ROMBERGER: PROGRESS UPDATE

Balance Analysis Web App

Skeleton site, dual CSV upload, and comparative data analysis pipeline

What was built

→ **Single-file skeleton**
Clean HTML/CSS/JS with Chart.js

→ **Dual upload zones**
Eyes-open (baseline) and eyes-closed (test) CSVs

→ **Auto-trim pipeline**
First & last 5s removed to discard handling artifacts

→ **CSV parser + preview**
In-browser parsing, tabbed preview, fullscreen modal

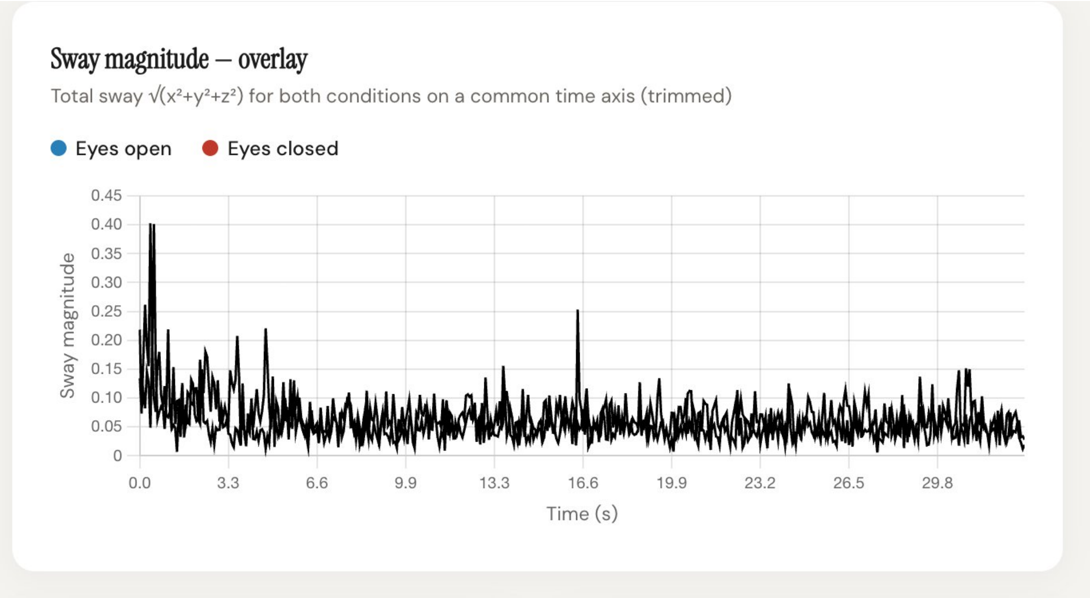
Analysis features

→ **Comparison stats**
RMS sway, peak, std dev, jerk, path length

→ **7 chart types**
Sway overlay, scatter, 3-axis, rolling RMS, histogram, delta

→ **Romberg quotient**
Closed/open RMS ratio with interpretation

→ **Auto-insights**
6 contextual findings + stability verdict



Sway magnitude overlay: eyes open (blue) vs. eyes closed (red) with trimmed accelerometer data

Live site: cs.umb.edu/~hdeblois/cs410/longproj01/t2-WR/

ROMBERGER: DATA PIPELINE

CSV Parsing & Comparative Analysis

From raw Sensor Logger export to automated balance comparison

01 Upload
Drag & drop CSVs into labeled zones (eyes open / closed)

→

02 Trim
Discard first & last 5 sec to remove handling artifacts

→

03 Extract
Parse x, y, z, t
Compute sway mag sqrt(x^2+y^2+z^2)

→

04 Analyze
Stats, 7 charts, Romberg quotient, auto-insights

Computed metrics (per condition)

RMS Sway
Root mean square of sway magnitude

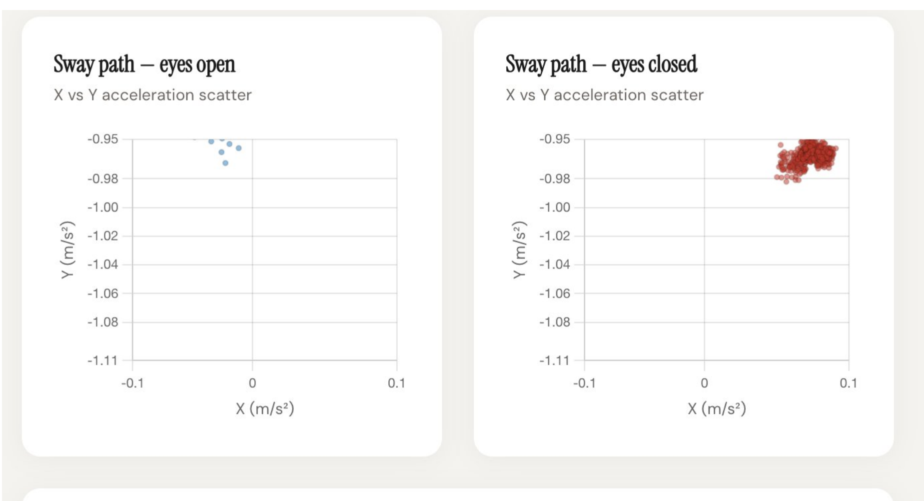
Peak Sway
Max instantaneous sway value

Mean Jerk
Rate of acceleration change (smoothness)

Path Length
Cumulative XY displacement

Sway Area
Std_x * Std_y ellipse proxy (spread)

Romberg Q
Closed/open RMS ratio (key metric)



Sway path scatter: eyes open (left, tight cluster) vs. eyes closed (right, wider spread)

Live site: cs.umb.edu/~hdeblois/cs410/longproj01/t2-WR/

ROMBERGER: FUTURE RESEARCH

Smartphone vs. Clinical Posturography

Can consumer accelerometers approximate lab-grade balance assessment?

Research thesis

Consumer smartphone accelerometers have reached sufficient precision to approximate clinical posturography for screening purposes, but significant validation gaps remain before they can replace lab-grade force plates.

Essay structure

- **Clinical gold standard**
  How posturography works in a clinic. Force plates (e.g. NeuroCom SMART Balance Master) measure center-of-pressure at 100Hz+. The Sensory Organization Test (SOT) protocol with six conditions.
- **What smartphones measure**
  Accelerometers capture trunk sway, not COP. Chest-mounted phone = different biomechanical signal. Tradeoff: zero cost + accessibility vs. lower precision.
- **Literature comparison**
  Survey studies (2015–2024) comparing smartphone IMUs to force plates. Typical correlations r = 0.6–0.85. Which features transfer across modalities.
- **Romberger as case study**
  Our pipeline demonstrates full feasibility: Sensor Logger → CSV → trim → extract → Romberg quotient → visual comparison. Map computed metrics to clinical equivalents.
- **Validation gaps**
  Sensor placement variability, self-administered vs. clinician-observed, phone model differences, and the fundamental issue: trunk acceleration ≠ COP.

Technical next steps

→ **500+ labeled recordings**
Multi-participant data collection for classifier training

→ **SVM classifier**
RBF kernel on 6 extracted features, in-browser or backend

→ **Grouped cross-validation**
Leave-one-subject-out to prevent data leakage

→ **Persistent database**
Store uploads with sample ID, session, label, prediction

→ **Confidence scoring**
Probability output instead of binary classification

Key research questions

Q1. How well does trunk-mounted accelerometer sway correlate with force-plate COP displacement?

Q2. Which extracted features (RMS, jerk, spectral) are most discriminative across both modalities?

Q3. Can a smartphone Romberg quotient achieve clinically meaningful sensitivity/specificity (>80%)?

Q4. What minimum sample size produces a generalizable classifier across age, height, and phone models?

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