



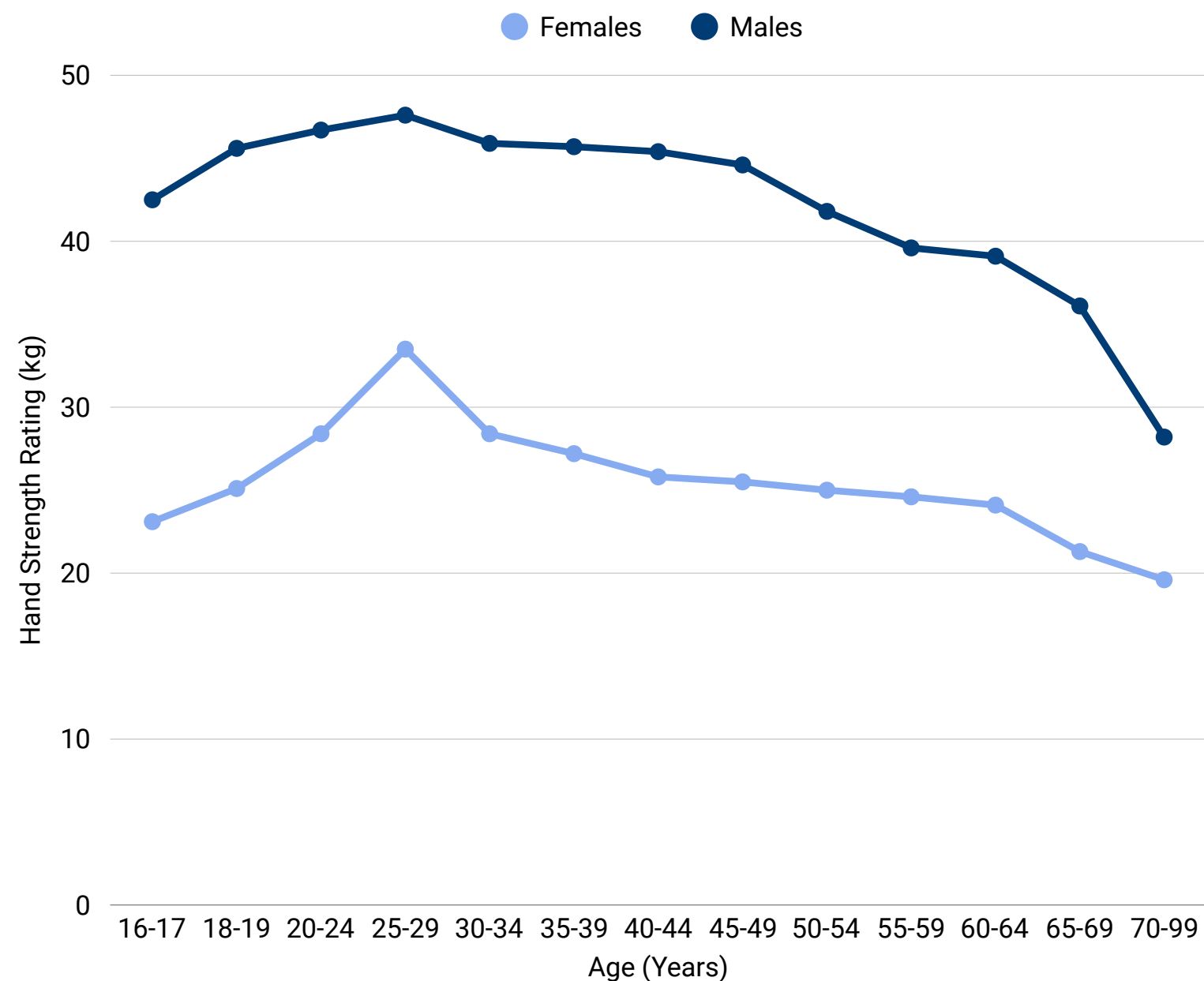
NeuroKeys

Development of an EEG+EMG Controlled Piano

UCLA Competition Team:
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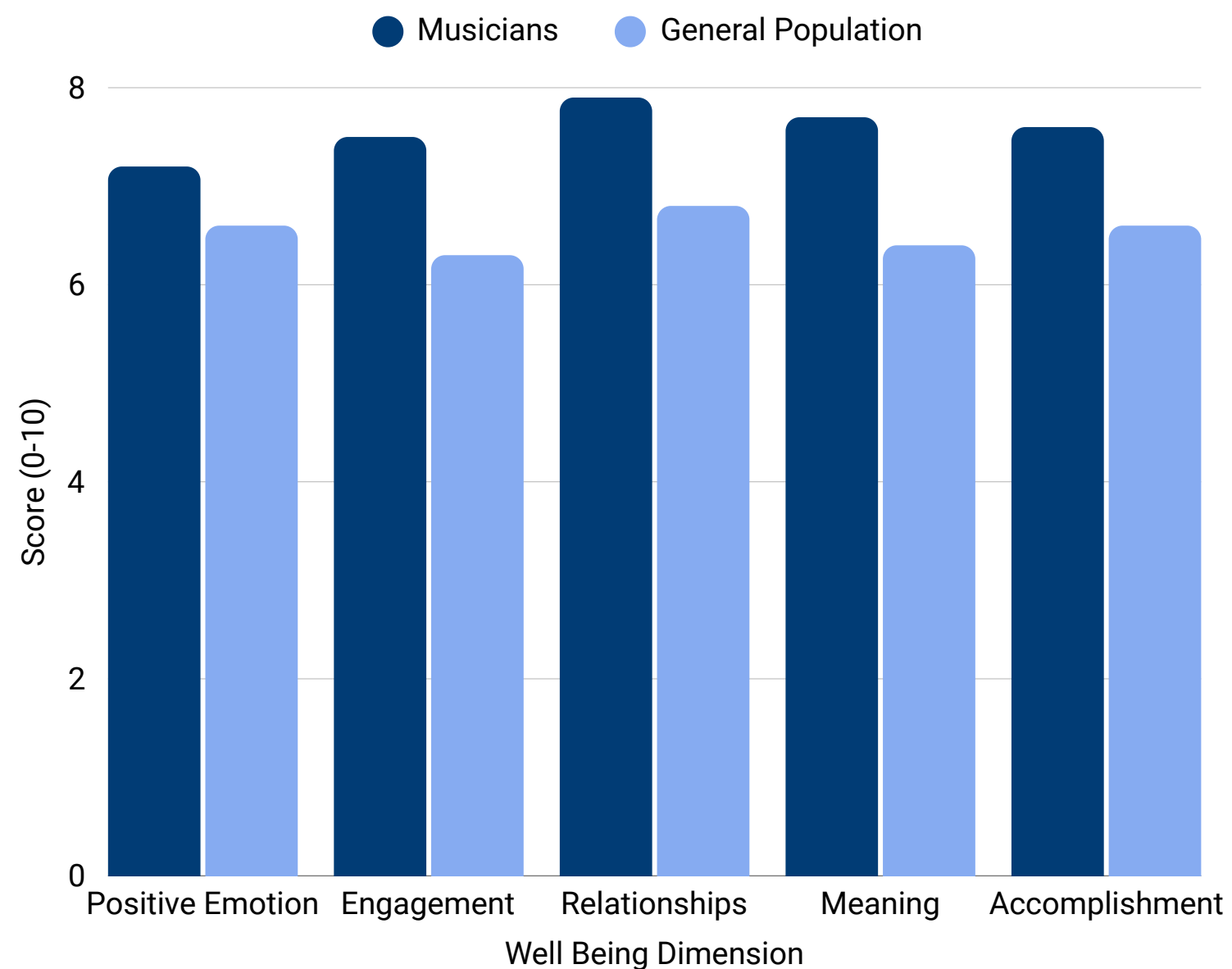
Losing mobility shouldn't mean losing music

Grip Strength (kg) over Time



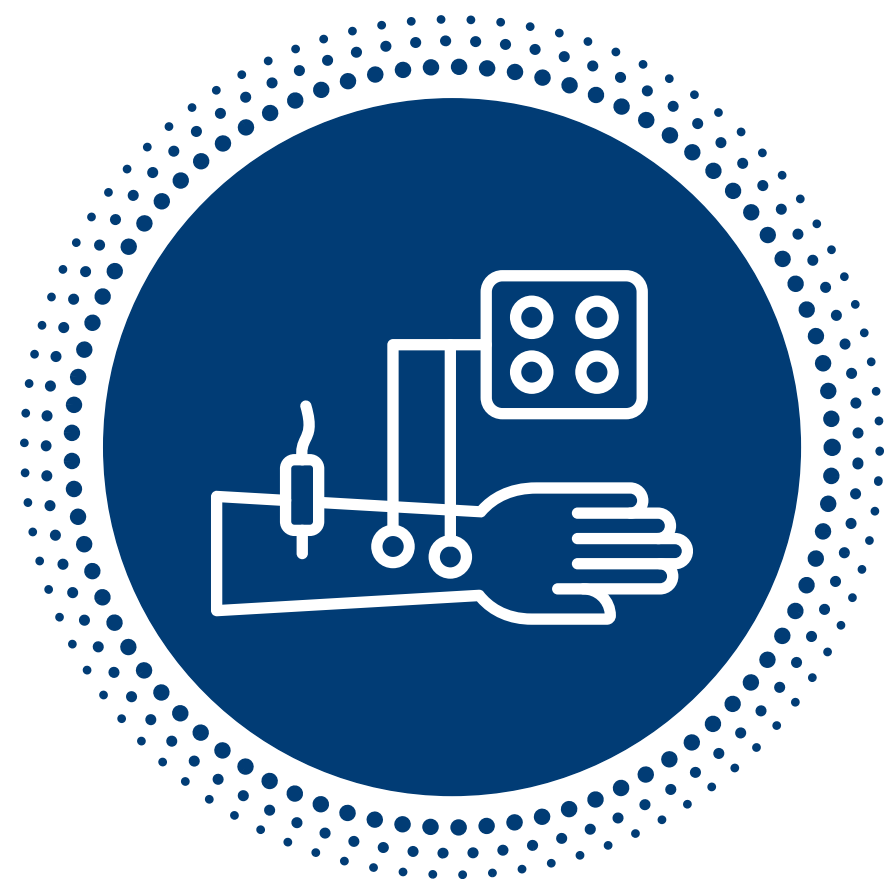
Source: [Tepend Sports, Hand Grip Strength Norms](#)

Average PERMA Well-Being Scores for Musicians and the General Population



Source: [Resounding Meaning: A PERMA Wellbeing Profile of Classical Musicians](#)

Our Solution



EMG

+



EEG



Music

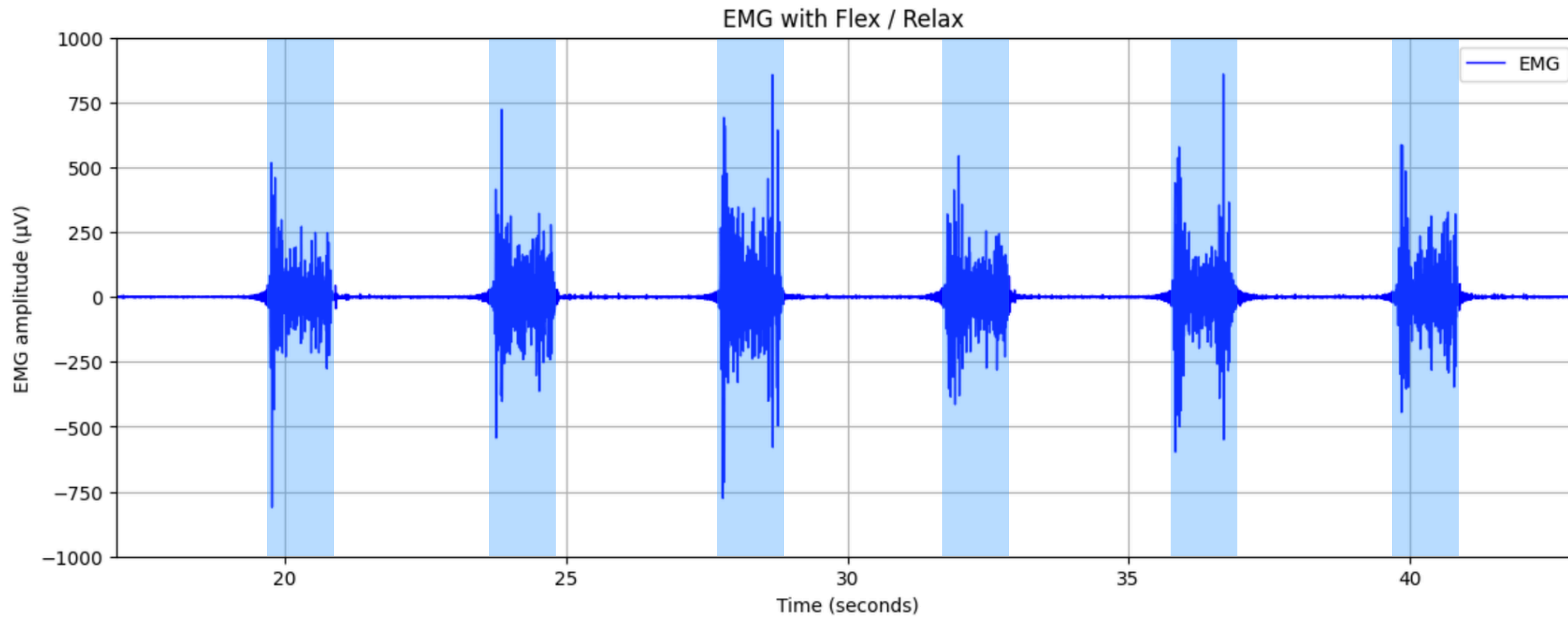




Software: EMG



How EMG Signals Work



Processing and Model



Data Collection

- 3-second intervals: flex vs. rest



Preprocessing

- Filter noise (bandpass/notch) + Segment into 0.5s windows



Feature Extraction

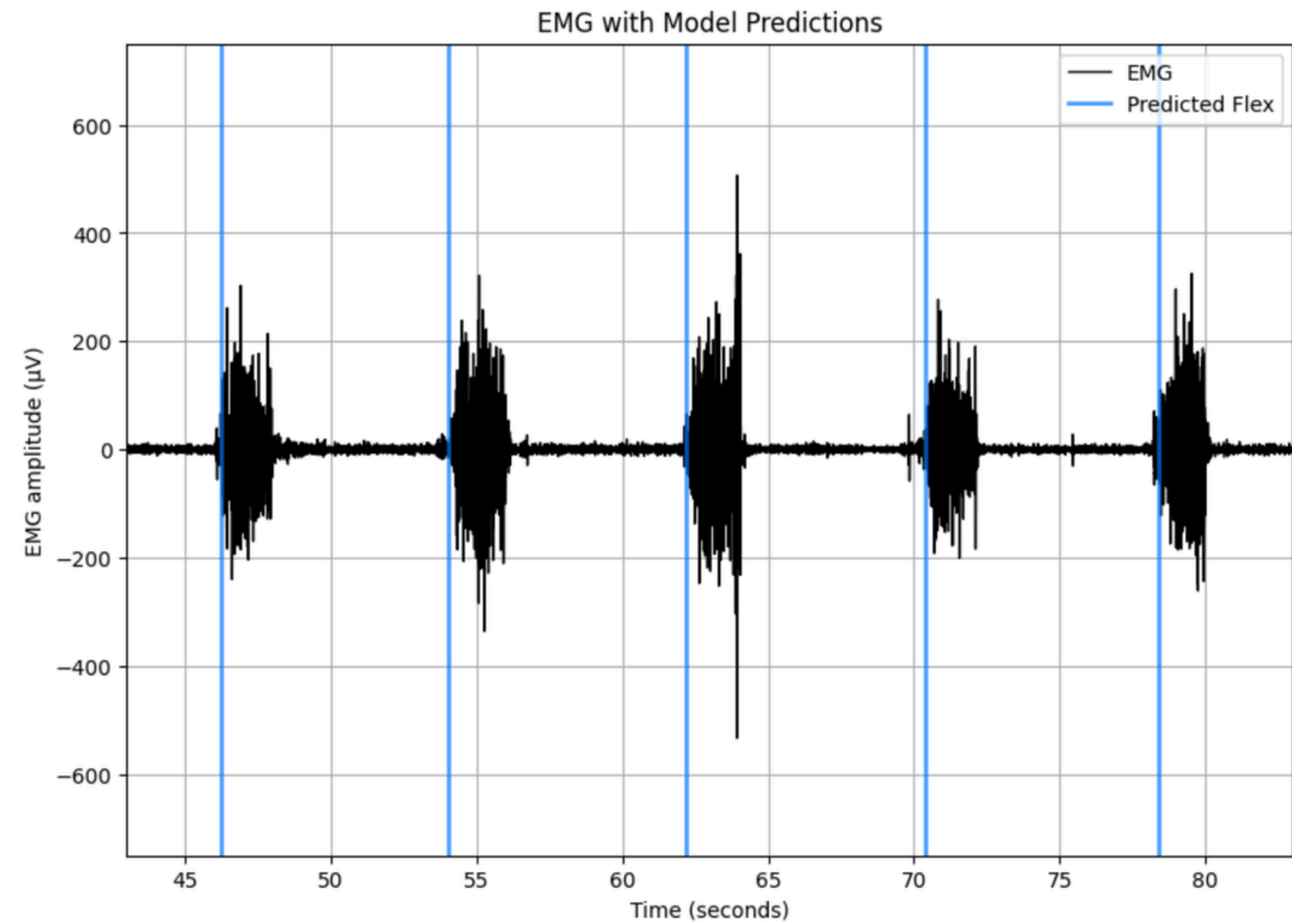
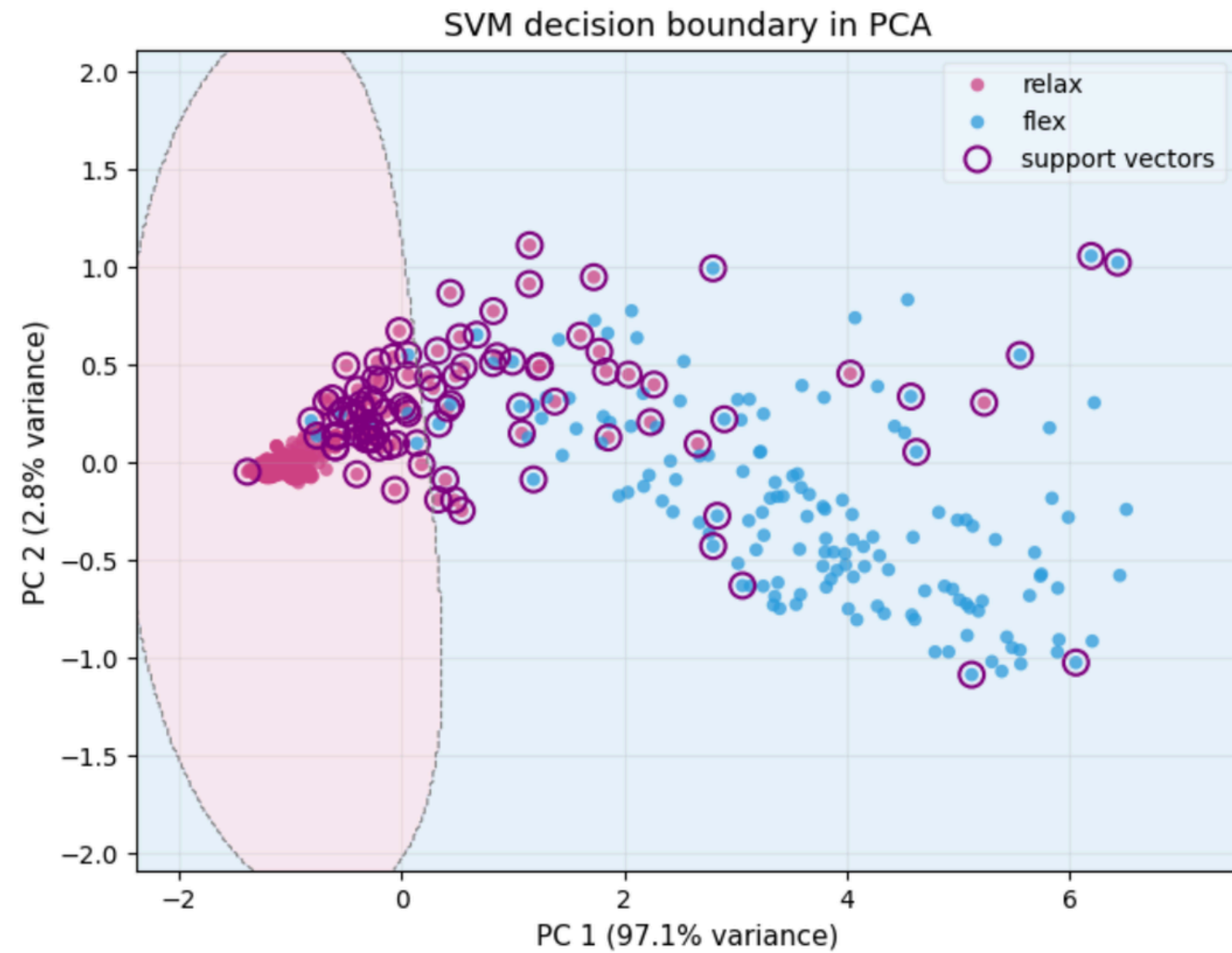
- MAV, SD, Peak-to-peak range, RMS, Signal change



Model

- SVM classifier → flex (1) vs. no flex (0)
-

Processing and Model





Software: EEG



User Interface

The screenshot displays a software interface for music composition. At the top, it reads "COMPOSE MODE" in green, followed by the instruction "Play notes to record. Assign chords below first." and a list of keyboard shortcuts: "ENTER=play BKSP=undo DEL=clear R=rest 0=deselect key SPACE=stim 1-6=sim ESC=quit". Below this, a section labeled "COMPOSE — sequence" features a treble clef on a five-line staff. Underneath the staff, a smaller instruction says "Play notes via EEG+EMG or keyboard (1-6). Double-clench = rest. ENTER = playback. BKSP = undo. DEL = clear." The main area contains three square boxes with black and white checkerboard patterns, each with a colored border and a frequency label above it: "7.5 Hz" (orange border), "10.0 Hz" (blue border), and "12.0 Hz" (purple border). Below each box are labels for left and right hand assignments: "L:C4+F4 R:—" for the 7.5 Hz box, "L:D4 R:—" for the 10.0 Hz box, and "L:E4 R:—" for the 12.0 Hz box. At the bottom, a digital piano keyboard is shown with four keys highlighted in colors matching the boxes: orange, blue, purple, and orange. Lines connect the labels "L:C4+F4", "L:D4", and "L:E4" to their respective keys on the keyboard.

Frequency Selection



Monitor Refresh Rate

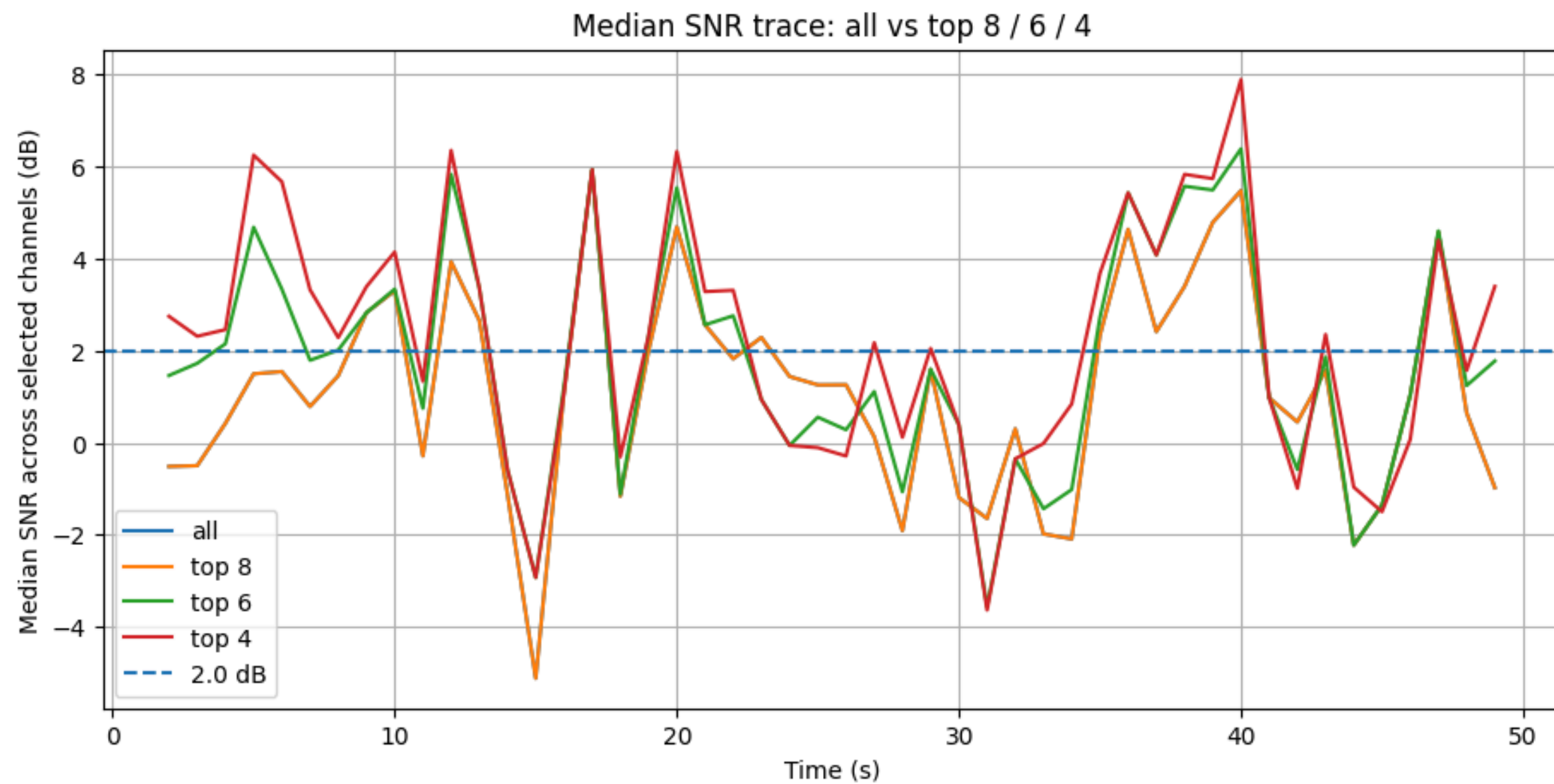
Frequencies must divide evenly into 60Hz to display cleanly.



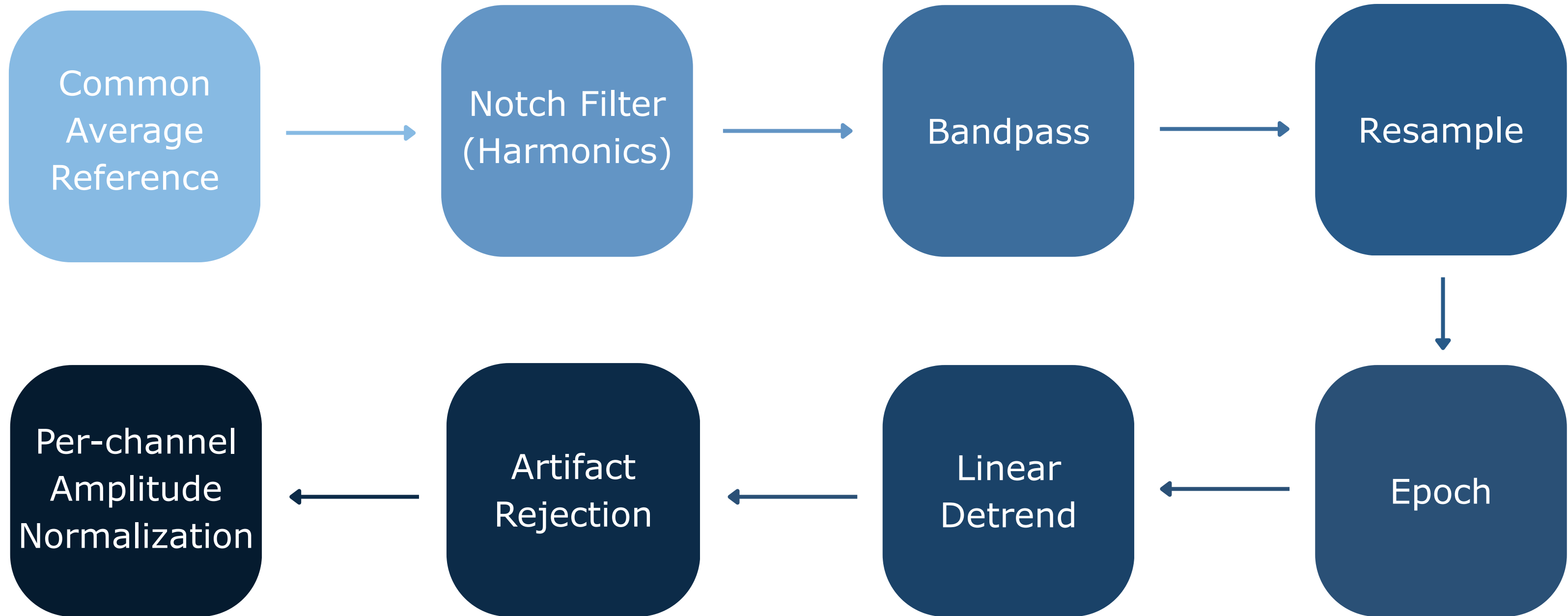
Ideal SSVEP Range

Ideal range is 8–15 Hz (alpha band) for strongest signal detection.

Data Collection

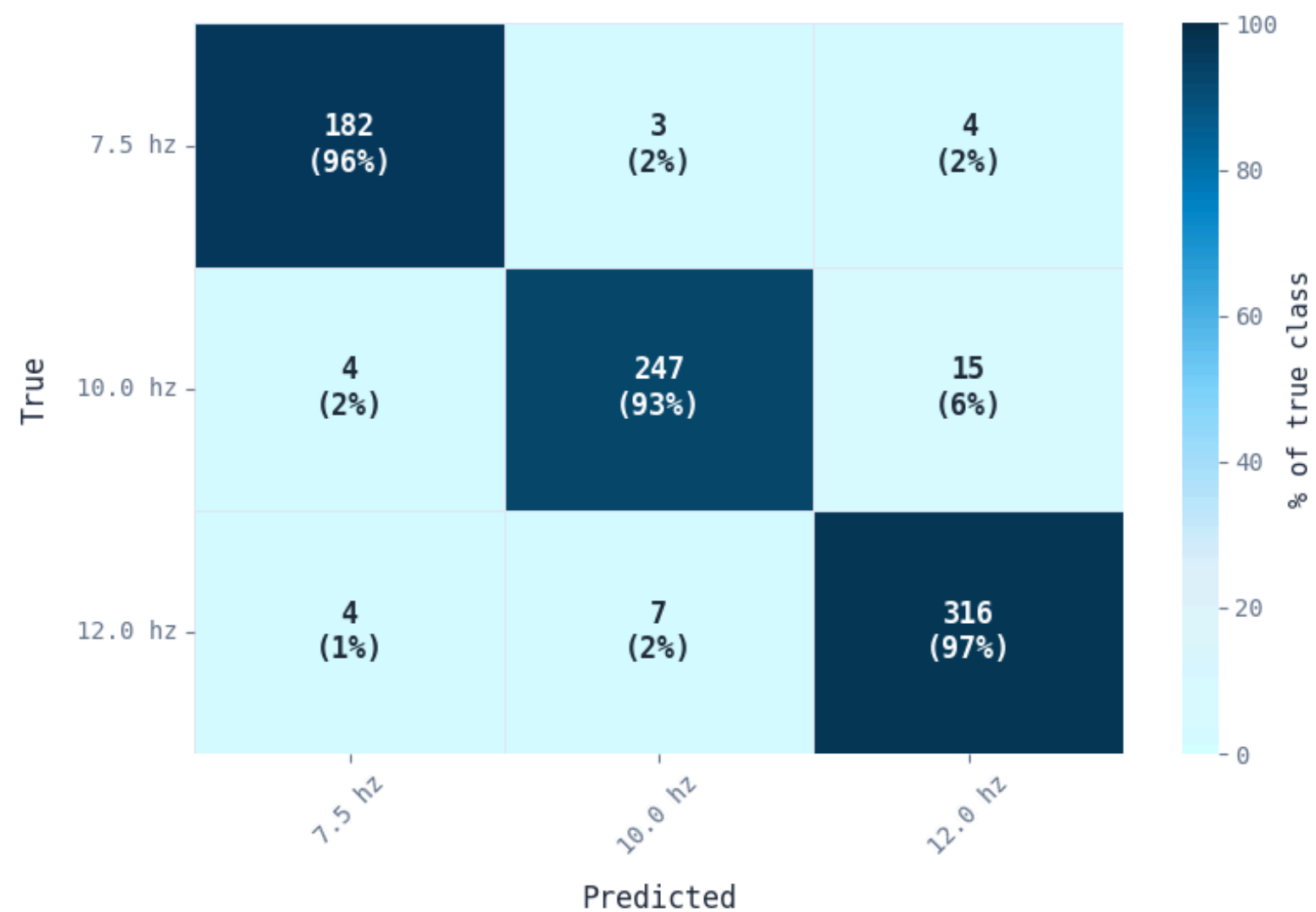


Preprocessing

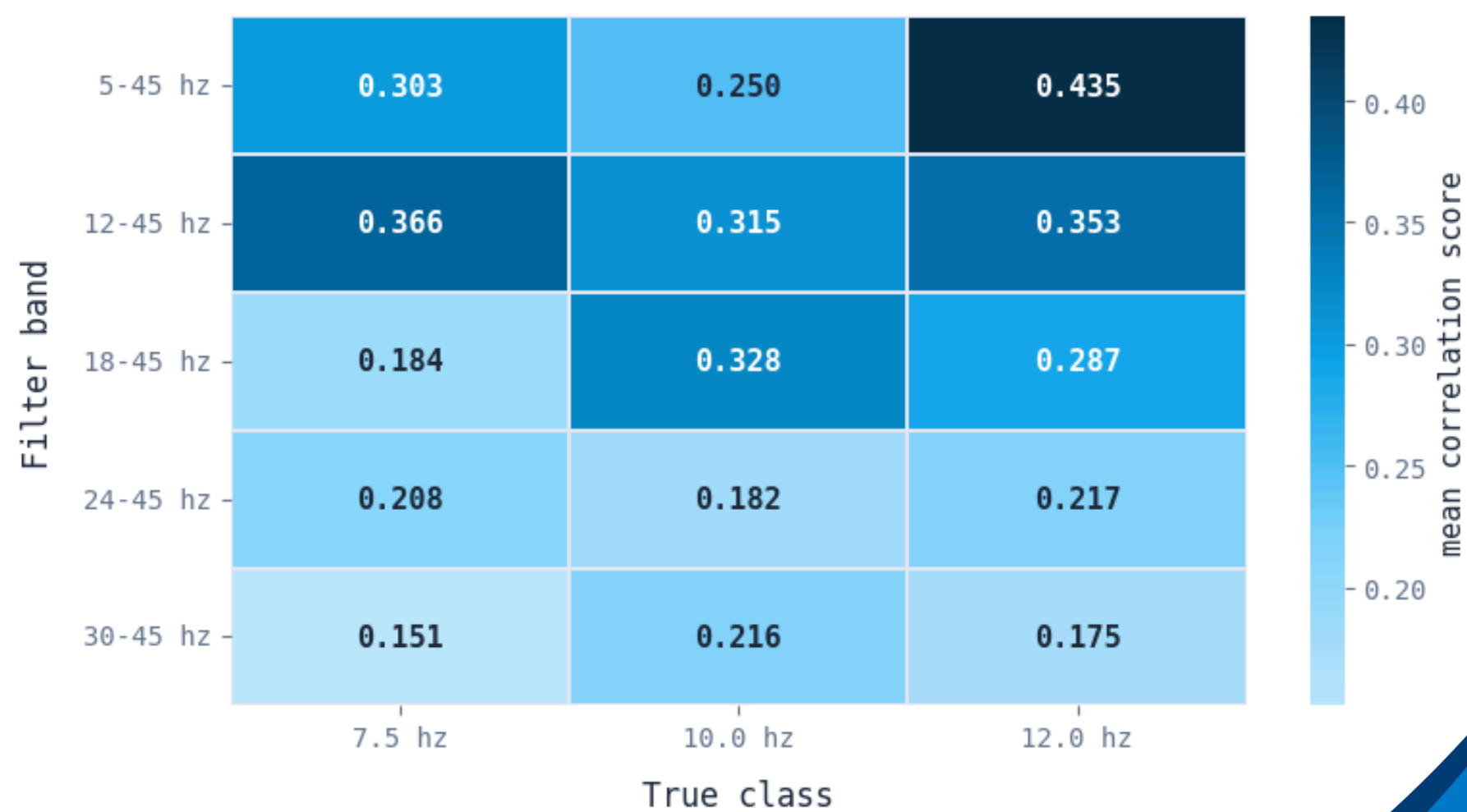


FBTRCA Model

LOFO Confusion Matrix – Pooled Accuracy: 95.3%
(Mean per-file: 95.8% ± 4.7%)

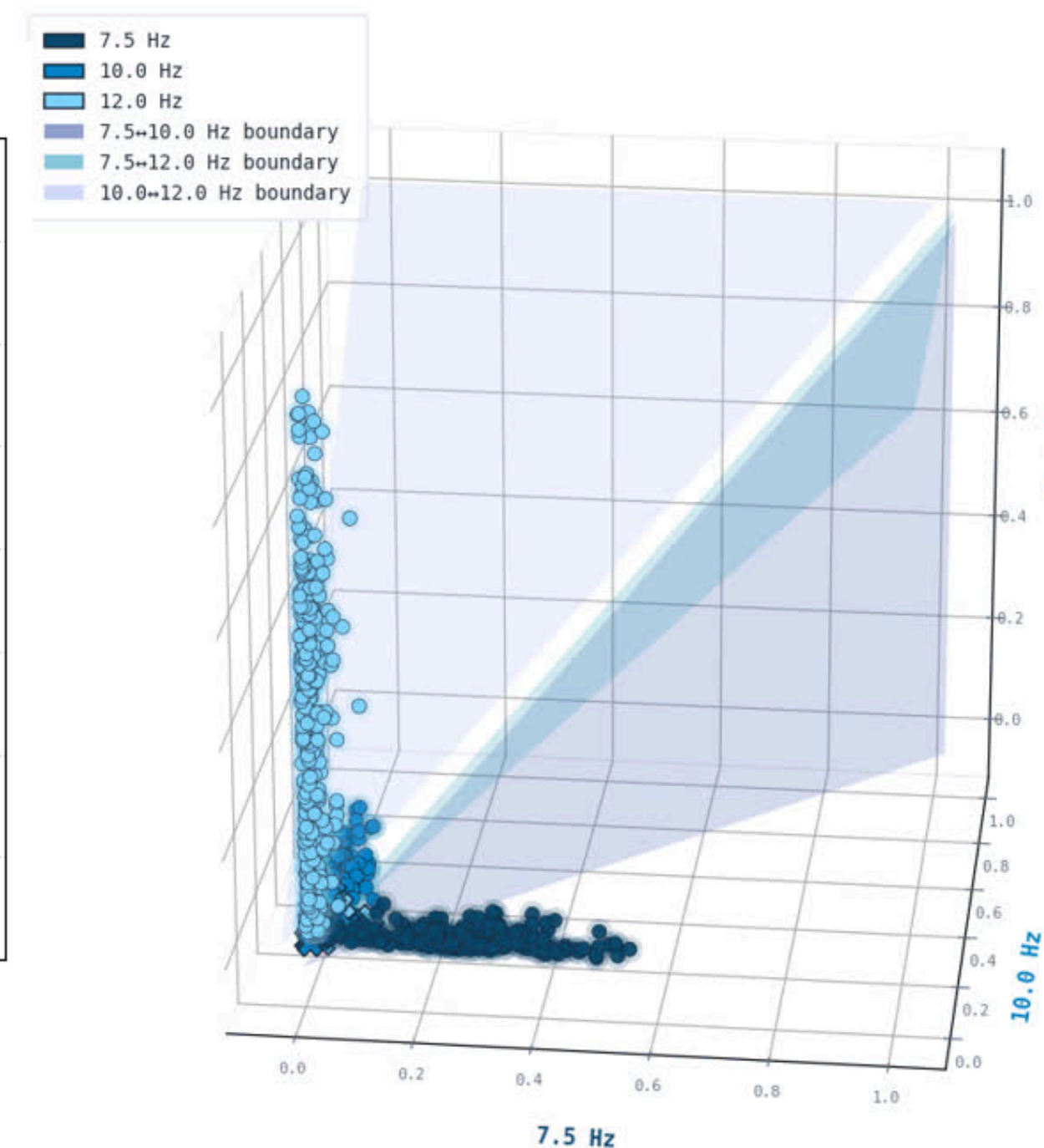
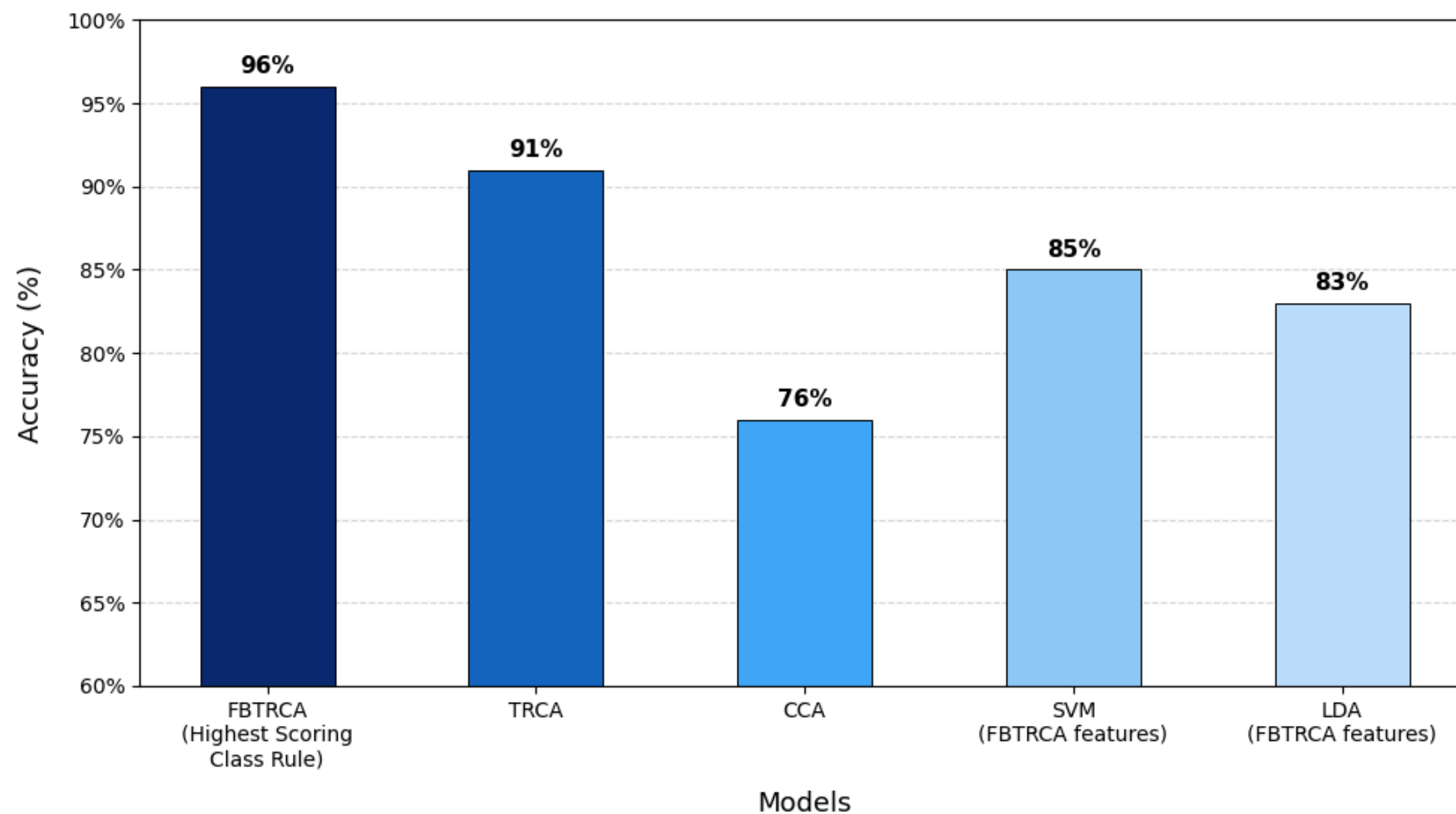


Band Contribution per True Class
(how much each band supports the correct class)

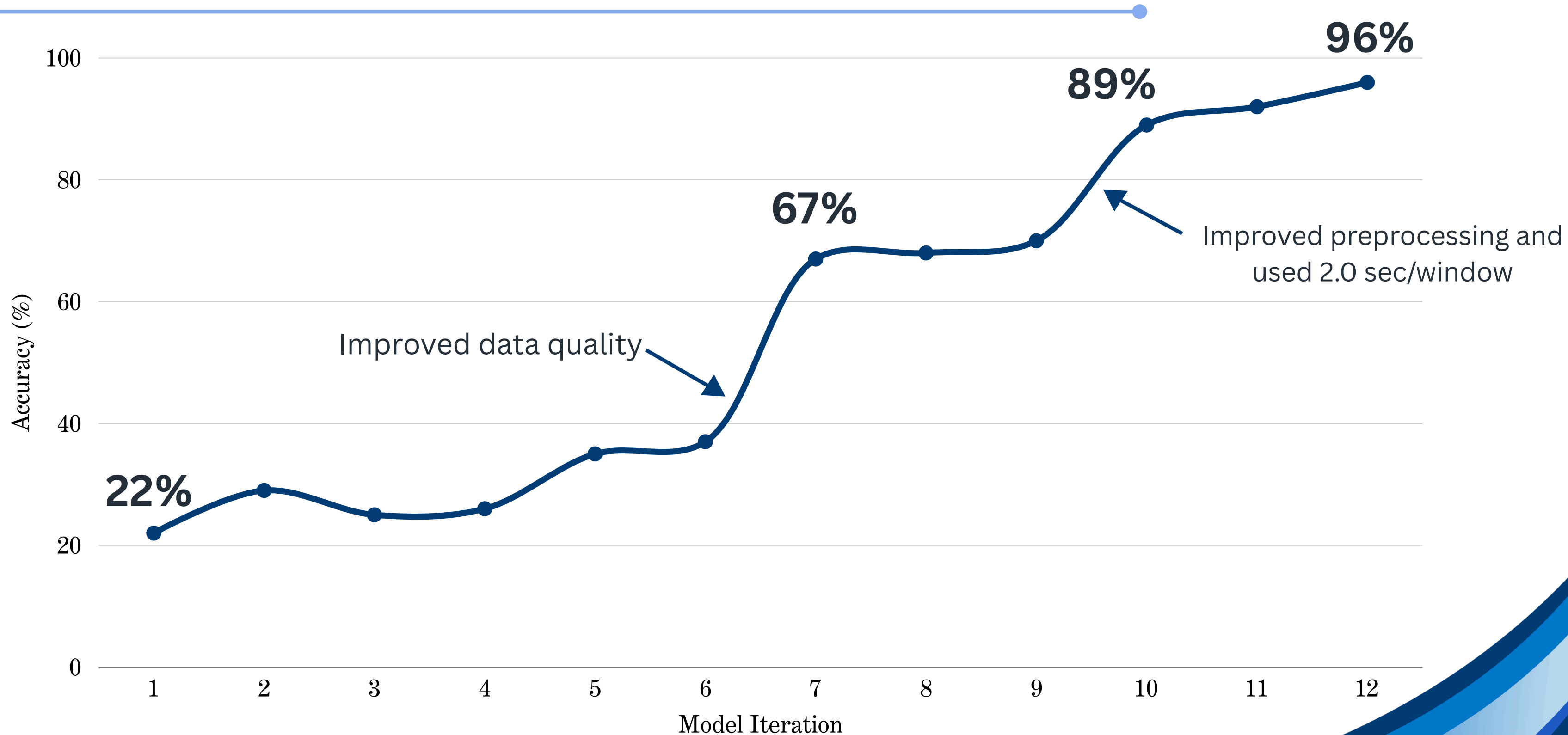


Why FBTRCA?

Model Accuracy Comparison



Accuracy Over Time



Improving Generalizability



Ensemble FBTRCA model for calibration.



70/30 base-calibration weight.



Improved individual accuracy by 13%.



Discussion



Challenges / Limitations

Unicorn Headset



Limited Data Collection



Monitor Display Frequency



Limited Cross-User Generalization



Future Direction

- 1. Adding more instruments**
 - 2. Improve Generalizability**
 - 3. Composition Tool**
-



Significance and Applications



Human-Centric EEG+EMG interface



Enabling Expression in People with Impairments




Improved Cognitive Fitness for the Aging Population



Demonstration

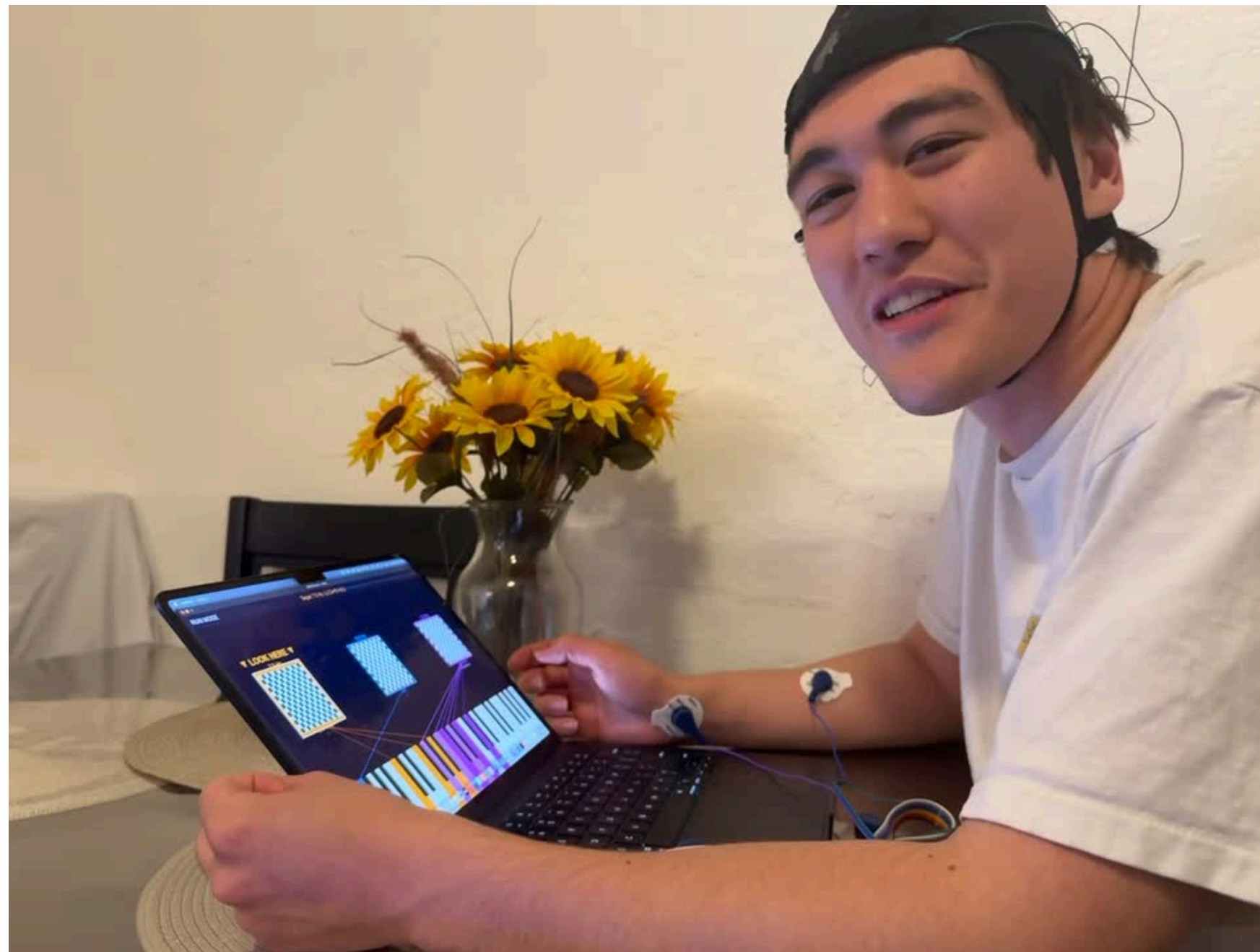
**Watch as we turn thoughts
into music!**



Demonstration



Demonstration



Thank You

**Feel free to ask us about
NeuroKeys!**

