TremorPause: A Wearable Inertial Hand Tremor Evaluation and Suppression System

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Pathological hand tremors affect 5% of the world population, yet diagnosis remains a subjective 0-4 visual score, and treatments are dangerous (Beta-Blockers), ineffective (orthotics), or expensive (Deep Brain Stimulation, $30k-$80k). TremorPause is a low-cost (~$440) and long-lasting (~2 hr.) wearable that quantifiably evaluates and suppresses hand tremors. To evaluate motion, an Arduino-BLE glove collected IMU data from 60 participants. A Fast Fourier Transform pipeline distilled 2.3 million raw angular velocity data points into 24,000 feature vectors. To isolate tremors from voluntary motion, a Random Forest AI was augmented with a Sigmoid-weighting function, centered at Youden's J-Index, improving classification accuracy from 28.3% to 96.7% ($p<0.001$, AUC=0.89). This produces Severity, a novel 0-100% quantitative metric. Statistical analysis revealed the effects of motion consciousness: when participants focused, tremors worsened; when they didn't, shaking decreased. For suppression, a brushless motor system inertially generates velocity-dependent counter-torques opposing hand oscillations, stabilizing the hand. Preliminary 2-participant hardware testing demonstrated a 49.8% tremor reduction. Despite small sample size, it is consistent with the theoretical physics prediction of 56.6%. The TremorPause mobile app provides users a clinician-free 0-100% severity score, the world's first quantitative tremor assessment anyone can self-administer anywhere. Users can upload their anonymous results to a global Firebase dataset on which the AI continuously trains. Where current studies average ~43 participants, TremorPause is positioned to become the largest in the field, and the only system that gets measurably smarter every time someone uses it, at zero additional cost.

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