The University of Texas at Austin
Cockrell School of Engineering
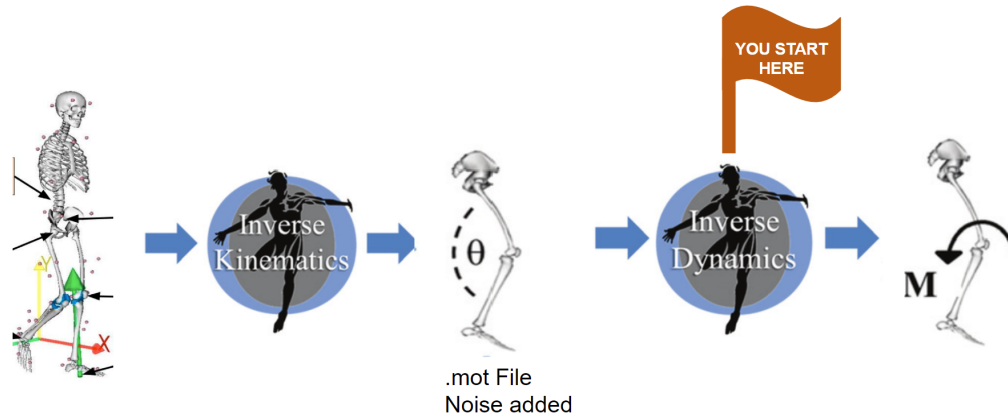
OpenSim: Hip in Motion

Python package for biomedical modeling, simulation, and analysis.

Run-Code-Repeat: Marina Espinosa, Eric Hu, and Kaleigh Renninger

Our OpenSim GitHub

OBJECTIVE:

To create and analyze a human musculoskeletal model walking within OpenSim and calculate the right hip flexion moment within the sagittal plane.

DOWNLOADS:

You MUST download all required files in order to:

1. Run our code and output the Hip Flexion Moment vs. % Gait Cycle Plots
2. Create the different musculoskeletal models

To run our code to get desired outputs (Hip Flexion Moment vs. % Gait Cycle Plots):

1. Navigate to OpenSim
   a. Follow the instructions for your specific environment to import the OpenSim Package

2. Run our code
   a. Check results of plots

To Create the Musculoskeletal Models:

1. Download the OpenSim GUI

  a. Navigate to the model ("gait2392_simbody_scaled.osim")
2. Open the OpenSim GUI
  a. Click on File
    i. Open Model
      1. Import the "gait2392_simbody_scaled.osim" model
3. Once the model has appeared in the visual window…
  a. Click on File
    i. Load Motion
      1. Select Original Data: "subject01_walk1_ik.mot" or Noisy Data: "noisedata0.5.mot", "noisedata1.mot", or "noisedata2.mot"
4. Once the desired motion file is loaded…
  a. Press play on the top of the screen
    i. Check results of simulations

BREAKDOWN OF OUR CODE:

Part 1: Retrieve Data & Add Noise

1. Import motion data ("subject01_walk1_ik.mot")
2. Convert to CSV file using pandas and numpy
3. Add normal Gaussian noise to the inverse kinematics results at different standard deviations
4. Convert CSV back to motion file:
  a. Original Data: "subject01_walk1_ik.mot"
  b. Noisy Data: "noisedata0.5.mot", "noisedata1.mot", "noisedata2.mot"

Part 2: Hip Flexion Moment Calculation

1. To calculate the hip flexion moment using the inverse dynamics module from the OpenSim package make sure the following is downloaded:
  a. The inverse kinematics motion file ("subject01_walk1_ik.mot")
  b. The experimental ground reaction force data file ("subject01_walk1_grf.xml")
  c. The scaled OpenSim file ("gait2392_simbody_scaled.osim")

Part 3: Hip Flexion Moment vs. % Gait Cycle Plots

1. Plot the Hip Flexion Moment vs. % Gait Cycle with the original data using matplotlib
2. Plot the individual Hip Flexion Moment vs. % Gait Cycle with the added standard deviations of noise using matplotlib (created within the Inverse Dynamics function (ID(...)))
3. Plot a combined plot of all the individual plots from the step above (created within the plots(...) function)

Below is the plot that combines all of our Hip Flexion Moments vs. % Gait Cycle with increasing noise levels. **Note:** the hip flexion moment values on the y-axis do not match measured hip flexion moments found in research. We plan to investigate and troubleshoot the code to resolve for future use in our research.

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