Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 6, Issue 12, December -2019

IK analysis for the Hip simulator using the OpenSim simulator

R Murasu[1], D.George Oliver[2] and R Amudhan[3]

[1,2&3]*Assistant Professor, Department of Mechanical Engineering, CK College of Engineering and Technology*

Abstract —*The model of the project to create a detailed assembly of muscles spotting the hip joint. Additional muscles and combinations were added to the baseline lower extremity assemblies currently available in OpenSim. The geometry of the muscles was adjusted to pair moment arms reported here. The slack moment and the isometric were added to the arithmetic value of the tanquntial assembly of joints*

Keywords- *Inverse Kinematics; skeleton; OpenSim; Inverse Dynamics; Marker Error*

I. INTRODUCTION

The system of the OpenSim solves the inverse kinematics problems through the output of the data analysis. The values are shown here to the movement disorders and the study of the bio mechanics frequently for the support of the computational tools. The OpenSim computes the common qualities for the computing.
OpenSim has tools for computing these quantities:

1. *Inverse kinematics* is used to analyse joint angles.
2. *Inverse dynamics* is used to analysis net joint reaction forces and joint moments.

Inverse kinematics computes the joint angles for a musculoskeletal model that best reproduce the motion of a mechanics. *Inverse dynamics* then use joint angles, angular velocities, the angular acceleration of the materials were proposed to the withheld of the mechanics to be hand over the regular dynamics analysis to the concern of the inverse to be analysis to manipulated and analysis.

II. EXPERIMENTAL INVESTIGATION

2.1 Generic Musco Skeleton Models

In this work, using a generic musculoskeletal model with 23 degrees of freedom and actuated by 54 muscles entitled 3DGaitModel2354.
To load the generic musculoskeletal model into OpenSim:

- Click the File menu and select Open Model. Find the *Gait2354_Simbody* folder default OpenSim resources directory— \Documents\OpenSim\Models for PC and Mac.
- Note: First launch OpenSim, prompted to provide a path to install the resources folder, the default is in the systems Documents folders.
- Open the *Gait2354_Simbody* folder, select the file *gait2354_simbody.osim*, and open

The subject analysis of the OpenSim to evaluate the analysis involves (i) **the properties of the scaling depends upon the load ,physical dimensions and the properties of the load factor , simulation factors were upload in the format as values** (ii) The registering the value of the approach has been incorporated to the scalling and the module of the subject were know to the concepts were the feedback and the analysis data were given to the scope of the index for the valu occupying to demonstration and the simulation generic gait2354 skeletal model to the dimensions of a subject has experimental data.

2.2 Model Scaling

Mass and Inertia center of the simulation were identically specified for the scaling through
(1) Manual Scaling: The auto analysis if the scaling sometimes will incomplete the format to run the analysis so deviation of the points were measured to develop a entry of the data for the muscular scale.
(2) Measurement-based Scaling: the specified points of the measure and were scaled through the performance based and the scaling based the specify points of the physical phenomenon were properties were identified

2.3 Inverse Kinematics

The marking performance of the IK are identified and specified for the particular mass moment of the physical dimensions and the moment factor were the position of the kinemtic vector and the kinamtics vector will have the scope to determine the marker for the further more movement of the coordinated from which the motion is initialized. The mtion then captured for thee total force of the vector analysis for the momentum and the axis to balance the body with respect for the position and the direction mode. The work done and the energy depends upon the minQ and the genelerized vision of the function qualities and the marker identified the joint angles and the inverse kinematic analysis

$$\min_{q}\left[\sum_{i\in \text{markers}} w_i \left\|\mathbf{x}_i^{\text{exp}} - \mathbf{x}_i(\mathbf{q})\right\|^2\right]$$

Where q is the vector coordinates (e.g., joint angles), x_i^{exp} is the position of *experimental marker i*, $x_i(q)$ is the position of the corresponding *model marker i* (which depends on q), and w_i is the weight associated with marker *i*.

2.4 Inverse Kinematics Motion

.The force and the momentum of the body requires the mass and the acceleration of the body to be on the experimental analysis on the residual motion. Due to errors in the experimental motion data and inaccuracies in the musculoskeletal

model, it turns out that Newton's second law is violated, or $\vec{F}_{\text{exp}} \neq m \cdot \vec{a}$. One method to handle this inconsistency is to compute and apply residual forces and moments to a particular body segment in the model, such that Newton's second law becomes:

An analogous equation relates the ground reaction moment, $\vec{M}_{\text{exp}}$ to the residual moment, $\vec{M}_{residual}$. In this musculoskeletal model, the residuals are applied to the pelvis segment.

To see the residuals from the inverse dynamics solution, in a new plot window, Plot pelvis_tx_force, pelvis_ty_force, and pelvis_tz_force versus time. While applying residual forces and moments makes the model's motion dynamically consistent with the external forces $(\text{i.e., } \vec{F} = m \cdot \vec{a})$, The strageties form the analysis of the square to the arithmetic and logrethemic analysis to cooperating the vectors to lie on the same systems on the residual of the data on the following additional information on the axis deformation and angulatior affirmation of the x,y,z -squares optimization the Residual Elimination Algorithm (REA) and the Residual Reduction Algorithm (RRA). OpenSim implements a Residual Reduction Algorithm as part of its workflow for generating muscle-actuated simulations. A detailed explanation of the Residual Reduction Algorithm (RRA) can be found on the Residual Reduction Algorithm page of the documentation. For additional information on these strategies, The figure shows a data accrued between the tangential force of the x,y,z where the load acting is lenient and propagate through the angle of the prospects to the body to balance the weight while the body is in motion and shows to constraints points activated to balance the dynamic properties to with the balance.

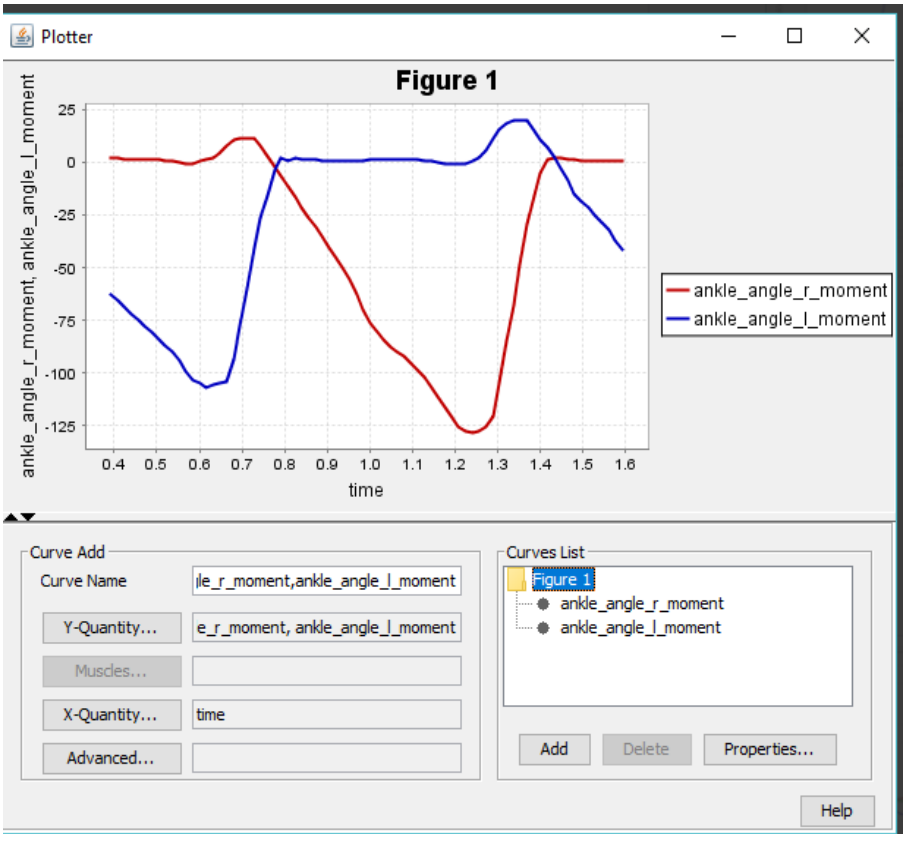

Figure 1. Kinematic Tools

2.5 Motion analysis

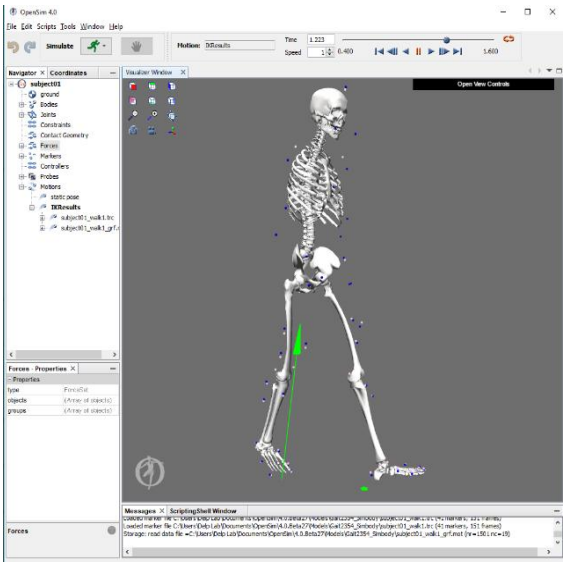

Figure 2. Dynamatic Tools

Structural balance is some important on analysis the data on the point of the gesture of the physical experiments and the value analysis for the function of the kinematics and the reverse kinematics to maintain the balance in the axis the physical momentum to balance the entire structure on the axis of the load and the moments applied

III. ACKNOWLEDGMENTS

Fig. 3 shows the experimental gait data were collected on OPenSim. The data include marker trajectories and ground reaction forces for an adult male walking at a self-selected speed on an instrumented split-belt treadmill.

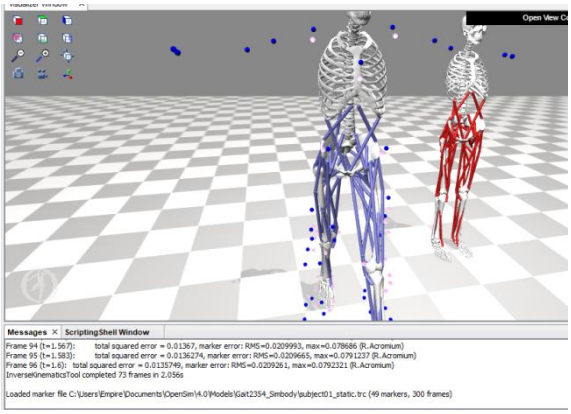

Figure 3. Kinematics plotting

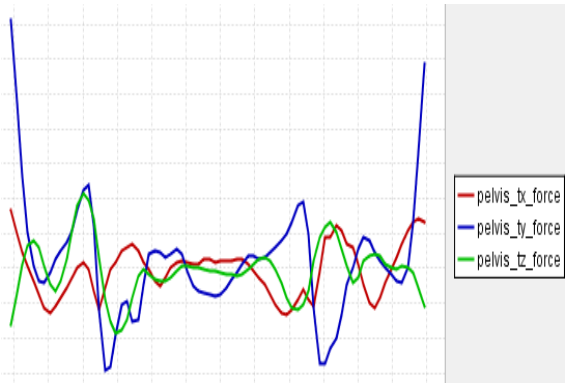

Figure 4. Pelvis inverse kinematic simulation

Fig.4 pelvis simulators shows a absolute and relevant data plotting in the point where the loads vary with the point constraints the pink and the blue colour conserves the preservatives of the modified and the colour red forms the difference of the load factor

IV. CONCLUSION

The curvature of the path determines the appends of the pelvic and the curve (i.e., left leg and right leg). The toe-off coordinated slide over the axis to make the structure stable It may be useful to use the Coordinate sliders to understand the angle convention for the ankle. The maximum magnitudes of the residual forces using the mass of the subject from fraction of body weight are the maximum residual moments acting on the entire force acting on the structure to balance the body mechanics.

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