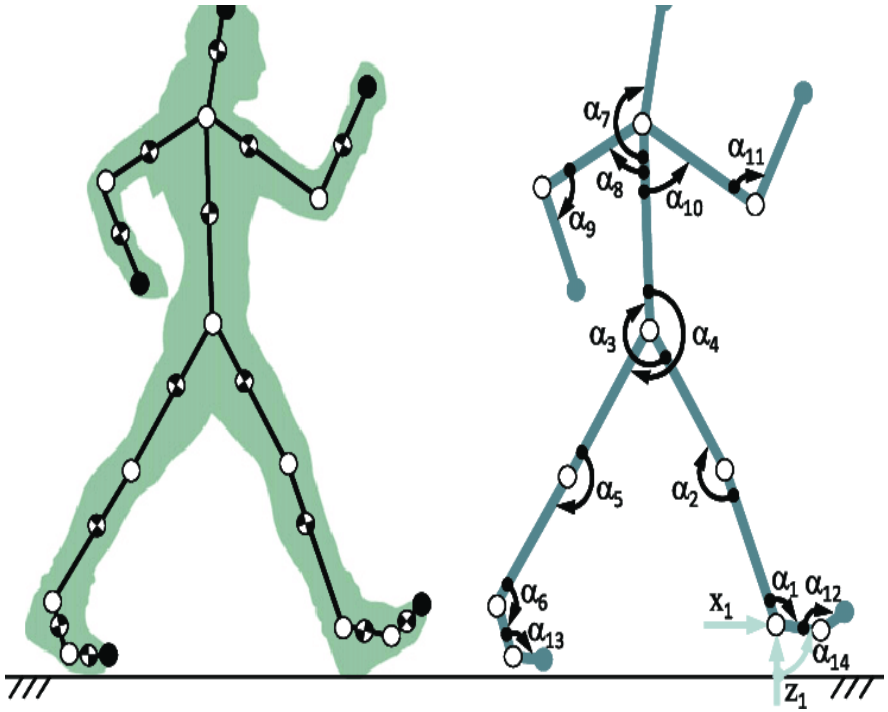
# Understanding the Inverse Dynamics Model of the Human Body

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# BIOMECHANICS

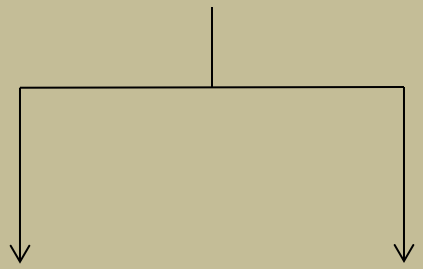
Study of the mechanics as it relates to the functional and anatomical analysis of biological systems and especially humans.

Necessary to study the body's mechanical characteristics & principles to understand its movement.

# BIOMECHANICS

Mechanics - *Study of physical actions of forces*

Mechanics is divided into



Statics – Dynamics

# BIOMECHANICS

**Statics** - study of systems that are in a constant state of motion, whether at rest with no motion or moving at a constant velocity without acceleration.

**Statics** involves all forces acting on the body being in balance resulting in the body being in equilibrium

# BIOMECHANICS

**Dynamics -** study of systems in motion with acceleration.

A system in acceleration is unbalanced due to unequal forces acting on the body.

# BIOMECHANICS

## Kinematics & kinetics

**Kinematics** - description of motion and includes consideration of time, displacement, velocity, acceleration, and space factors of a system‘s motion.

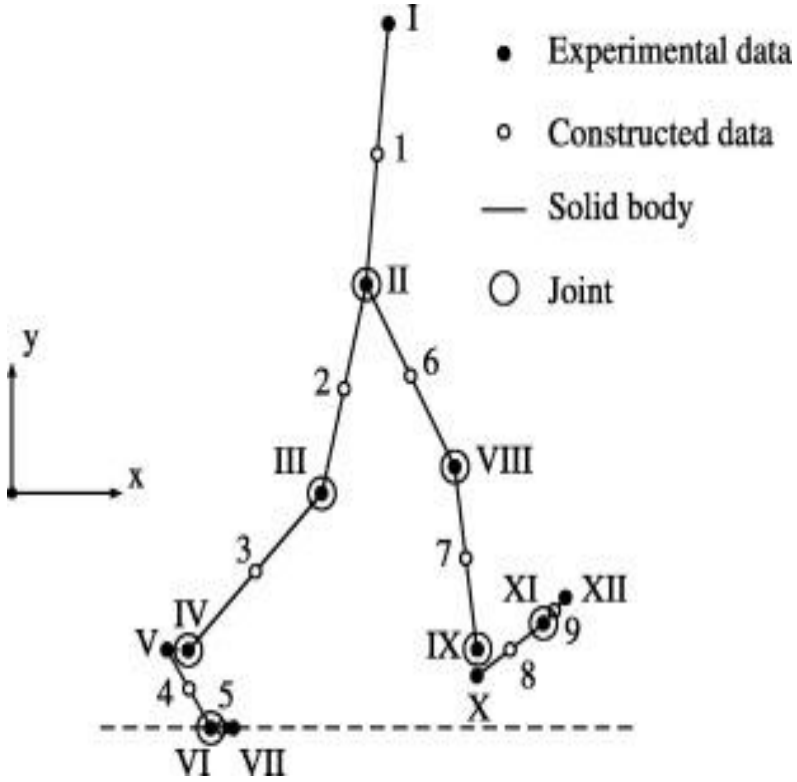
**Kinetics** - study of forces associated with the motion of a body.

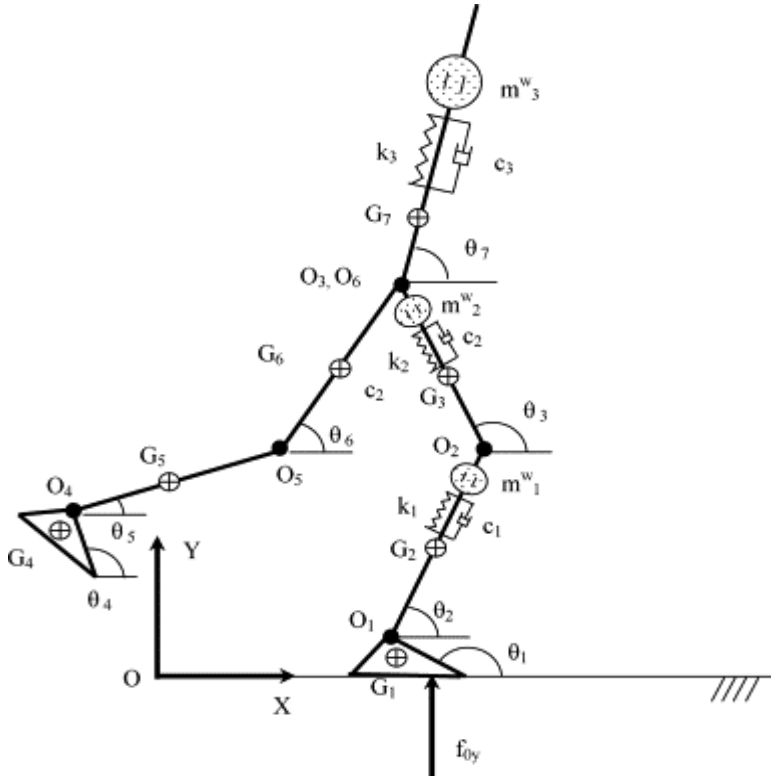
# BIOMECHANICS

**Inverse dynamics** is a technique in which measured kinematics and, possibly, external forces are used to calculate net joint torques in a rigid body linked segment model.

# BIOMECHANICS

## Inverse Dynamics



# BIOMECHANICS

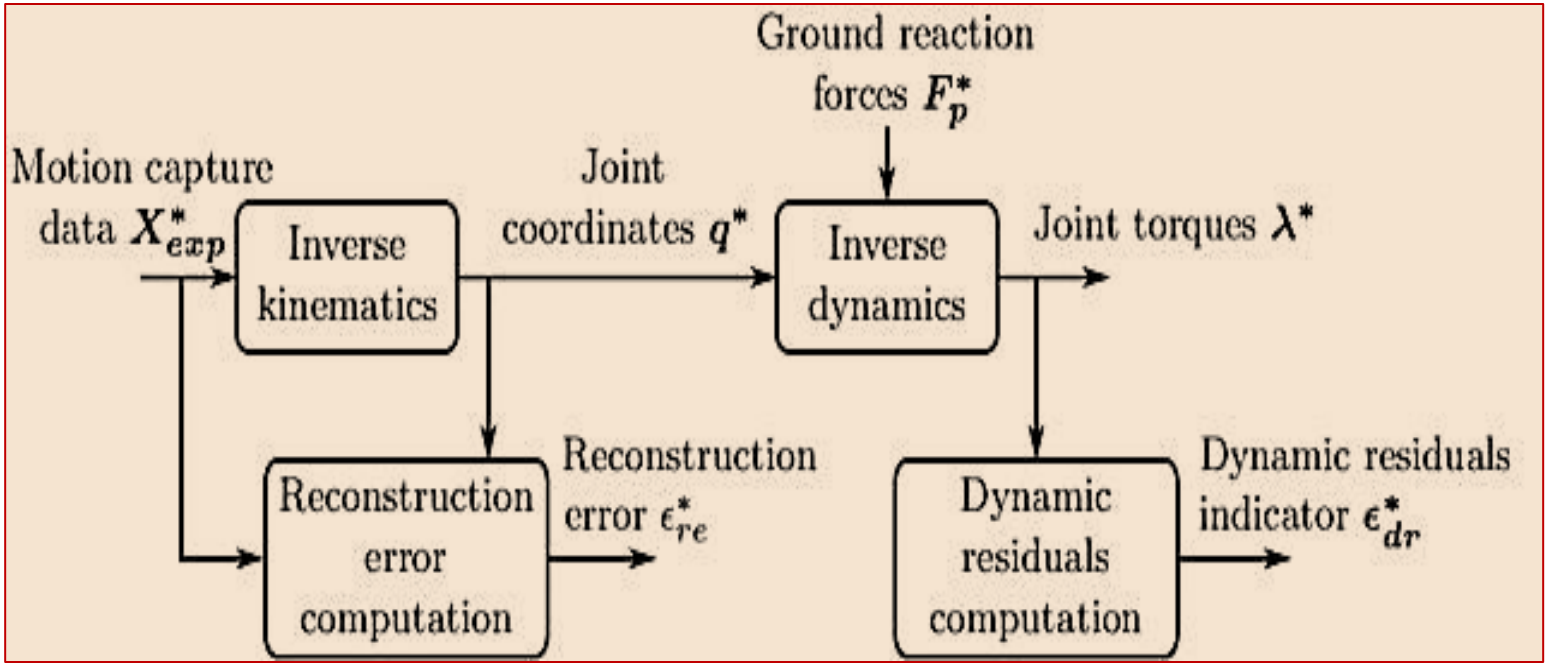
**Inverse dynamics** In the field of biomechanics, inverse dynamics analysis is commonly used to investigate aspects of the mechanics, energetics and control of movement.

An inverse dynamics analysis is typically based on measurement of the kinematics of the body segments, often complemented with measurement of selected external forces (e.g. the ground reaction force).

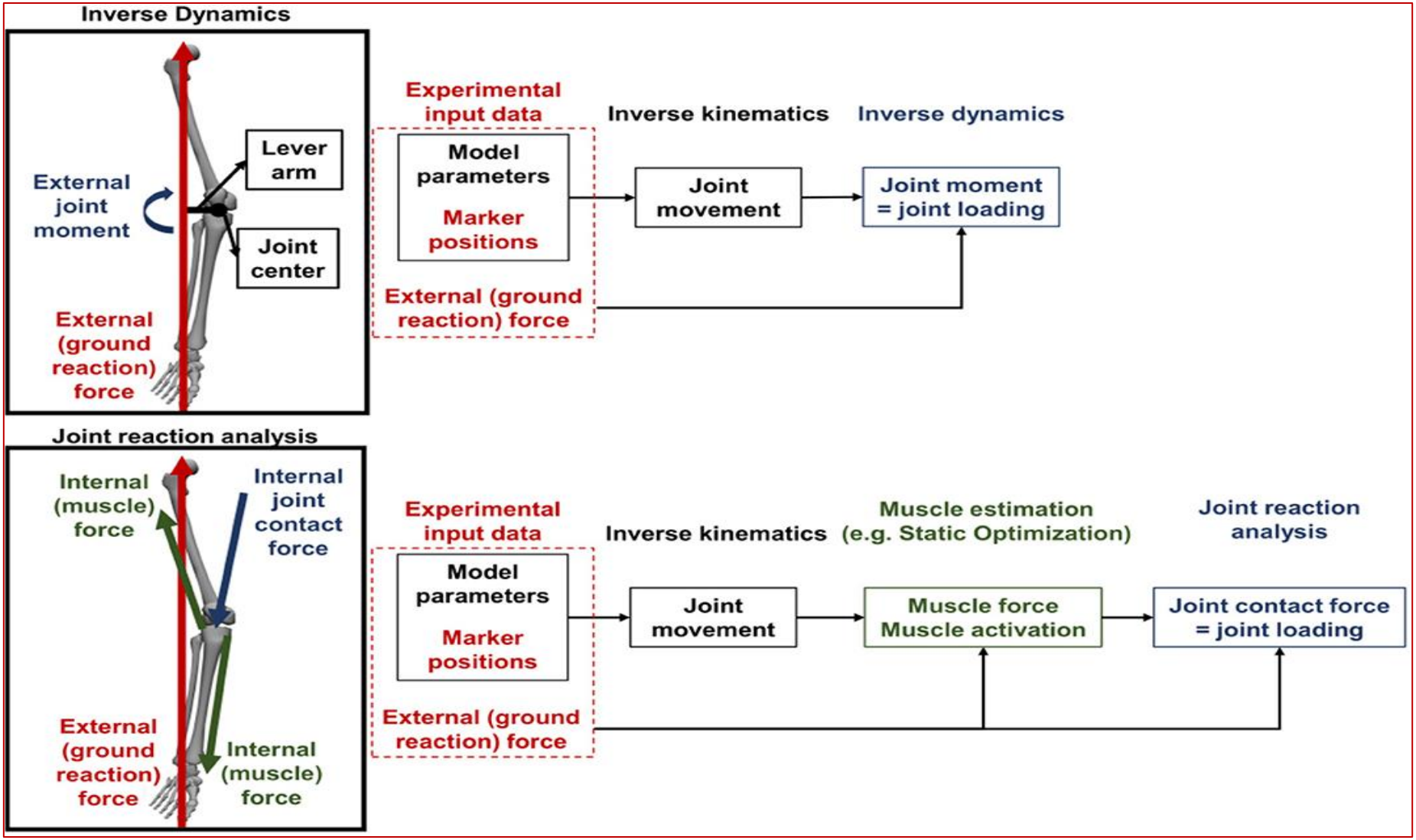
Using these data, the net joint torques and net joint reaction forces are calculated using Newton's equations of motion applied to a model containing a (chain of) rigid segments .

# BIOMECHANICS

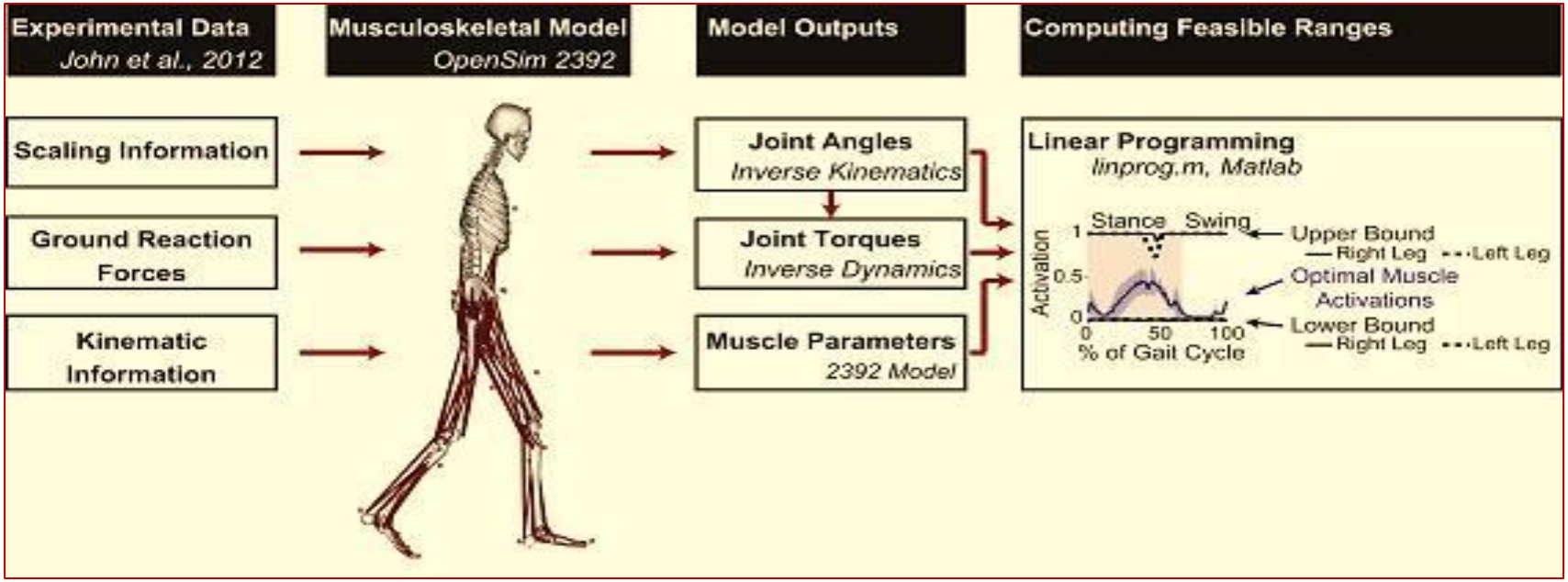
## Biomechanical Functioning



# Biomechanical Functioning - Representation



# OPENSIM MODELING



# OPENSIM MODELING

## Scale Modeling

Adjusted Body Weight with Default Model

Default Model Weight : **80.45 Kg**

Adjusted Model Weight : **54 Kg**

# OPENSIM MODELING

## Inverse Kinematics

Co-ordinate Values acquired during Karate Kick.

From Video its projections validated

Using Projections, created **.trc file** [ track row column file ]

# OPENSIM MODELING

## Inverse Dynamics

Based on output of Inverse Kinematics **.mot file** [motion file], inverse dynamics of the karate kick data acquired in the form of states **.sto [ torques ]**

# OPENSIM MODELING

## Static Optimization

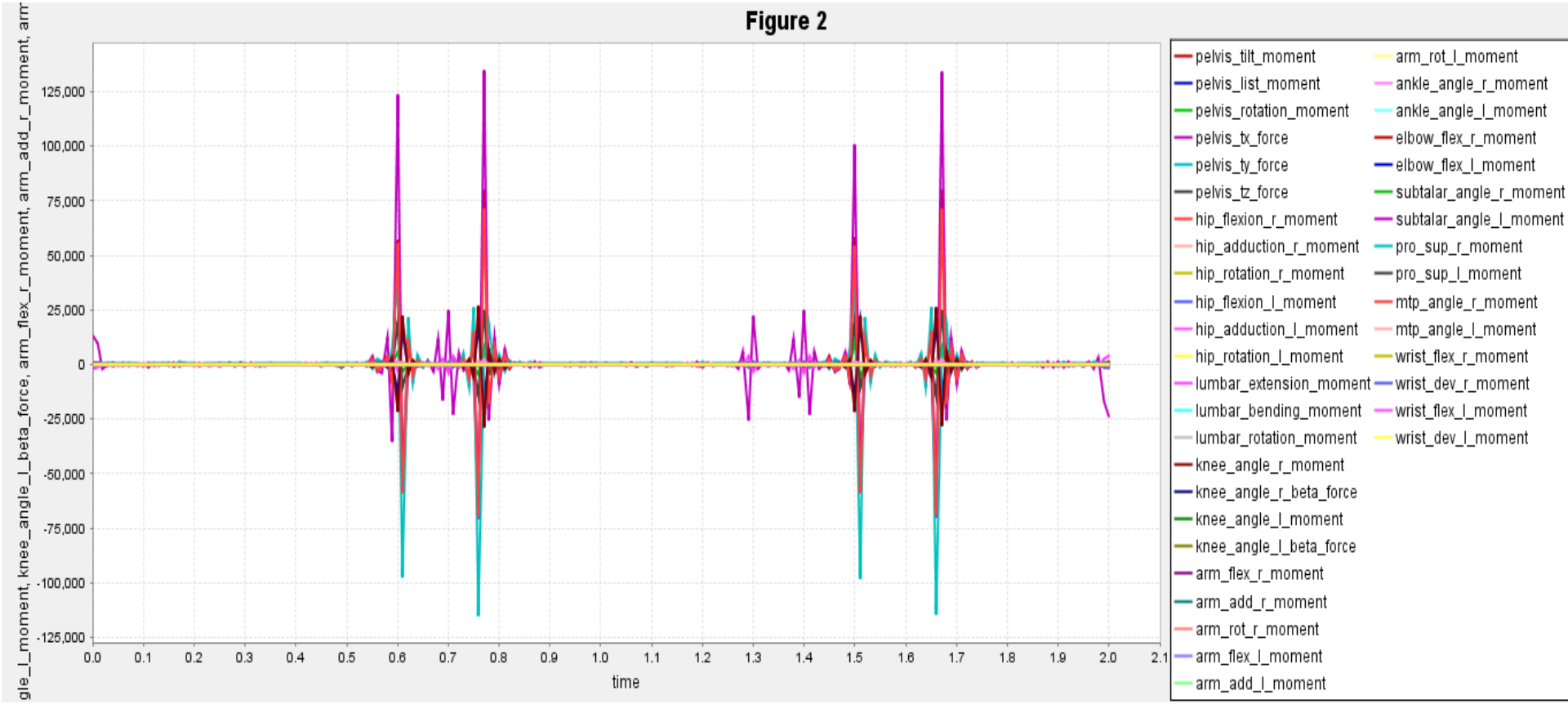
Based on **.mot** and **.sto, muscle and joints activation and forces data** acquired using the Static Optimization tool

# OPENSIM MODELING

## Computed Muscle Control

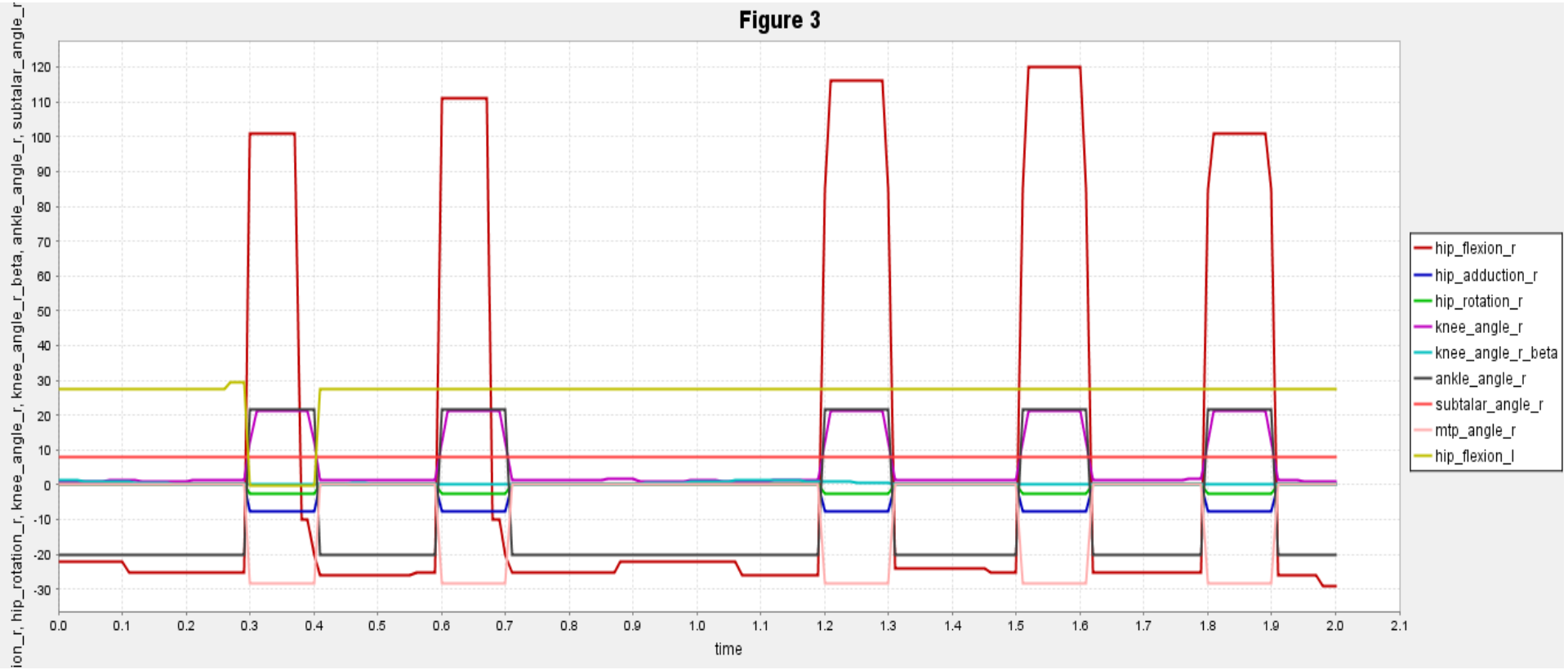
Based on **.mot** and **.sto**, **muscle and joints activation and forces data** acquired from the Static Optimization tool used for execution of CMC tool [Computed Muscle Control], helped to analyze **Body, muscle and joints Kinematics and kinetics.**

# OPENSIM MODELING



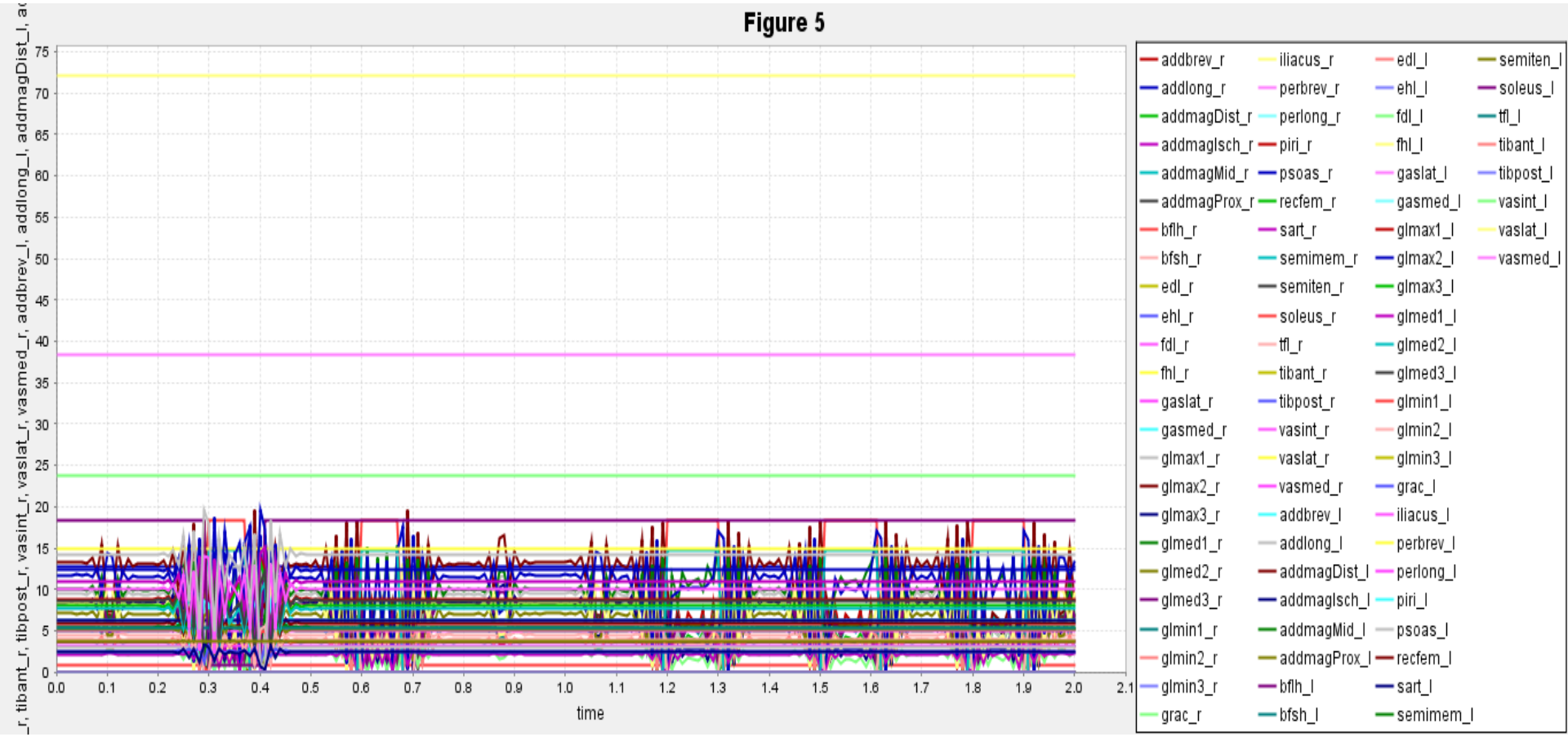

Inverse Dynamics Responses of all the joints during karate kick - Torques

# OPENSIM MODELING




Inverse Dynamics Responses of Right Leg during karate kick - Torques

# OPENSIM MODELING




Inverse Dynamics Responses of muscles during karate kick – Fiber Forces

# Thank you

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