Upper Limb Trajectory Reconstruction using Low-Cost IMUs

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Purpose

To develop & validate a low-cost wearable sensor, then integrate it into the outREACH mHealth system to provide quantitative information about movement strategy & quality

Methods

- Twelve participants between the ages of 21 & 35 years of age
- Three prehension tasks
  - 1D task (table slide), 2D task (washer task), 3D task (pour water task)
- Kinematic movement data were collected using a 7-camera Vicon 3D motion analysis system & wearable sensor
  - 100 Hz sampling rate
  - 3 reflective markers placed on wearable sensor

Results and Discussion

- Current wearable sensors integrated into mHealth rehabilitation systems are hampered by:
  - High cost
  - Clinically uninformative data
  - Low overall system usability
- The quaternion & Madgwick compensation filtering algorithm along with SVM resulted in improved trajectory reconstruction (corr = 0.875)

Future Research & Implications

- Determine whether other machine learning techniques (e.g., RNN, HMM) can better reconstruct the 3D trajectories
- Development of reliable & valid low-cost IMU
- Integration of IMU into the outREACH tele-rehabilitation system
- Utilize tele-rehabilitation systems for individuals who do not have financial &/or physical access to rehabilitation services

References