Raw Signals

IMU
(3-axis accel.)

PPG
(3 wavelengths)

EDA
(skin cond.)

Preprocessing

Resampling
Low-pass filtering

Resampling
High-pass filtering

Resampling
Tonic/Phasic split

Temporal Segmentation

5-second windows • 10% overlap • 1421 labeled segments

Feature Extraction

IMU (30)

Quantiles, entropy
Katz fractal dimension
Sum of abs. changes
Variance of differences

PPG (183)

Statistical moments
RMSSD, SDNN, pNN50
LF/HF power ratio
Heart rate variability

EDA (47)

Tonic level (SCL)
Slope, IQR, MAD
Mean absolute diff.
Skewness, kurtosis

Fusion & Alignment

Time alignment → Modality fusion → Label matching

Feature Selection

Correlation ranking → Redundancy pruning ($r > 0.90$) → LOSO-consistent filtering

Model Training

Random Forest (n=100, depth=6) • LOSO Cross-Validation • Per-modality models

LOSO Results

IMU
r = 0.52

PPG
r = 0.26

EDA
r = 0.02

Key finding: Only motion-based features (IMU) generalize across elderly patients