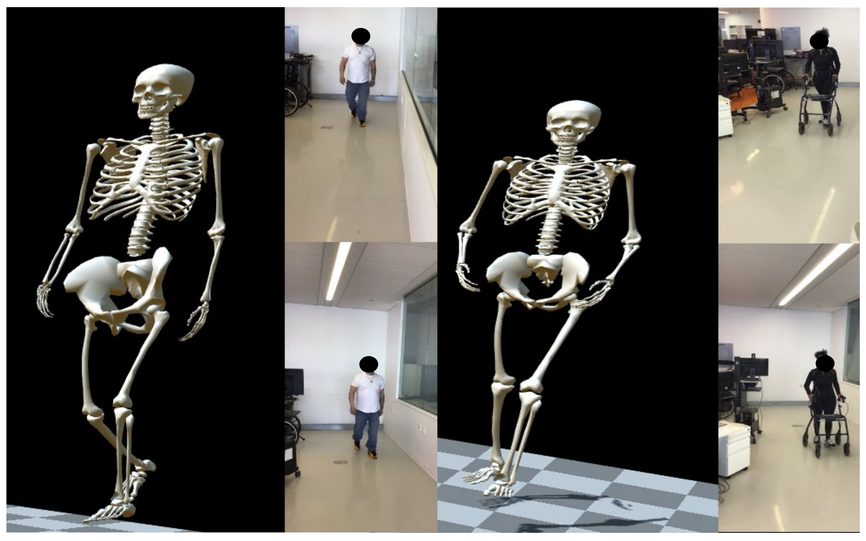
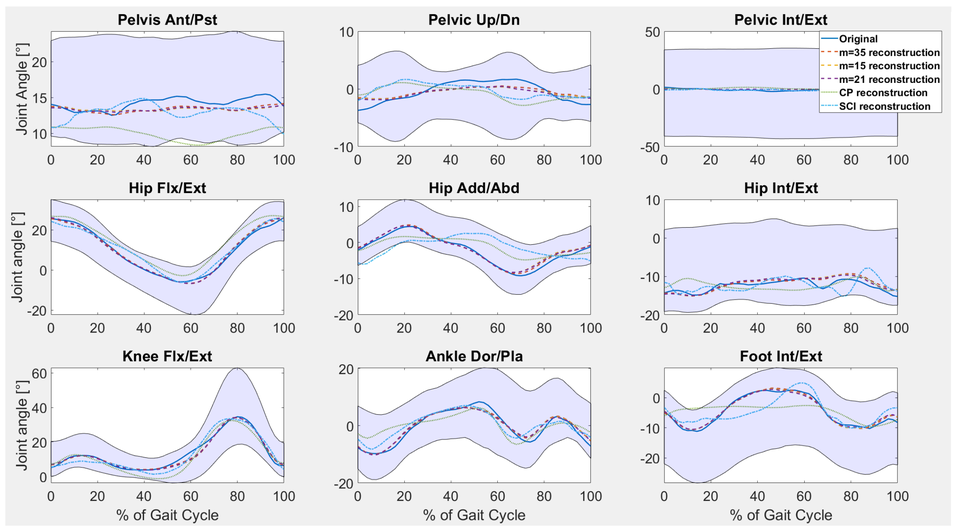
Development and Validation of a Gait Deviation Index for Individuals with Multiple Sclerosis

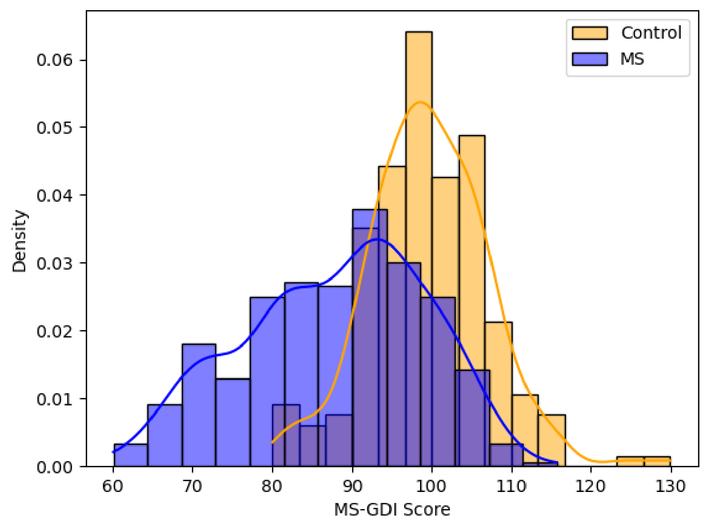
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Data collection with OpenCap marker-less motion capture



Kinematic feature extraction



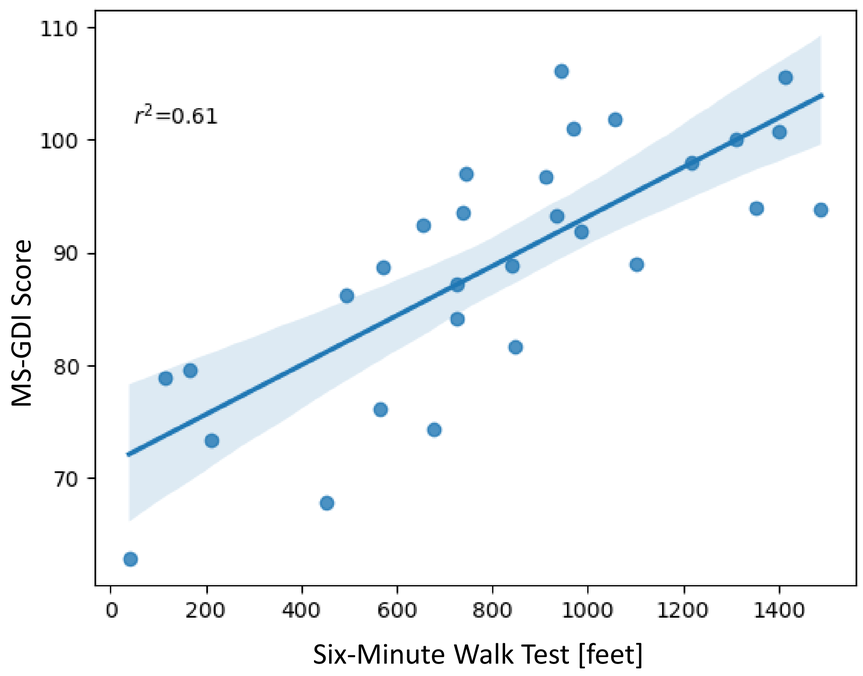
MS-Gait Deviation Index derivation

Background

- Gait dysfunction is common in individuals with multiple sclerosis (MS)[1] yet there is no widely adopted and interpretable measure of overall gait quality in clinical care.
- Gait Deviation Index (GDI) provides a single score summarizing deviation from normative gait pattern and has been used in Cerebral Palsy[2], and SCI[3].
- Recent pose estimation algorithms allow high quality 3D kinematics to be captured with low-cost equipment [4].

Results

- Have collected data from n=29 participants to data
  - n=417 individual strides
  - 95% of data used for SVD training n=396
- With a basis of f=35 features:
  - VAF: 98.92 ± 0.04%
  - ϕ native: 98.01 ± 0.04%
  - ϕ reconstructed: 86.84%
- MS-GDI has significant positive correlation with 6MWT score
  - $r^2 = 0.61$, $p<0.0001$



Methodology

Participants

Characteristic	Mean ± SD [range]
Age	55.0 ± 13.0 [31 77]
BMI	27.2 ± 5.6 [18.7 37.9]
Gender	20**F**/10**M**
Race	18 White/5 African American or Black/ 1 Asian
Ethnicity	28 non-Hispanic/2 Hispanic
Years since Diagnosis	18.9 ± 13.7 [1 45]
MS Phenotype	18 Relapse Remitting/ 5 Secondary progressive/1 unknown



Gait reconstruction with n=396 strides

Procedure

- Two iPhones connected to OpenCap software recorded gait data
- At least 5 steps recorded for each participant
- All participants completed the Six Minute Walk Test (6MWT)
- Subset of all data (95%) used for training Singular Value Decomposition algorithm
- Grid search for feature set which:
  1. Has a Variance Accounted For (VAF) ≥ 98%
  2. Reconstructs trained (ϕ native) gait cycle ≥ 98%
  3. Majority of test data reconstruction (ϕ reconstructed) ≥ 95%
- Control kinematics with MS features to generate MS-GDI
- Calculated MS-GDI for each participant

Continued Work

- Collect up to n=40 participants
- Use a new reduced number of joints model to increase generalizability
- Validate MS-GDI against other MS-specific gait measures such as 25 Feet Walk Test and Timed Up-and-Go test.

Conclusions

- Able to capture gait kinematics in MS with OpenCap system
- Generated MS-GDI based on collected walking data
- Validated MS-GDI score against clinical measures

Acknowledgements

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