Accelerometer-Based Laughter Detection in Social Interactions

Evaluating Segmentation Strategies and Annotation Bias in Wearable Laughter Detection from Time-Domain Motion Features

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1. Introduction

Laughter plays a crucial role in human interaction—it regulates emotions, reinforces social bonds, and signals engagement [1] Detecting laughter automatically is an important goal in affective computing.

Traditional methods rely on:

Why Accelerometer?

Accelerometers offer a privacy-preserving and non-invasive way to detect body movements related to laughter. Unlike audio or video, they do not capture identifiable content, making them ideal for real-world applications. Prior research has demonstrated their effectiveness in detecting laughter using acceleration signals [2]

Inter-Segmentation: Training on a segmentation strategy and testing on another
Continous Binary Segments: Segments that are continuous in time and are either fully laughter or fully no-laughter in the annotations
Padded Fixed Window: continuous binarysegments padded
Timeline-Centered: continuous binary segments fixed from original signal
Sliding Fixed Window: Baseline sliding overlapping fixed window

[1] Robin I. M. Dunbar. Laughter and its role in the evolution of human social bonding. Philosophical Transactions of the Royal Society B, 377:20210176, 2022.
[2] Elena Di Lascio, Shkurta Gashi, and Silvia Santini. Laughter recognitionusingnon-invasivewearabledevices. InProceedings of the 13th EA International Conference on Pervasive Healthcare Technologies (PervasiveHealth '19), pages 262–271. ACM, 2019
[3] Chirag Raman, Jose Vargas-Quiros, Stephanie Tan, Ashraful Islam, Ekin Gedik, and Hayley Hung. Conflab: A data collection concept, dataset, and benchmark for machine analysis of free-standing social interactions in the wild. In NeurIPS Datasets and Benchmarks Track, 2022.
[4] Andreas Bulling, Ulf Blanke, and Bernt Schiele. A tutorial on human activity recognition using body-worn inertial sensors. ACM Computing Surveys, 46(3):33:1–33:33, 2014.

> ***How effectively can chest-worn accelerometer data be used to detect laughter in spontaneous social interactions?***

2. Methodology

2.1 Signal

Chest-worn accelerometers capture torso motion obtained from the Conflab Dataset [3]. We filter and standardize the signal, to identify laughter patterns without audio or video.

2.2 Modalities

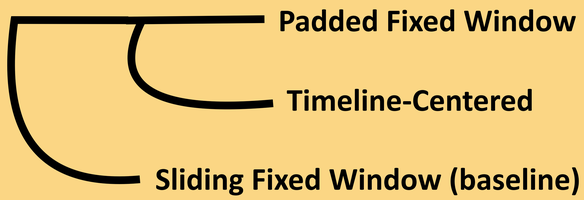
(No_Audio) *(With_Audio)* *(Only_Audio)*

Cont Laughter Distribution

	Laughter (1)	Non -Laughter (0)
Mean (s)	1	31
Max (s)	11	121

We decided on window sizes (second) of 1, 2 and 10

2.3 Segmenting Techniques



2.4 Feature Extraction

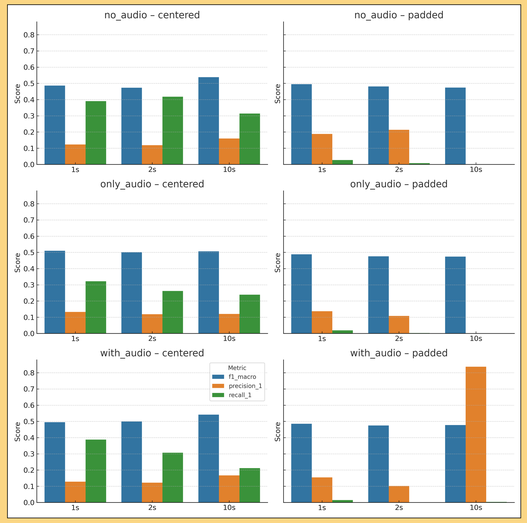
From each window, we compute time-domain features like axis-wise means, derivatives, energy, and inter-axis correlations—capturing both posture and motion dynamics during laughter [4].

3. Results

Using Random Forest we trained the following:

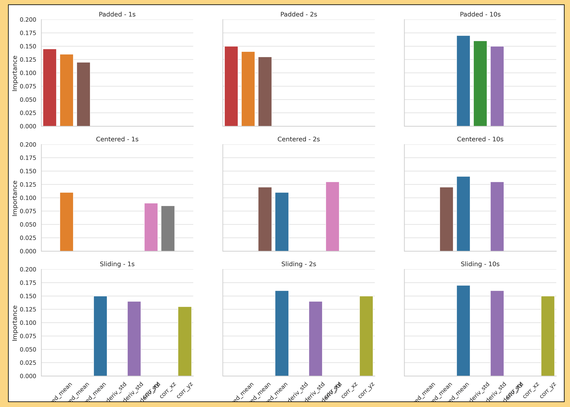
Inter-Segmentation Performance

Hypo: Misalignment between segment types harms generalization.
Models trained on padded or centered segments were tested on sliding windows. Performance drops revealed sensitivity to segmentation mismatches.



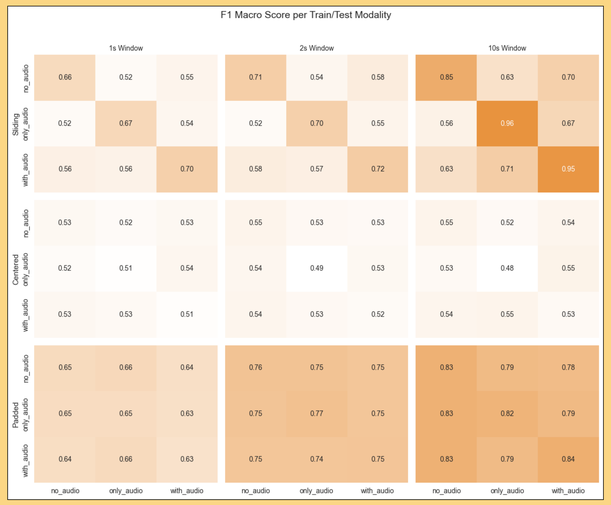
Features Importance

Hypo: Laughter involves both posture shifts and dynamic motion.
We analyzed Random Forest feature importances. Axis-wise means, derivatives, and inter-axis correlations ranked highest



Modality Performance

Hypo: Models trained on multimodal annotations generalize better across modalities.
We trained on one annotation modality (e.g., With Audio) and tested on others (y = training, x = testing)



4. Conclusion

Contiguous segmentation strategies (padded and centered) preserve behavioral boundaries but show limited context and weak generalization in real-world conditions. Although padded segmentation generalizes moderately across modalities, sliding window segmentation outperforms it in real life scenarios.
Multimodal annotations (With Audio) significantly enhance cross-modal generalization, demonstrating that richer perceptual cues lead to improved label quality.

Chest-worn accelerometer data, combined with simple statistical features and Random Forest classifiers using robust window segmentation strategies and well-annotated multimodal data, provide a robust, effective, and privacy-preserving solution for detecting laughter in realistic social interactions.