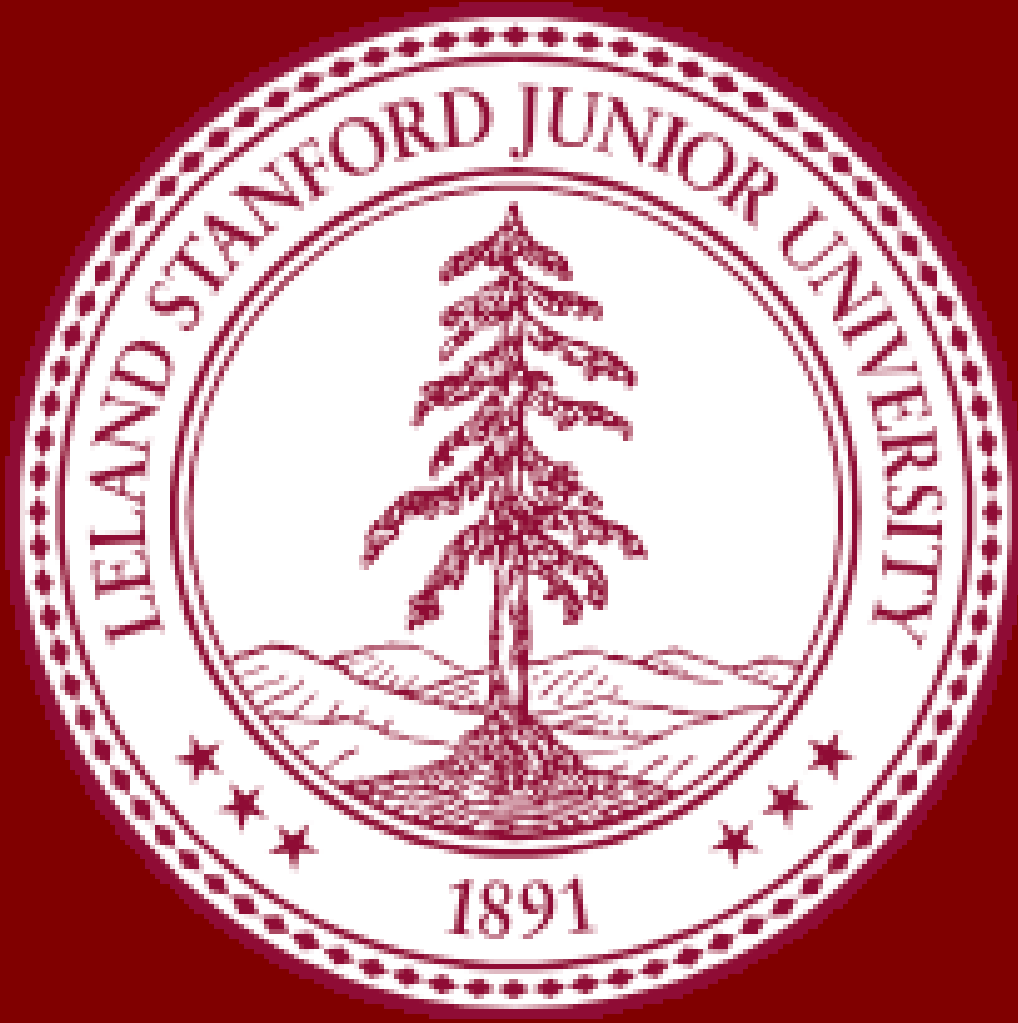
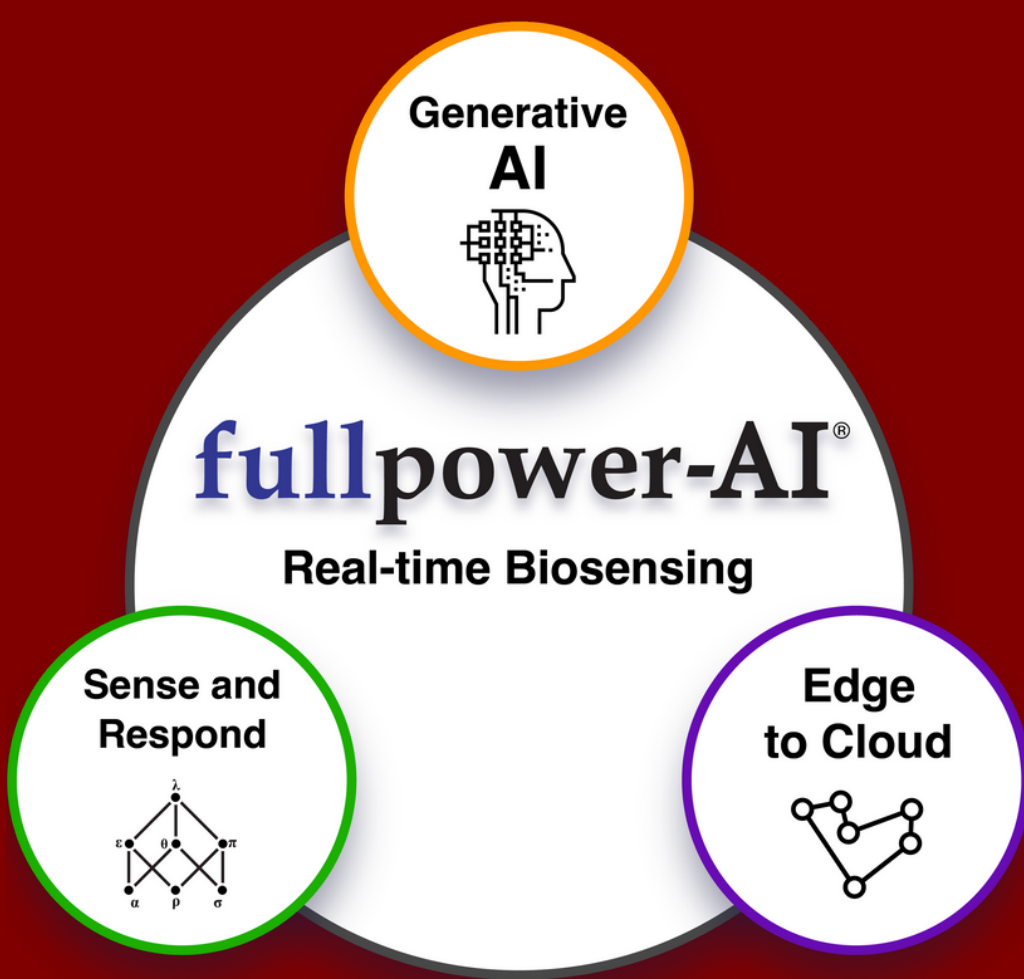




Validation of an Under-Mattress Monitoring Device Against Polysomnography for Heart Rate (HR) and Heart Rate Variability (HRV) Accuracy Assessment



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Introduction

HRV is a key marker for autonomic nervous system function and sleep health. PSG with ECG is the gold standard but is complex for routine/home use. Advances in artificial intelligence have enabled the development of contactless, non-invasive sleep monitoring devices. The Sleeptracker-AI device from Fullpower uses multiple piezoelectric sensors placed under the mattress to detect heartbeats, respiration, and movement via ballistocardiography (BCG)

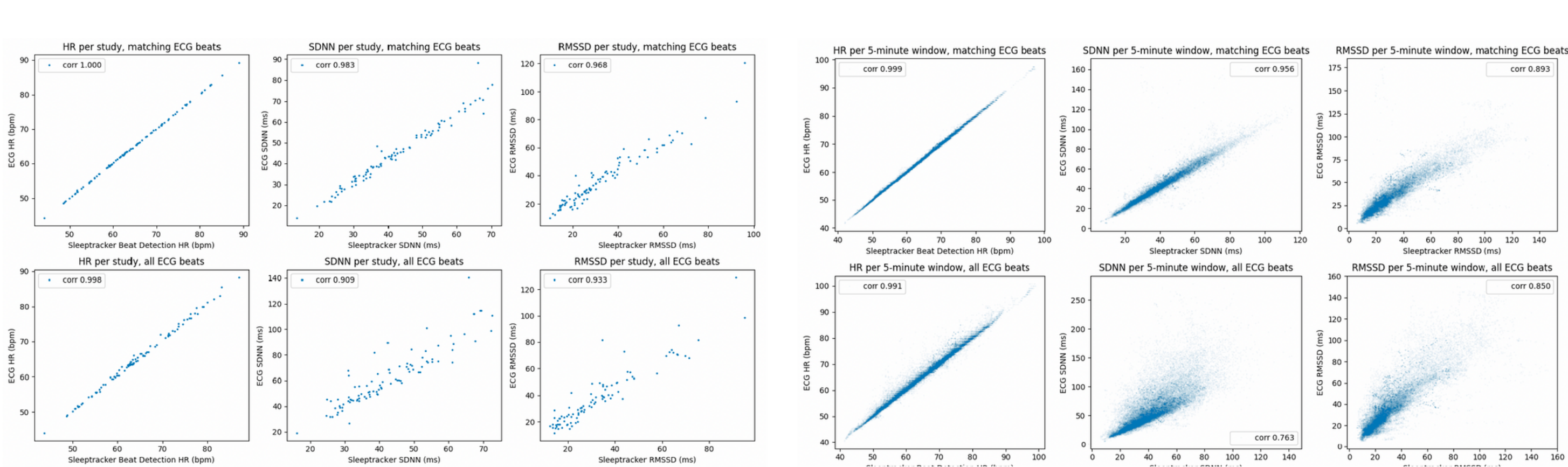
Methods

Participants: 102 adults (55% men, 45% women; mean age 40.6 ± 13.7 years; BMI 26.8 ± 5.8 kg/m²)
Study Design: Participants underwent a one-night unattended study with simultaneous monitoring using standard PSG and Sleeptracker-AI
Data Analysis: HR and HRV metrics were compared between the two devices by analysing both 5-minute windows and full-study averages. Data were evaluated across all ECG beats and matching beats (ECG beats within ±500 ms of a detected Sleeptracker-AI beat), during all sleep stages and periods of wakefulness while the participant was in bed.
Agreement assessment: Bland-Altman plots and Pearson correlation coefficients. Accuracy and variability quantification: Mean absolute error (MAE), root mean square error (RMSE), median absolute error, and robust RMSE were calculated for matching and non-matching beat conditions.

Agreement of Sleeptracker-AI and PSG

Metric	Condition	Correlation (r)	Median absolute error
RR Interval (ms)	Matching beats	—	5.3ms
Heart Rate (bpm)	Matching beats	1	0.10 bpm
Heart Rate (bpm)	All beats	0.99	0.48 bpm
SDNN (ms)	Matching beats	0.98	2.34 ms
SDNN (ms)	All beats	0.9	16.18 ms
RMSSD (ms)	Matching beats	0.96	3.84 ms
RMSSD (ms)	All beats	0.93	4.74 ms

Per Study and Per 5-Minute-Window Comparisons



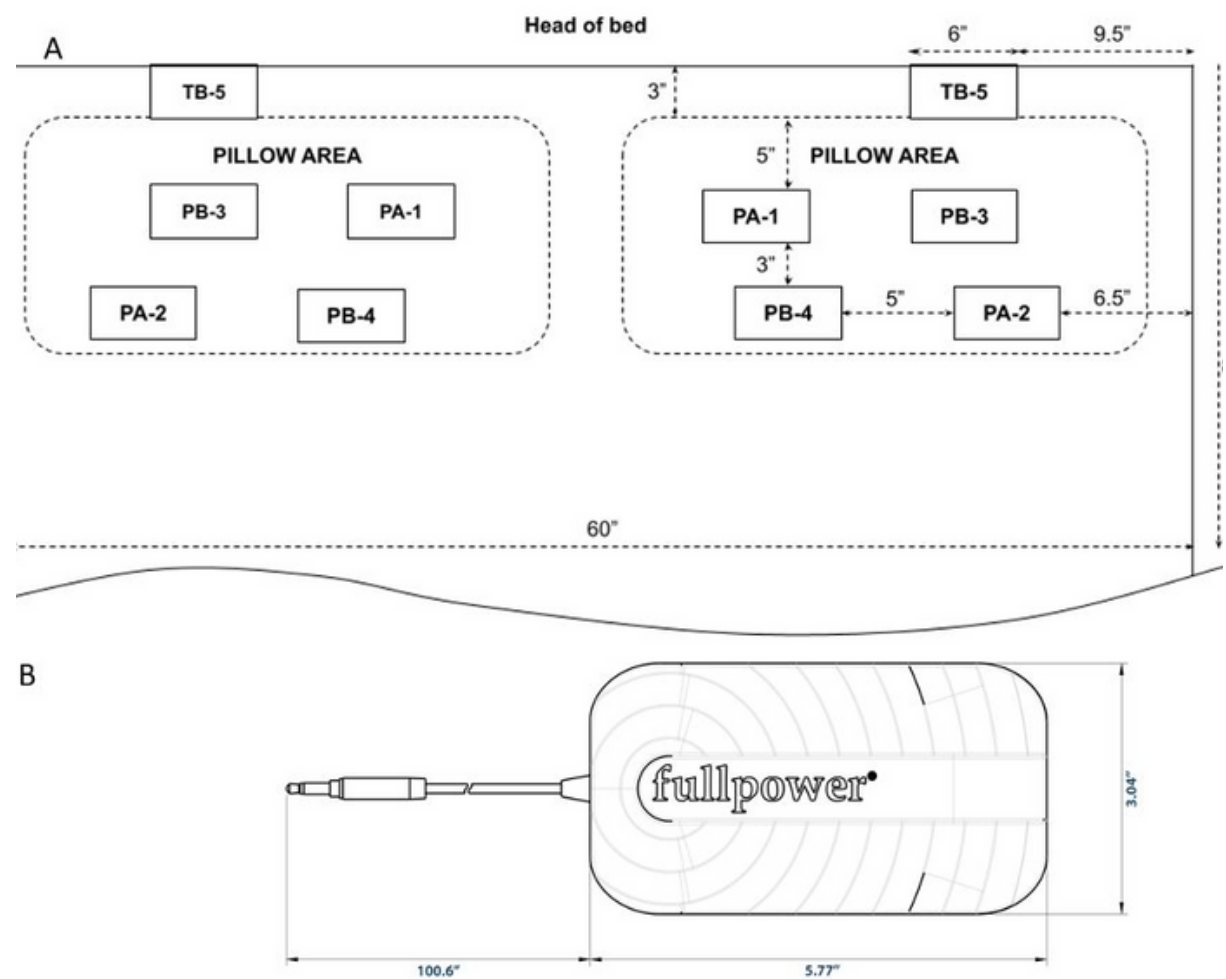
Conclusion

These findings indicate that the Sleeptracker-AI system provides reliable, long-term HR and HRV monitoring, particularly when beat detection coverage is high. Its non-invasive, contactless design makes it a practical tool for tracking cardiac autonomic dynamics and sleep health in real-world settings. Sleeptracker-AI supports its utility for both research and clinical applications.

Objective

This study aimed to validate the accuracy of Sleeptracker-AI’s heart rate and HRV metrics, specifically HR, Standard Deviation of Normal-to-Normal intervals (SDNN), and Root Mean Square of Successive Differences (RMSSD), by comparing them to simultaneous PSG-derived values

Device Setup



A) Sleeptracker-AI Monitor sensor positions tested. Each position corresponds to an independent Sleeptracker-AI Monitor, with independent predictions.
B) Dimensions of Sleeptracker-AI Monitor.

Results

Strong agreement between Sleeptracker-AI and PSG for cardiac metrics

- RR interval (matching beats):
 - Bias of -0.5 ms
 - Limits of Agreement -15.0 to +14.9 ms
- HR (full study): Excellent agreement with PSG.
 - Correlations: r = 1.00 (matching beats); r = 0.99 (all beats).
 - Median absolute errors: 0.10 bpm (matching); 0.48 bpm (all)
- SDNN:
 - Strong correlation (matching beats): r = 0.98.
 - Median absolute error: 2.34 ms (matching beats), increasing to 16.18 ms (all beats).
- RMSSD:
 - Strong correlation (matching beats): r = 0.96.
 - Median absolute error: 3.84 ms.

Correlations of Sleeptracker-AI and PSG by Sleep Stage

Metric	REM Sleep	Light Sleep (N1, N2)	Deep Sleep (N3)	Wakefulness
HR (Matching Beats)	0.998	0.995	0.99	0.983
HR (All ECG Beats)	0.995	0.994	0.989	0.923
SDNN (Matching Beats)	0.982	0.954	0.907	0.794
SDNN (All ECG Beats)	0.864	0.892	0.883	0.752
RMSSD (Matching Beats)	0.925	0.959	0.932	0.926
RMSSD (All ECG Beats)	0.897	0.911	0.893	0.867

