In Vivo Lumbar Spine Biomechanics during A Sagittally Symmetric Lifting Task

Ameet Aiyangar: **Empa**, *Swiss Federal Laboratories for materials Science and technology, Switzerland*

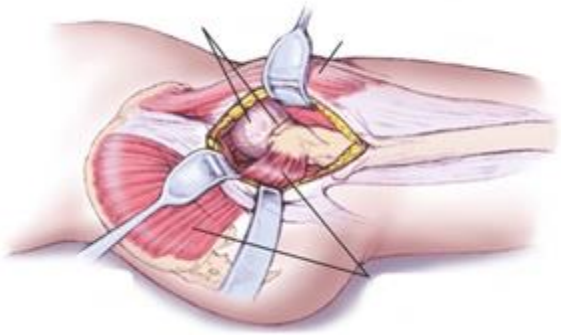
Project Goal:

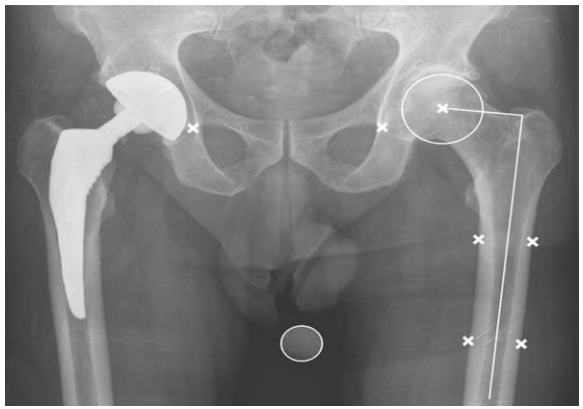
- Implement OpenSim model with a combination of
  - Digital Stereo-Xray based 3D bone kinematic data
  - Vicon based surface marker data
- Implement the workflow to obtain Joint reaction forces at the intervertebral joints

Biomechanical Outcomes Following Total Hip Arthroplasty

Jasvir S Bahl
School of Health Science, University of South Australia

My project investigates the restoration of hip joint geometry following total hip arthroplasty and its effects on gait, joint contact loading and muscle forces.



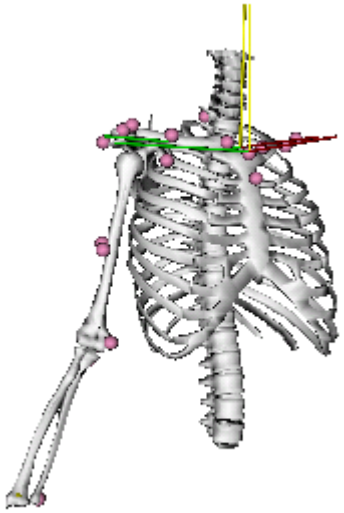


Modelling felids

Andrew Cuff (Royal Veterinary College, UK)

- Modern cats maintain a crouched posture at all body sizes (1kg-300kg)
- Dissections shows that muscle metrics (masses, fibre lengths, forces) mostly scale isometrically.
- Aim to develop SIMM/OpenSim models for the fore- and hindlimbs of a big and small cat (lion and domestic cat).
- Output from these will give muscle activation and forces during locomotion to test for differences.
- Ultimately create models for vertebral columns combined with limb data, and create models for some extinct felid species.

Kinematic analysis of the upper limb motions



Cristina Curreli - PhD student at Pisa University (Italy)

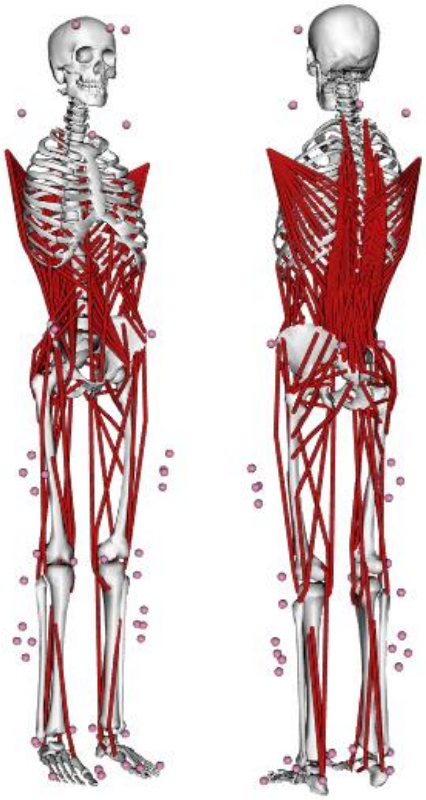
The main object of the workshop project is to analyze some motion data of the upper limb with two different musculoskeletal models developed by the OpenSim community.
The comparison of the results wants to point out the influence of different kinematic chains definition in the kinematics analysis.

Musculoskeletal Modeling for Investigation of Low Back Pain

Clément Favier, Imperial College London

The project aims at developing a combined MSK and FE model of the lumbar spine to investigate low back pain. Joint reaction forces and muscle forces obtained with the MSK model are used as boundary condition in the FE model.

To account for balance and stability strategies, a full body MSK model is developed. It is based on bone geometry segmented from MRI images of a single volunteer to insure consistency throughout the model, but also with the FE model of the lumbar region.



FASTBall Project

Xavier GASPARUTTO – Technical University Delft

The project aim at getting a better understanding of the biomechanics of baseball pitching

-> Two Goals: Increase ball speed and reduce injuries

-> Collaboration between various partners

- Academy: TU Delft, VU Amsterdam
- Sport field: Dutch Baseball federation (KNBSB)
- Medical field: ManualPhysion

Goal of the workshop

- Better understanding of Opensim tools (IK, SO, IAA)
- Get the model running and estimate muscle forces

The amount of hamstring release to normalize gait performance in crouch gait

Christian Greve, Human Movement Scientist,
Department of Rehabilitation Medicine, University Medical Center Groningen, The Netherlands

Aim was to establish the possibilities and limitations of OpenSim to model the optimal amount of hamstring release needed to normalize gait performance in crouch gait.

Physiological markers for impaired muscle function in knee osteoarthritis

Jan Henriksson, Department of Physiology and Pharmacology, Karolinska Institutet, SE-171 77 Stockholm

An important part of this project is to investigate movement pattern and joint loads in some selected everyday movements. For this we sample data with the Vicon Plug-in-gait system and perform analysis in OpenSim. The relevance of the project is to use its results to prevent the worsening of knee osteoarthritis and improve evidence-based conservative (non-operative) treatment in early and moderately developed knee osteoarthritis.

Scaling, IK and Forward Dynamics of a CP model,

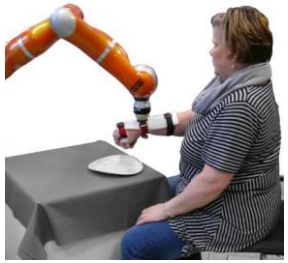
Andrés F. Hidalgo, CSIC(Spain)

The purpose of the project is the design of assistive control strategies to improve the mobility in some pathological gaits. To this end we expect to scale a CP model and to perform some predictive simulations. Additionally, we expect to see the effect that some added actuation can have in the fmodel movement.

Individualized rehabilitation therapy by self-adapting robotic assistance

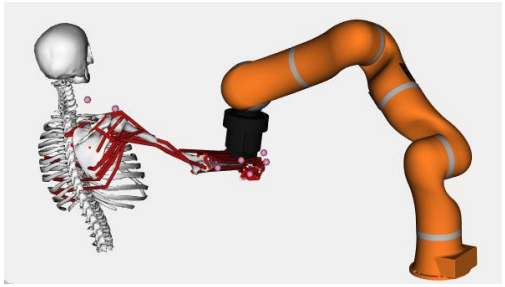
Sonja Husmann, Institute of Automatic Control,
RWTH Aachen University

The project handles with individual rehabilitation on upper extremities. A lightweight robot is used to lead the arm of a patient, while the patient is exercising a movement. For example a stoke patient needs to redo a movement many times, to perform a movement independently.



My part of the project is to control the movement of the robot. The robot has seven axes and because of that seven degrees of freedom. So the position of the robot arm could be chosen while the tool center point do not move.

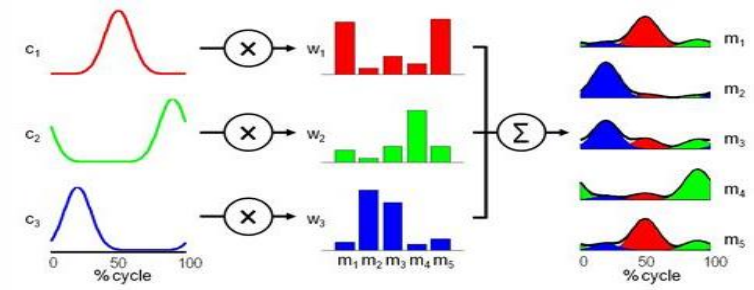
Furthermore the stiffness of the robot can be changed to give the patient a individual amount of help.



Prediction of muscle EMG and joint torques in Healthy and Amputee Subjects

Pouyan Mehryar (Master of Mechanical and Medical Engineering)
Ph.D. candidate in Mechanical-Engineering - Institute of Design, Robotics and Optimisation (iDRO) – University of Leeds - UK

This project aims at predicting joint moments, muscle forces, muscle excitations, and muscle co-contraction in healthy, transtibial and transfemoral subjects using experimental EMG signals and three dimensional joint angles.
In addition, instead of EMG, set of activation profiles and weighting factors can be used as inputs to estimate excitation.



Three neural control solution algorithms are used:

a) EMG-driven mode (Open Loop)
b) EMG-assisted mode (Close Loop)
c) Static optimization mode

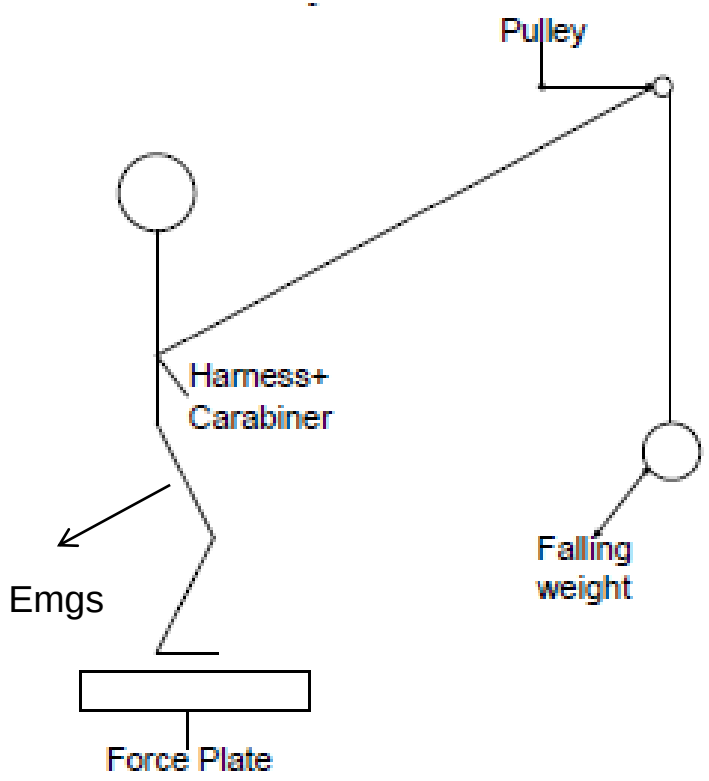
“Hamstring biomechanics in sprinting”

Olli Okkonen
University of Bath

Aim is to analyse sprint running and hamstring muscle biomechanics to produce information that could be used in prevention of hamstring injuries.

Influence of muscle pre-activation in recovery balance-My Goals

Alice Palazzo, Phd student, University of Genova



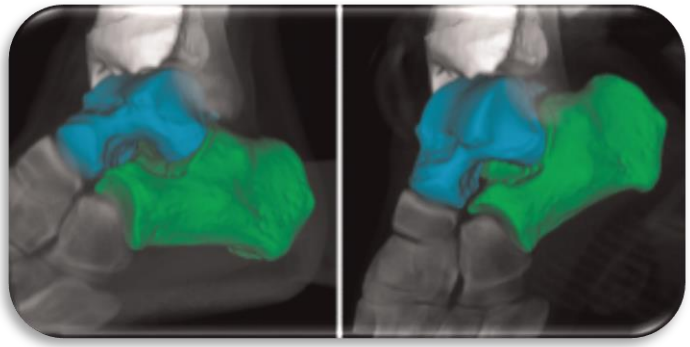
1. External Forces
2. Contact Geometries
3. Muscle Behaviour

Foot and Ankle Biomechanics and Imaging

Wouter Schallig, VU medical Centre Amsterdam

- The project aims to evaluate and develop existing and new biomechanical ankle/foot models informed by detailed information from musculoskeletal imaging and driven by the clinical need for appropriate information

- The ankle/foot model will be used to develop personalized medicine for CP and OCD patients, related to foot surgery, calf muscle function, and ankle loading.



Knee stability in patients with osteoarthritis

Jim Schrijvers, VU medical centre, Amsterdam

- **63% -74%**[1-3] of the patients with knee osteoarthritis (OA) report knee joint instability during daily activities.
- There is **no universally accepted objective measure** for dynamic knee joint stability.

Goal of project is to develop a reliable and valid objective measure for knee joint stability during gait in knee OA patients

Literature: 1. Knoop et al. 2012, 2. Ramsey et al. 2007, 3. Skou et al. 2014
Pictures: http://health.usnews.com, http://www.atlasinteriors.co.uk

Validation of lower limb joint kinematics

Rob van der Straaten – Hasselt University

To evaluate the kinematics and kinetics of functional movements from healthy persons, persons with knee osteoarthritis / replacement

Effects of acromioclavicular joint injuries in shoulder movement

Tran Vi Do
BioRobotics Institute, Sant'Anna di Pisa, Italy

A model of the shoulder with acromioclavicular joint dislocation will be proposed.
The goal of this biomechanical model is to estimate motion kinematics of the shoulder movement with different types of Rockwood acromioclavicular dislocation and to help evaluation of the recovery of the patient after treatment.

Balance Control during plate perturbations

Tom Van Wouwe

To study motor control during balance, the goal is to compare predictive simulations of musculoskeletal models with optimal feedback as a control strategy to experimental data. In this manner we want to validate the whether optimal feedback is a possible physiological control strategy. The other goal of the project is to relate the optimization criteria of the predictive simulations to different possible strategies for balance control (e.g. ankle vs hip strategies).

During the OpenSim Workshop I will process the experimental data of subjects that are standing on a force plate that exerts short but fast translations. The subjects restore their pose of these perturbations relying on their balance control.

Calculation of knee joint contact forces using Grand Challenge competition experimental data set

Azin Zargham, PhD kandidate, KU Leuven

1) Importing experimental data including marker trajectories, joint angles, and force data (using Grand Challenge data set)
2) Scaling a generic model of knee joint to match the Grand Challenge experimental data
3) Performing inverse kinematics analysis to estimate developed model's kinematics and kinetics
4) Performing inverse dynamics analysis to calculate muscle and joint forces and compare them with Grand Challenge data set.
5) Performing Joint Reaction analysis to calculates the resultant forces and moments in the knee joint and compare calculated contact force with Grand Challenge data set.

Intrinsic foot muscle length change during walking and running

Xianyi Zhang, KU Leuven

The project aims at estimating the intrinsic foot muscle-tendon (e.g. Abductor hallucis) length change during walking and running with a multi-segmental foot model.