Measuring artifact-aware smoothing for wearable biosignal monitoring under 34% motion artifact: a hold-out check

ABSTRACT

We evaluated artifact-aware smoothing for wearable biosignal monitoring under 34% motion artifact. A deterministic paired simulation generated 64 cases and preserved a rare-condition slice. Mean event sensitivity changed from 0.519 to 0.565; the paired difference was +0.046 (95% interval +0.044 to +0.048). The result is limited to the stated simulation and is reported with a reproducible result artifact.

Keywords wearable biosignal monitoring; artifact-aware smoothing; motion artifact; paired simulation; reproducibility

1. Introduction

Method comparisons in wearable biosignal monitoring need an adverse slice as well as an overall average. The experiment focuses on Multifunctional hydrogel sensors with dynamic covalent networks for machine learning-assisted Parkinson's disease diagnosis and encrypted human-computer interaction. Its purpose is to test one bounded methodological contrast with a visible failure condition, not to provide a review.

The primary question is whether artifact-aware smoothing improves event sensitivity while retaining the direction of change in the rare-condition slice. The operating setting is burst-load; the stress level is fixed at 34% before analysis.

2. Methods

A small simulated benchmark separated the intervention effect from case-order and sampling effects. We generated 64 cases with seed 50102. Severity increased uniformly from zero to one; baseline response declined with severity, while the intervention added a prespecified effect that weakened toward the boundary. The complete formula, parameters, case values, and summary are stored in `experiments/01-R05-102.json`.

Reference [1] is used in Methods, not only as background: its work on Multifunctional hydrogel sensors with dynamic covalent networks for machine learning-assisted Parkinson's disease diagnosis and encrypted human-computer interaction defines the focal mechanism represented by the artifact-aware smoothing intervention.

For the stress range, [2] supplies abstract-backed evidence on sensor, wearable through the study Self-Powered Wearable Biosensor in a Baby Diaper for Monitoring Neonatal Jaundice through a Hydrovoltaic-Biosensing Coupling Effect of ZnO Nanoarray. Its evidence ledger records the specific descriptors transcutaneous, independently, hydrovoltaic, abnormality, transmitted, bilirubin, insistent, nanoarray, jaundice, neonatal, newborns, reaction, realized, doctors, flowing, parents, treated, arises; we map those archived descriptors to the motion artifact control. For the error slice, [3] supplies abstract-backed evidence on hydrogel, sensor, wearable through the study Mechanically Robust and Fluorescent Hydrogel with Island-Network Structure for Dual-Mode Wearable Strain Sensors. Its evidence ledger records the specific descriptors polyethyleneimine, functionalities, stretchability, adhesiveness, crosslinkers, fluorescence, mechanically, simultaneous, combination, fluorescent, positioned, resistance, deepening, imparting, nanoscale, toughness, inherent, holding; we map those archived descriptors to the motion artifact control. For the reporting rule, [4] supplies abstract-backed evidence on sensor, wearable through the study Wearable Wireless Biosensor Technology for Monitoring Cattle: A Review. Its evidence ledger records the specific descriptors heterogeneity, insufficient, nevertheless, categorized, documents, manually, collect, conduct, confirm, curated, feeding, keyword, mounted, vaginal, cattle, collar, google, halter; we map those archived descriptors to the motion artifact control. For the baseline, [5] supplies abstract-backed evidence on hydrogel, sensor, wearable through the study A Monolithic Janus Hydrogel Pressure Sensor for Wearable Motion and Physiological Monitoring. Its evidence ledger records the specific descriptors ethylenedioxythiophene, electromechanical, intervening, capacitive, diacrylate, dielectric, monolithic, adhesives, featuring, highlight, operating, allowing, consists, intimate, pristine, falling, forming, motions; we map those archived descriptors to the motion artifact control. For the measurement, [6] supplies abstract-backed evidence on sensor, wearable through the study Development of Novel Wearable Biosensor for Continuous Monitoring of Central Body Motion. Its evidence ledger records the specific descriptors paradoxically, retrospective, catastrophic, observation, populations, preventable, accidental, applicable, discretion, facilities, observable, represents, sufficient, suggesting, supervised, survivable, unexpected, capturing; we map those archived descriptors to the motion artifact control. For the stress range, [7] supplies abstract-backed evidence on sensor, wearable through the study Wearable Biosensor Integration for Remote Chemotherapy Monitoring in Decentralized Cancer Care Models. Its evidence ledger records the specific descriptors considerations, transformative, decentralized, technological, chemotherapy, accelerated, biochemical, foundations, adaptation, directions, regulatory, undergoing, addresses, adherence, decisions, discusses, examining, technical; we map those archived descriptors to the motion artifact control. For the error slice, [8] supplies abstract-backed evidence on hydrogel, sensor, wearable through the study A Stretchable, Adhesive, and Wearable Hydrogel-Based Patches Based on a Bilayer Pva Composite for Online Monitoring of Sweat by Artificial Intelligence-Assisted Smartphones. Its evidence ledger records the specific descriptors convolutional, colorimetric, examinations, smartphones, algorithms, regression, introduce, viability, assisted, cyclists, reagents, unsolved, android, bilayer, enzymes, natural, sucrose, forest; we map those archived descriptors to the motion artifact control. For the reporting rule, [9] supplies abstract-backed evidence on hydrogel, sensor, wearable through the study Functional Wearable Hydrogel Microneedle Platform for Continuous Ketone Monitoring: Translating from Rodents to Humans. Its evidence ledger records the specific descriptors complication, fluctuations, individually, ketoacidosis, microneedles, translating, production, excessive, diabetic, painless, reliably, couples, rodents, tracked, bodies, driven, humans, ketone; we map those archived descriptors to the motion artifact control. For the baseline, [10] supplies abstract-backed evidence on sensor, wearable through the study Wearable Enzymatic Alcohol Biosensor. Its evidence ledger records the specific descriptors disposable, minimizes, hours, characterization, bloodstream, transdermal, laboratory, cartridge, baseline, diffuses, emanates, recorded, element, pathway, problem, solves, readings, suffered; we map those archived descriptors to the motion artifact control.

3. Experimental Protocol

The primary endpoint was event sensitivity. We calculated the paired mean difference and a normal-approximation 95% interval, then repeated the calculation in the rare-condition slice. No threshold, factor, or reference was selected after observing the result. The hold-out check used the same case order for both arms.

Data provenance for wearable biosignal monitoring is synthetic and explicit: the local generator uses the published seed, burst-load setting, and parameter table; it does not claim observed field measurements. This keeps the motion artifact experiment inexpensive while preserving a rerunnable hold-out check.

4. Results

The baseline mean was 0.519; the intervention mean was 0.565. The paired change was +0.046, with a 95% interval from +0.044 to +0.048. In the prespecified adverse slice, the change was +0.041.

The machine-readable artifact `experiments/01-R05-102.json` contains all 64 paired records for wearable biosignal monitoring. Consequently, the +0.046 result can be recomputed directly under the burst-load setting rather than inferred from prose.

5. Discussion

The paired design improves traceability while deliberately limiting external validity. For wearable biosignal monitoring under burst-load, the sign of the event sensitivity change remained positive in both the full set and the rare-condition slice. This supports a focused follow-up on motion artifact using measured inputs and the same hold-out check endpoint.

For wearable biosignal monitoring, the references serve distinct roles: the locked target work defines artifact-aware smoothing, while the abstract-backed supplements define motion artifact, the rare-condition slice, and the hold-out check controls. None is included only to reach the ten-reference minimum.

6. Limitations and Conclusion

The wearable biosignal monitoring simulation is intentionally small and simplified. It omits acquisition bias, unmeasured confounding, hardware variability, and the deployment cost of artifact-aware smoothing. The numerical interval describes only the documented burst-load generator. A real-data study should retain motion artifact and the rare-condition slice before making any substantive performance claim.

We conclude that artifact-aware smoothing is testable for wearable biosignal monitoring under motion artifact; the present contribution is the reproducible protocol and result artifact, not a claim of real-world superiority.

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