Musculoskeletal Atlas Project

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Te Whare Wānanga o Tāmaki Makaurau

Musculoskeletal Atlas Project (MAP) Overview

- Why
- Goal
- Challenges

Why?

- Increasing epidemic of Musculoskeletal disorders
  - Diabetes
  - Osteoporosis
  - Osteoarthritis
  - Patella-femoral pain
- Who is going to pay for the increase in these disorders

An interesting question?

- What do these Musculoskeletal disorders have in common?

If we understand the mechanical environment of the tissue as well as the tissue response to loads we have a chance at designing an appropriate intervention strategy

Goal

- One goal of the Musculoskeletal group is to create Musculoskeletal models to predict clinical outcomes and personalize treatment strategies.

This is the ultimate goal which is some way off.

Challenges to Clinical Implementation

1. Creating patient specific models
2. Validating the models
3. Implementing the models to do clinical prediction

1. Patient Specific

- Treatments have generally been standardized for the many rather than the few
- We aim to move away from this and look at patient specific models
- A typical workflow for creating Musculoskeletal models
  - Take some image data in which we want to define some geometry
  - Apply some material properties
  - Look at whole joint kinematics or motion data
  - Estimate some boundary conditions muscle-joint forces
  - Apply this to understanding tissue level stresses and strains

2. Validation

- It is often very difficult to measure some of the variables of interest.

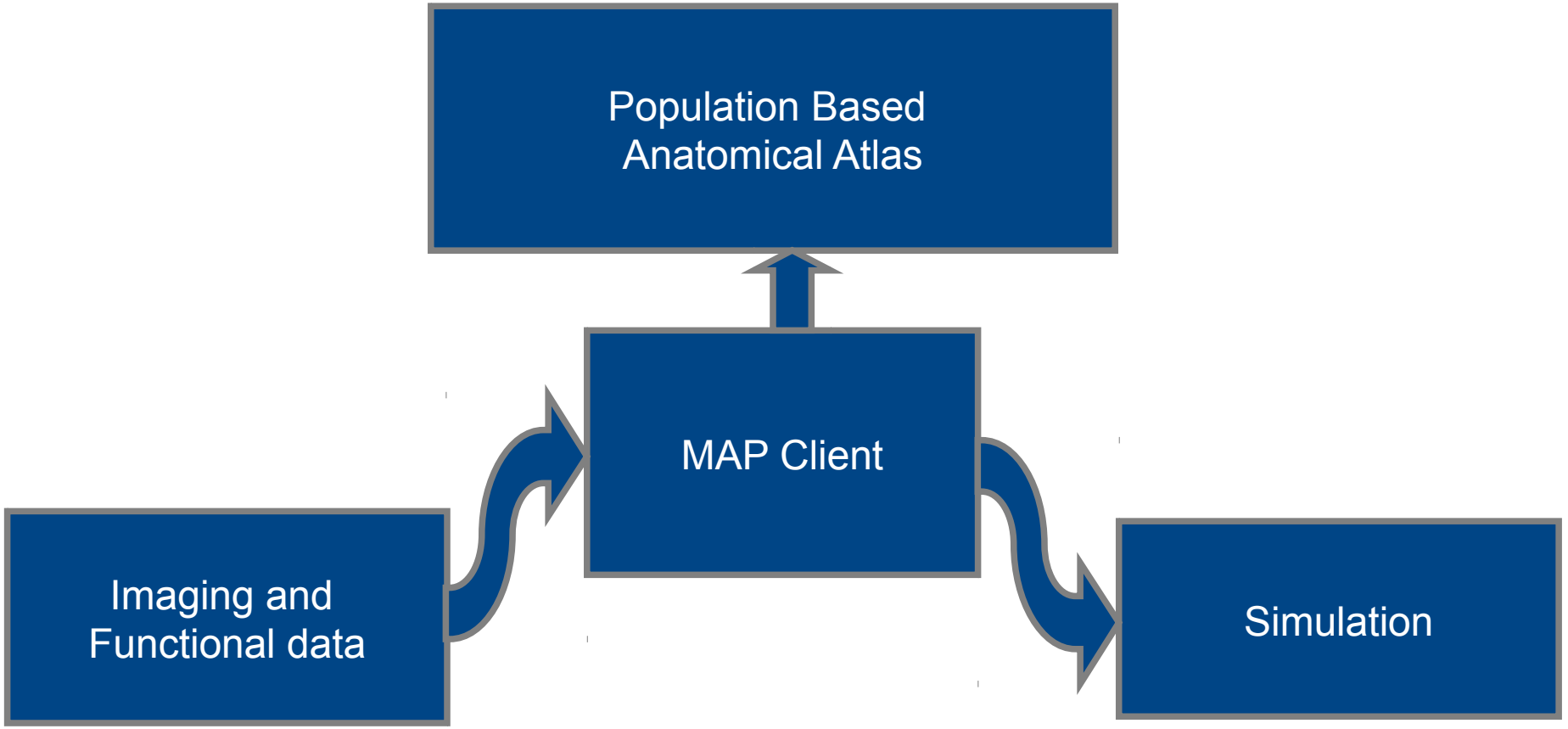
3. Clinical Prediction

- A Clinician does a clinical examine
- Tries various method
  - Strapping
  - Bracing
  - Surgery
- Assist this process with information taken from the modeling – smarter interventions

MAP Client

- The MAP Client looks to address the first problem.
- Creating subject specific models, which is a current bottleneck in this problem.
- A typical workflow has multi-level body dynamics
  - Use OpenSIM for rigid body dynamics at the organ level
  - Get boundary conditions for the tissue level
  - Use OpenCMISS-Iron for simulations to investigate tissue level stresses using the boundary conditions determined above
- Typically we see a disconnect between these two models
  - OpenSIM model doesn't take into account accurate geometries.
  - Accurate geometries a critically important for calculating contact forces.

MAP Framework



MAP Client

- We decided to create a client side Python application
- Have a plugin architecture for extensibility

Python for non-programmers, enabling many people to adopt and create their own workflows and workflow steps

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