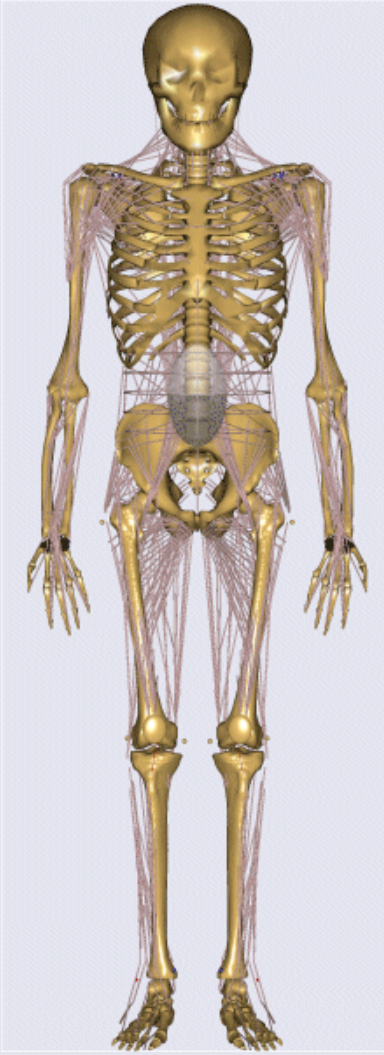
AnyBody Model Library Updates



Søren Tørholm

The web cast will start in a few minutes….

Why not spend the time checking these points:
Does your screen fit the presentation?
Try this:
The “Sharing” menu (upper right corner)->View->Autofit

Is your system set up to receive the broadcasted sound?
Please follow these instructions to set up the audio:
www.anybodytech.com -> Events->Webcasts (bottom of the page)

- Introduction
- Body models
  - Overview of body models
  - Twente Lower Extremity Model
  - Scaling: DEMO
  - Selected output :DEMO
  - Generic body models: DEMO
- Applications
  - Overview of applications
  - New applications
- License terms
- How to obtain the models

ANYBODY TECHNOLOGY

Presenters

Søren Tørholm
(Presenter)

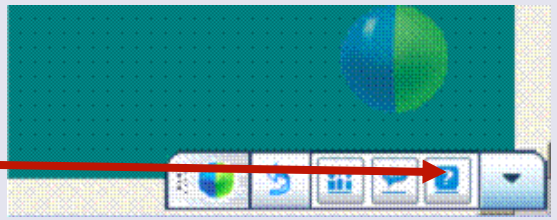
Casper Gerner Mikkelsen
(Host)

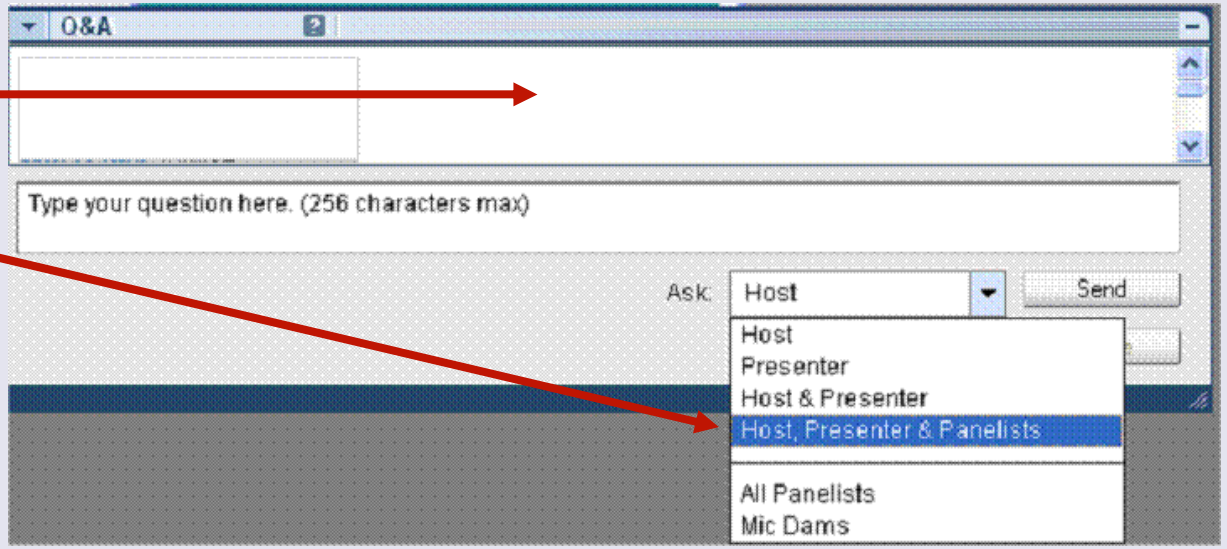
Sylvain Carbes
(Panellist)

ANYBODY TECHNOLOGY

Q&A Panel

- Launch the Q&A panel here.
- Type your questions in the Q&A panel.
- Send the question to ”Host, Presenter & Panelists”





Notice the answer displays next to the question in the Q&A box. You may have to scroll up to see it.

ANYBODY TECHNOLOGY

Difference with normal approach

- Most research groups start with a problem and build a model to solve that particular problem
- We want to build **general models**, which can give information about a number of yet unknown problems

Our goal

- To develop general detailed models which:
  - can predict muscle, ligament and reaction forces for a given movement.
  - will facilitate sharing of the model.
  - will give the opportunity to scrutinize and improve the model by other groups

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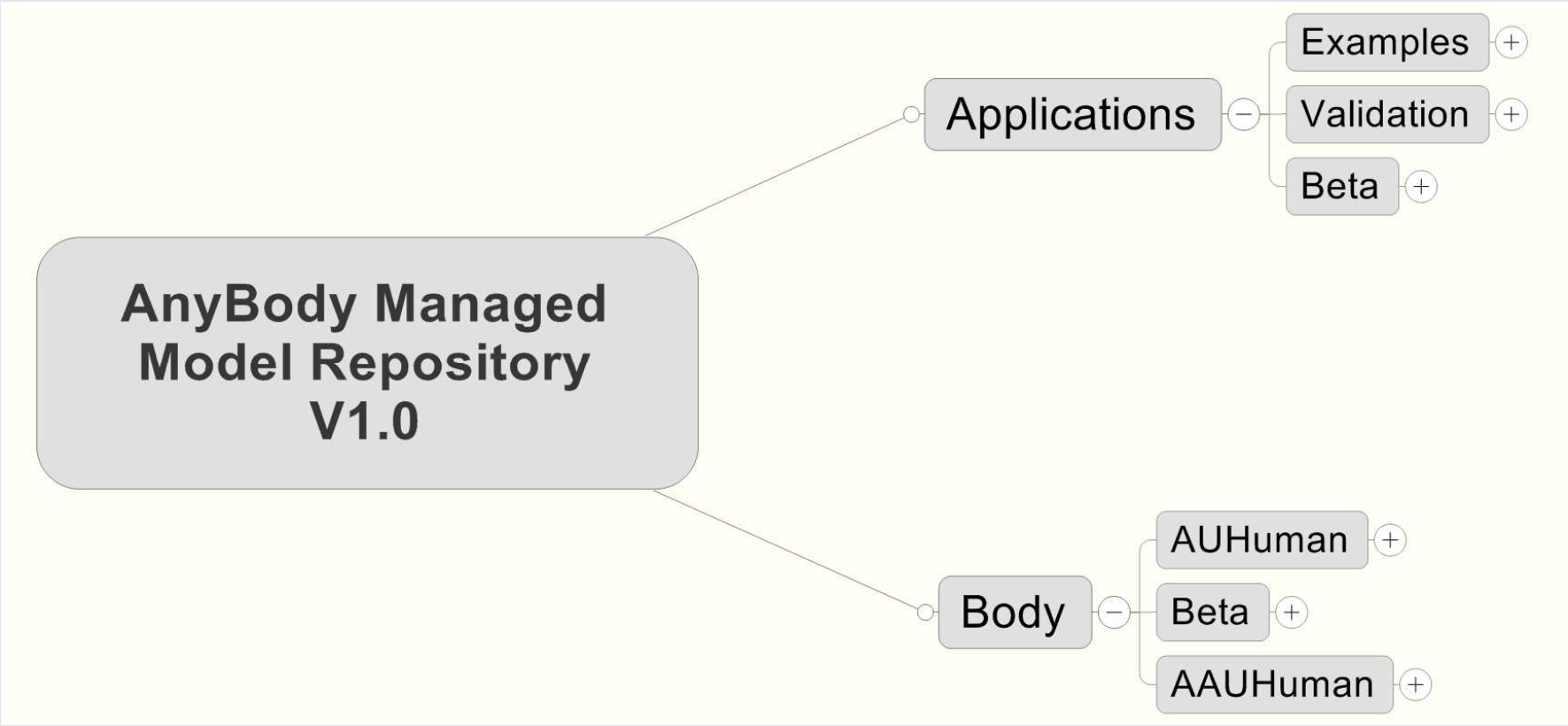
ANYBODY TECHNOLOGY

Repository structure

One of the focus areas of this release of the repository has been to increase the user friendliness, by making it easier to get access to output and define new models.

The repository structure remains the same it has a strong separation between applications models and body models



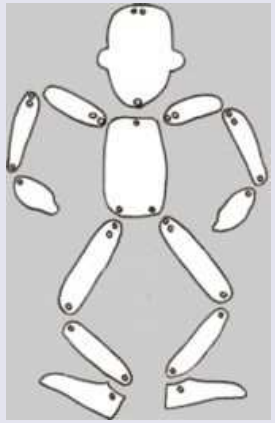
This version of the repository runs with AnyBody Ver. 4.0

ANYBODY TECHNOLOGY

Repository structure Body

A modular block building technique, which makes it easy to change and connect different body parts, has been developed. The philosophy is that when building for example a leg model, the model should be self-contained.

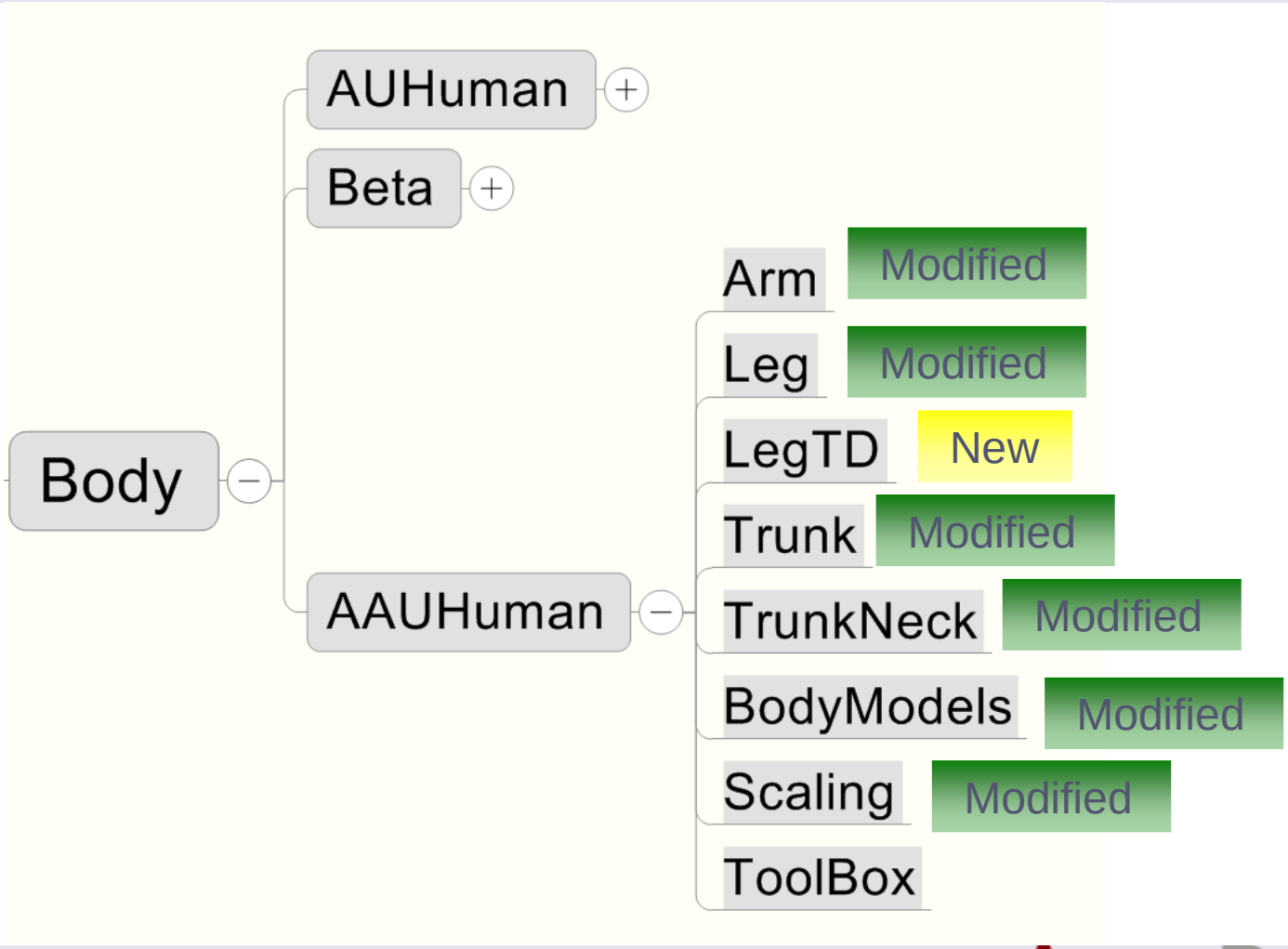
The Body parts does not contain any motion drivers for the body parts. These are added in the application.



Body parts in Body have no drivers applied

ANYBODY TECHNOLOGY

Body



ANYBODY TECHNOLOGY

Spine model

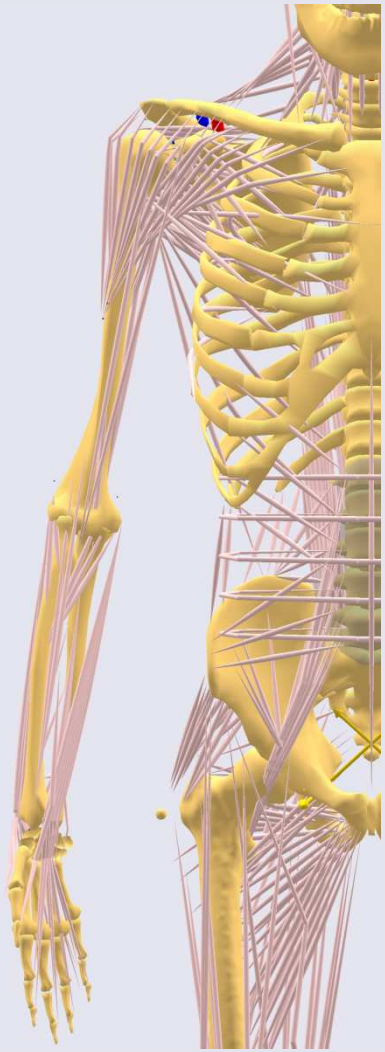
- Cervical
  - 7 vertebra
  - 136 muscle fascicles
  - 3 dof spherical joints from T1 to C2
  - 1 dof universal joint from C2 to head

  De Zee et al. 2007: J. Biomech.40, S284
- Thoracic
  - Under construction
- Lumbar
  - 5 vertebra
  - 188 muscle fascicles
  - Intra abdominal pressure
  - 3 dof spherical joints

  Hansen et al. 2006: Spine 31, 1888-99
  De Zee et al. 2007: J. Biomech. 40, 1219-27

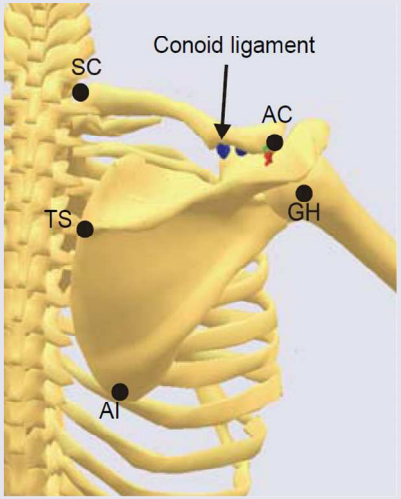
ANYBODY TECHNOLOGY

Shoulder

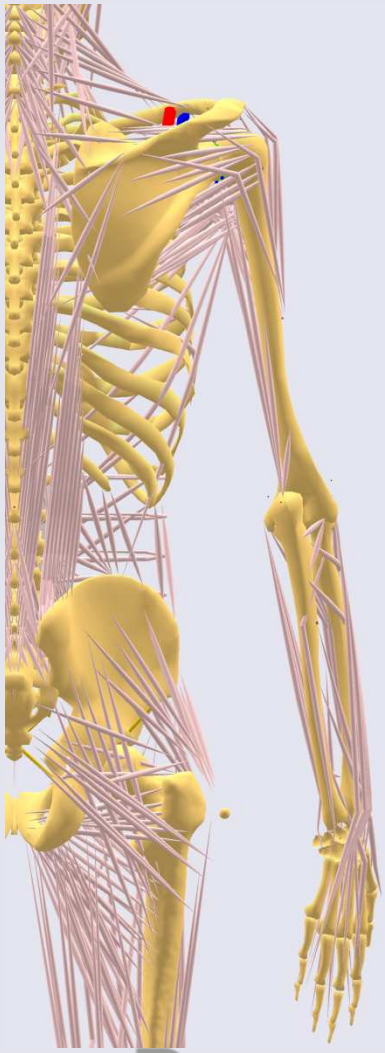


- 118 muscle fascicles on each side
- Wrapping of muscles by contact mechanics
- Contact criterion in the GH joint

Veeger et al. 1991: J. Biomech. 24, 615-29
Van der Helm 1994: J. Biomech. 27, 551-69
Veeger et al. 1997: J. Biomech. 30, 647-52



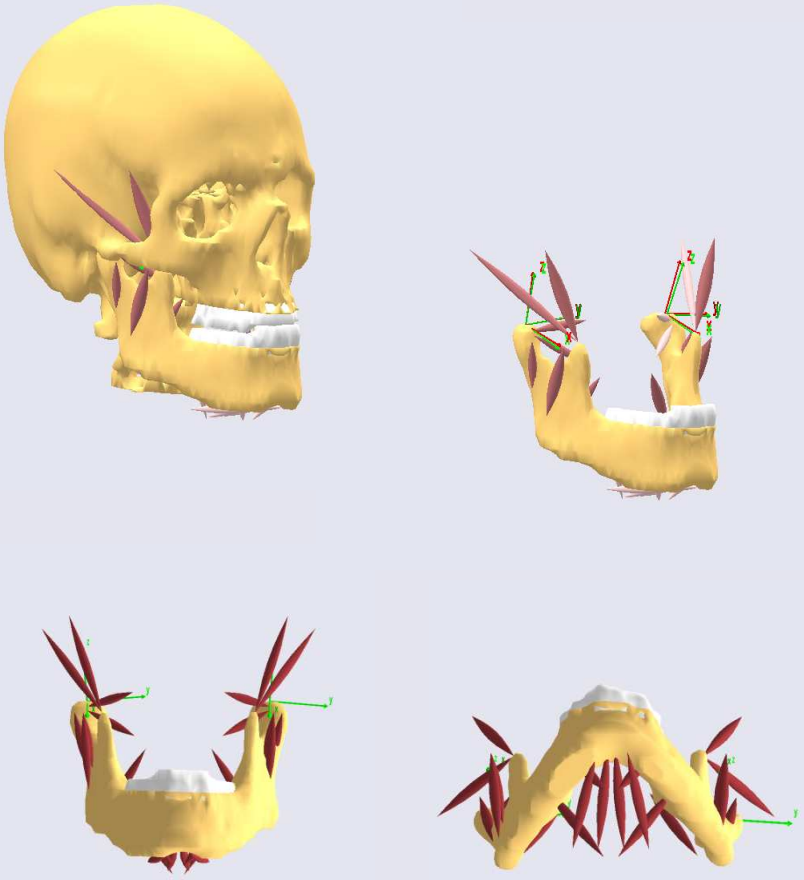
AC Spherical joint
GH Spherical joint
SC Spherical joint
TS Scapula thoracic gliding plane, ellipsoid
AI Scapula thoracic gliding plane, ellipsoid



ANYBODY TECHNOLOGY

Mandible model

- Based on CT scan of ”normal” face of a 30 year old male
- 24 hill-type muscles (Koolstra and Van Eijden, *J. Biomech.* 38: 2431-2439, 2005)
- Mandible modelled with 4 DoF

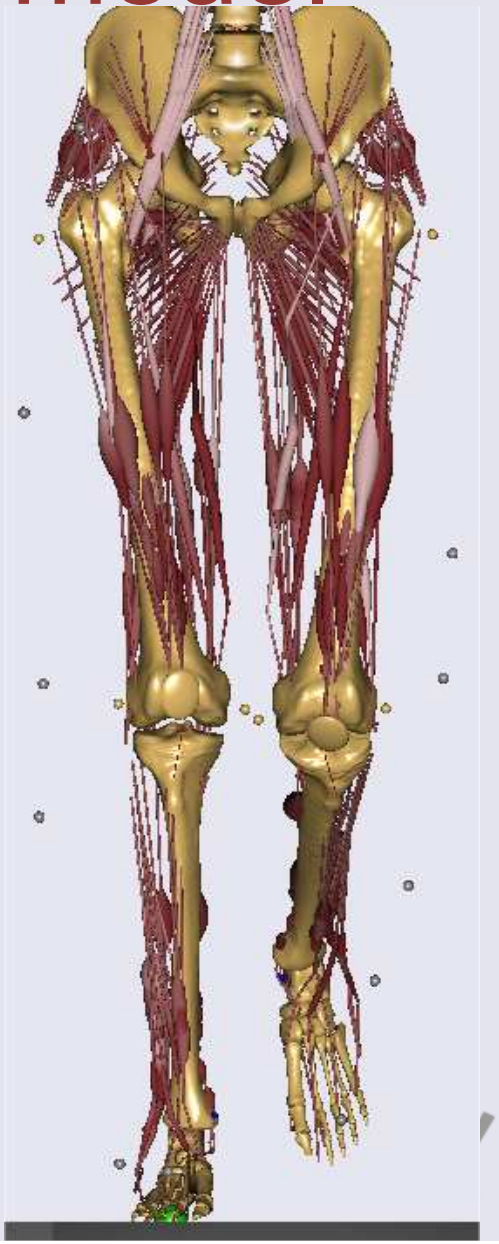


Zee et al., Journal of Biomechanics 40 (2007) 1192–1201

ANYBODY TECHNOLOGY

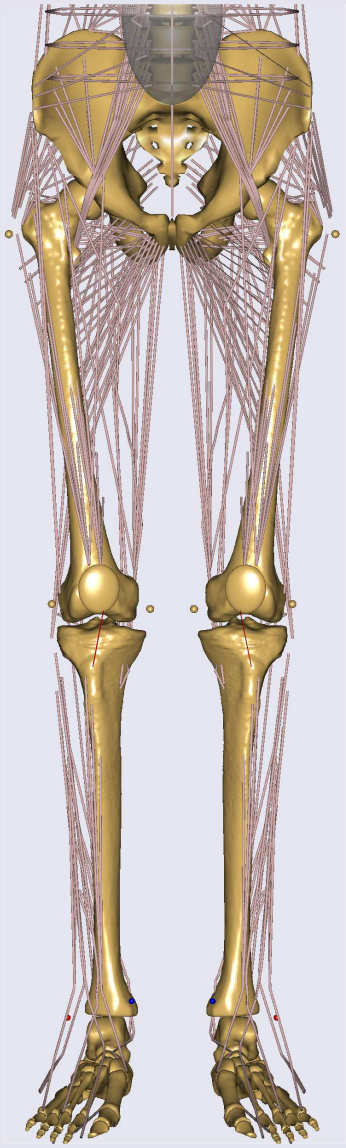
Twente lower extremity model

- This model has been released previously as a standalone model.
- The model is based on a recently published morphological consistent anatomical dataset* on muscle and joint parameters.
- Model is now available in combination with any other body part.
- Shift freely between different leg models

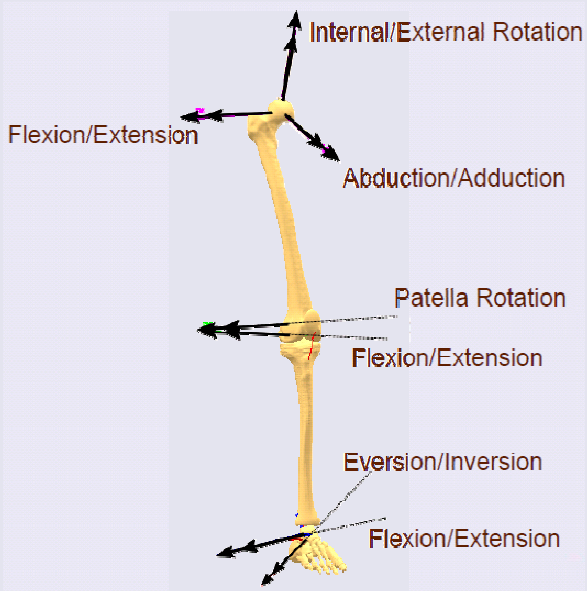


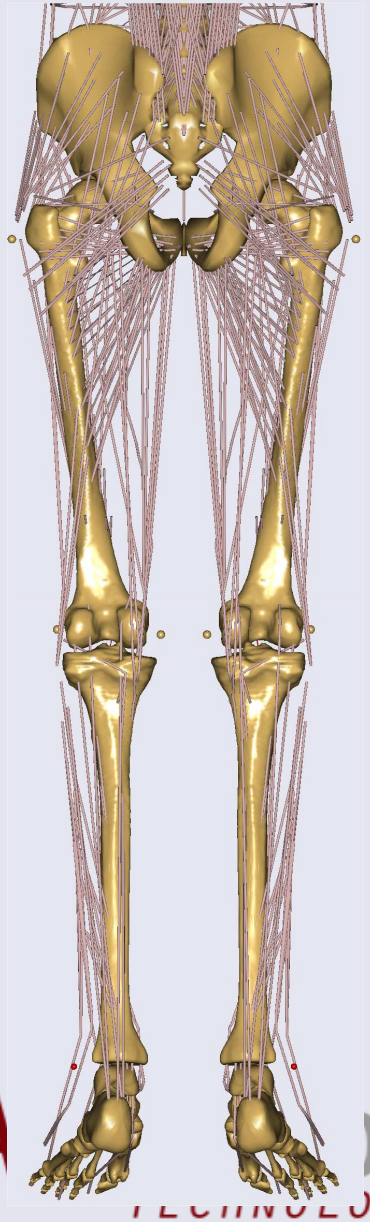
*Morphological muscle and joint parameters for musculoskeletal modelling of the lower extremit, *Clinical Biomechanics*, Volume 22, Issue 2, Pages 239-247 M. Klein Horsman, H. Koopman, F. van der Helm, L. Prosé, H. Veeger

Twente lower extremity model



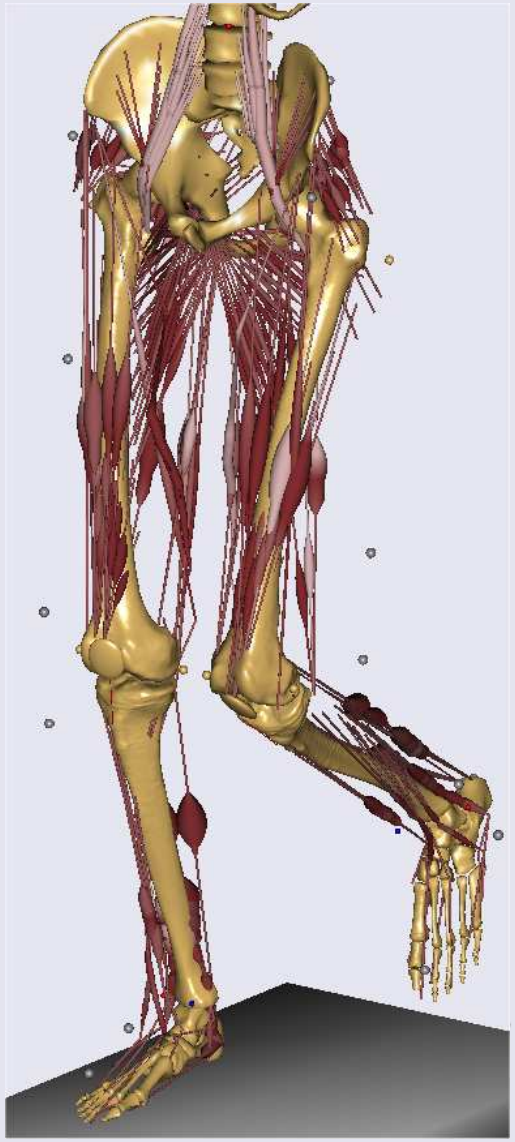
- Comprehensive and consistent dataset from one donor (77 y, 1.74 m, 105 kg)
- 55 Muscles divided in 159 fascicles per leg
- 7 degrees of freedom



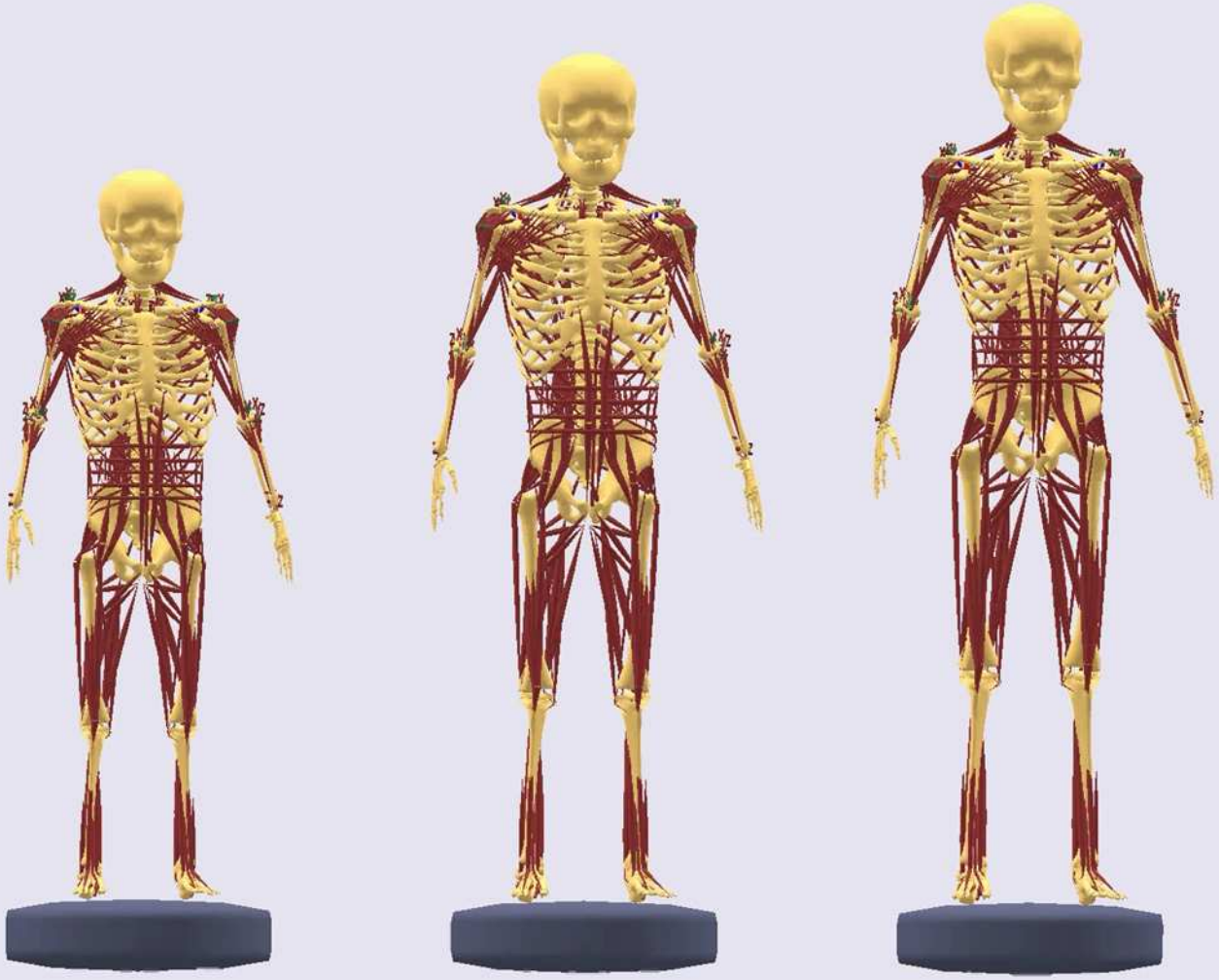


Twente lower extremity model

- New application based on this model
  - GaitUniMiamiTD
  - GaitUniMiamiRightLegTD
- For more details on this model please see the webcast
  - **TLEM: A new detailed lower extremity model** (Sebastian Dendorfer, PhD, 20. August, 2008) at http://www.anybodytech.com/196.html



Scaling



ANYBODY TECHNOLOGY

Introduction

The musculoskeletal models have been made scalable in size. This is no simple task since it involves changing literally thousand of parameters, properties like:

- mass and inertia
- geometry: muscle insertion points, joint centers etc.
- muscle parameters
- wrapping surfaces.

The scaling procedure is implemented in a generic manner and allows for user-defined scaling laws.

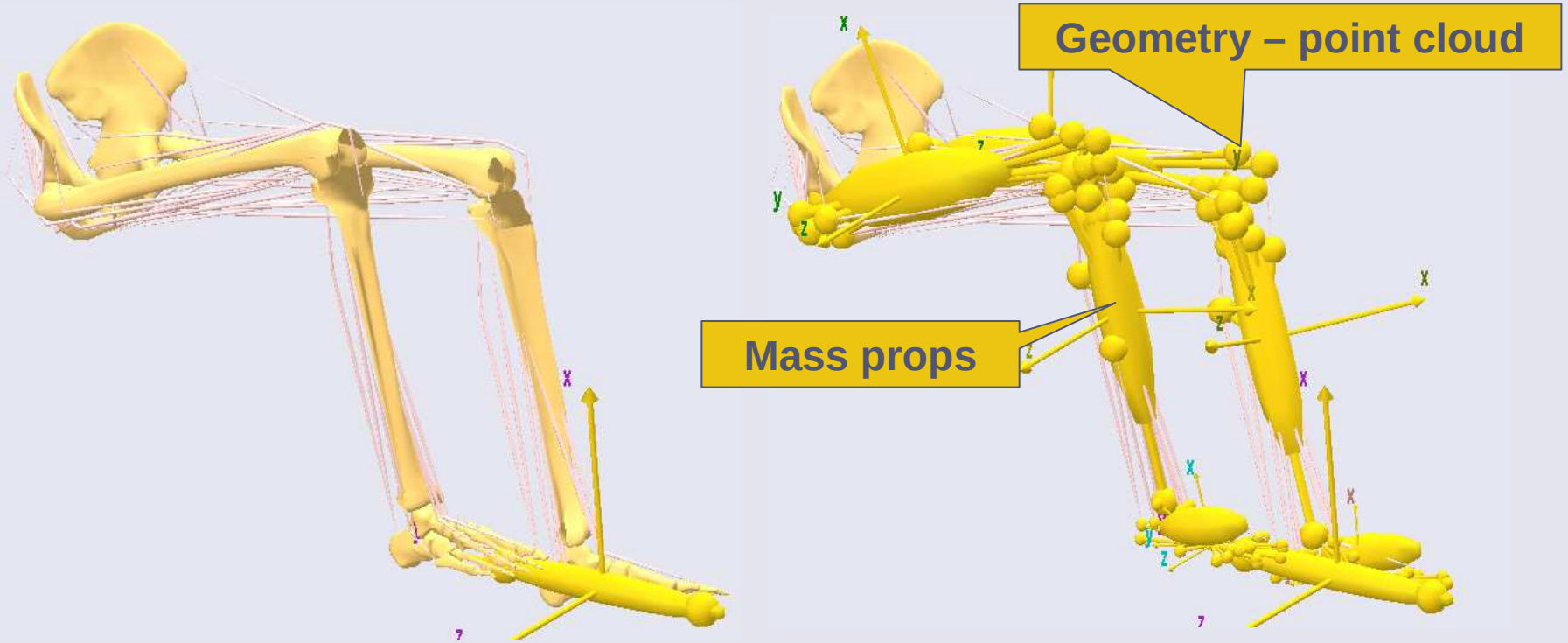
Scaling Scenarios

- Overall population level
  - Investigate ergonomic compatibility for a broad range of the population
  - Based on anthropometric databases
- Individual level
  - Sports biomechanics for a particular athlete
  - Gait analysis of a particular individual
- Detailed level
  - Purpose-specific modeling based on scans, ultrasound data, and similar
  - Detailed data for each mode

This has always been possible because AnyBody models are fully accessible.

ANYBODY TECHNOLOGY

How a segment is defined



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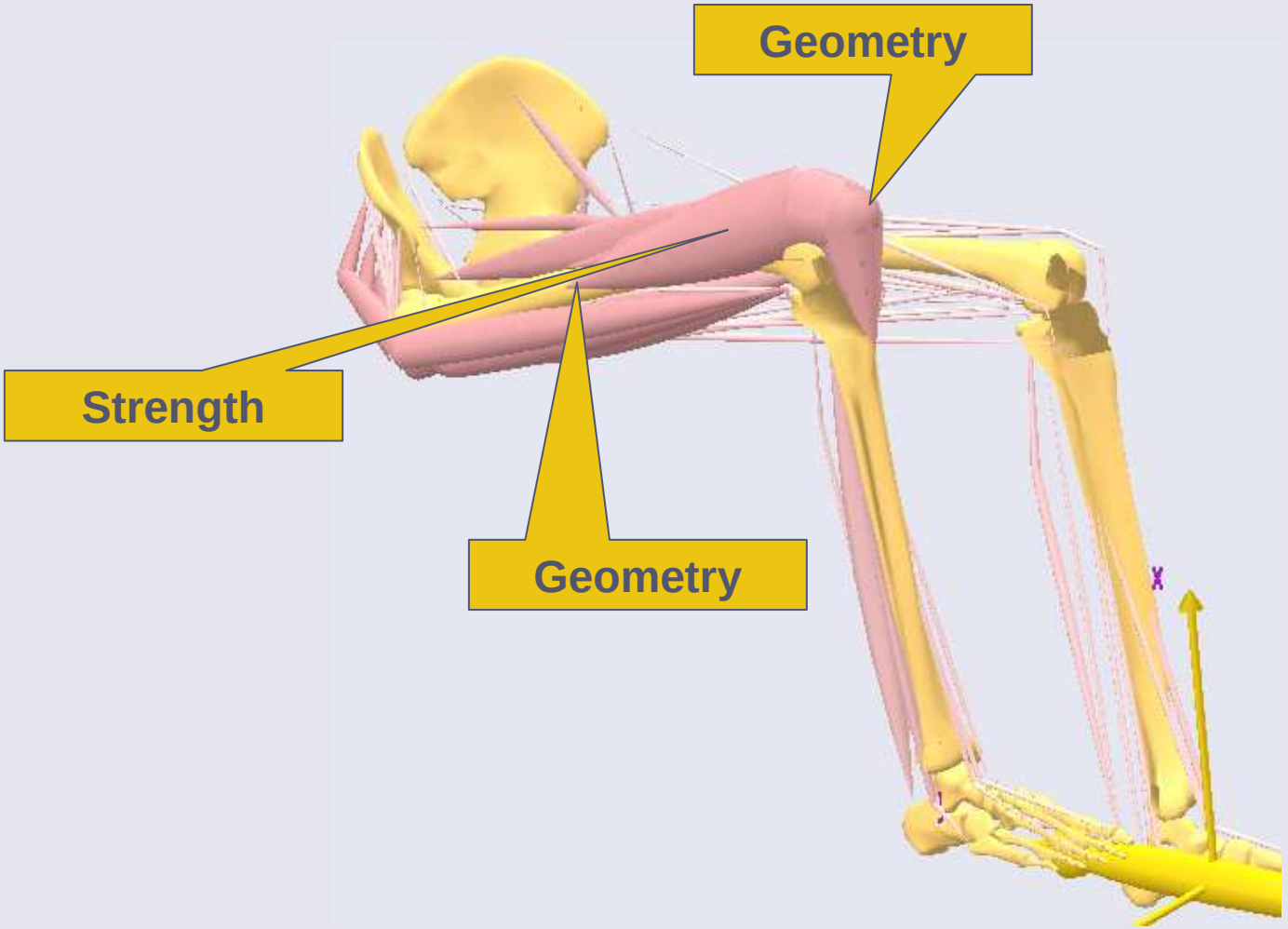
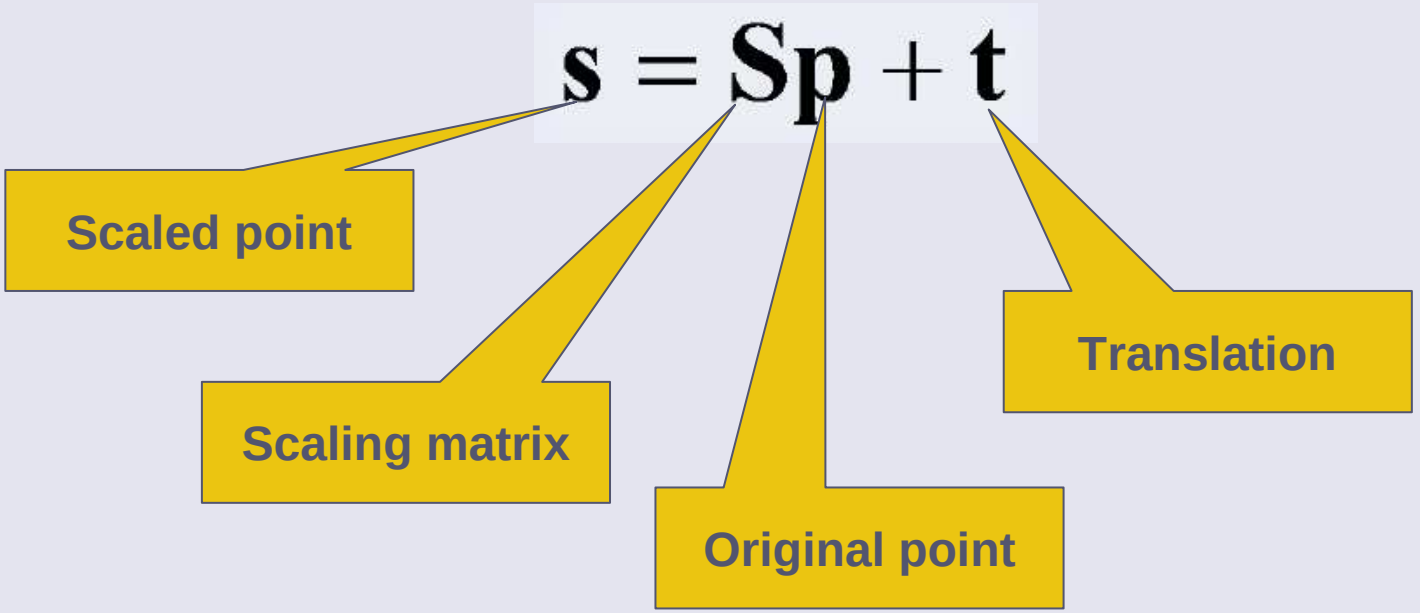
How a muscle is defined



ANYBODY TECHNOLOGY

Linear geometry scaling



Different choices of **S** ant **t** lead to different scaling laws

ANYBODY TECHNOLOGY

Scaling laws

Uniform scaling

- Same scaling factor in all directions.
- Does not seem to fit well with imperical data.

$$\mathbf{S} = \begin{bmatrix} k_L & & \\ & k_L & \\ & & k_L \end{bmatrix}$$

Length-mass scalin

- Scale the length to dimension and sca obtain the specifie

Length-mass-fat sca

- Idea: Take the fat account.
- The fat percentage can be estimated from the BMI
- - or it can be measured directly.

This means that the scaling is implemented into the models and not into the system:

•Accessible to all users

•Can be modified by the user

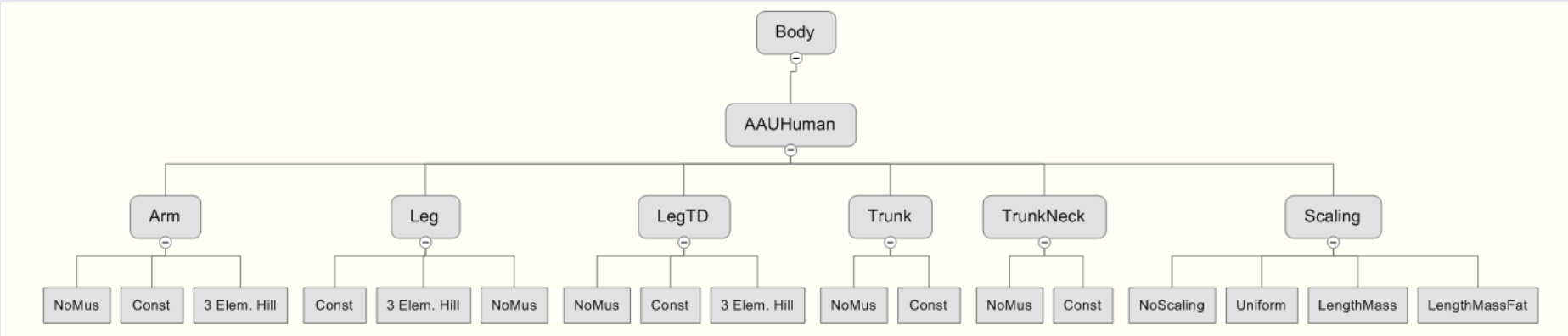
•New scaling methods can be defined by users

ANYBODY TECHNOLOGY

Generic body

Generic body model enables the user to easily define the desired combination of body parts, in contrast to preselected collections of body parts.

The repository contains, a number of body parts, which each has different muscle configurations, on top of this there are different scaling laws. In total there are more than 3000 possible combinations.



The new generic setup allows you to easily setup any combination of body parts

ANYBODY TECHNOLOGY

Generic body models

```
// Trunk: 1 included, 0 not included
// *********************************
#define TRUNK 1
// This is just the bones,
// Choose one of the following options to add muscles
#define TRUNK_SIMPLE_MUSCLES 1
// RightArm: 1 included, 0 not included
// *********************************
#define RIGHT_ARM 1
// This is just the bones,
// Choose one of the following options to add muscles
#define RIGHT_ARM_SIMPLE_MUSCLE 1
#define RIGHT_ARM_SIMPLE_MUSCLE_ONLY_ON_NECK 0
#define RIGHT_ARM_MUS_3E 0
```

ANYBODY TECHNOLOGY

Selected output

- AnyBody models can generate a lot of output, it can be overwhelming
- Now each body model comes with a folder named ***SelectedOutput***
- It contains:
  - Reaction forces from each joint with explanation on directions and a reference frame
  - Muscle envelope curves for each limb
  - Summation of the moment the muscles generates around each dof. This is computed by measuring the contribution from all muscles spanning a certain joint.

DEMO

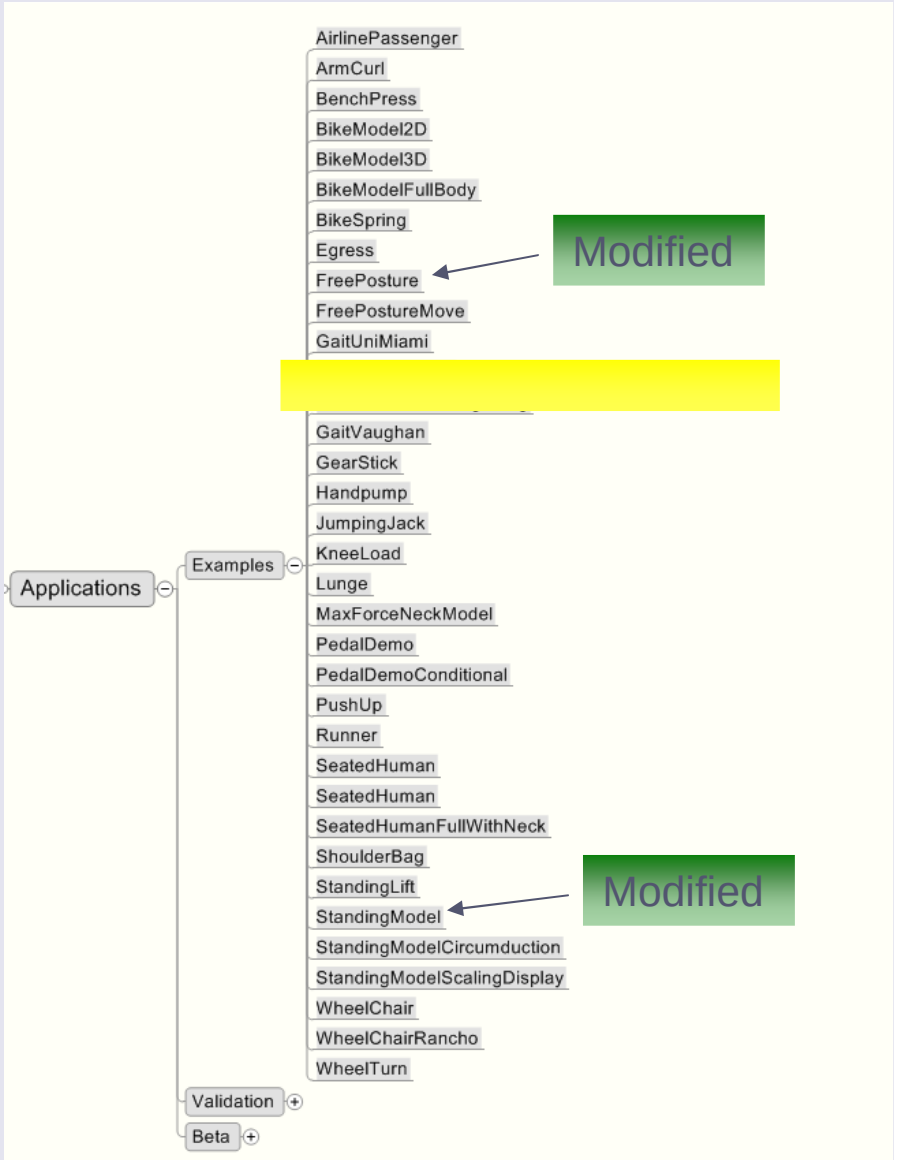
ANYBODY TECHNOLOGY

Applications

This slides gives an overview of the applications in the Examples directory branch.

New applications are constantly being added.

The repository contains a wide variety of models, if you are trying to model a specific case, it is normally a good idea to start with one of the applications as a basis for your model.



Application Categories

This table tries to categorize some of the features of the models

Model	FullBody -Model	Friction	Conditio- nal contact	Marker driven	Gaitappli cation2 driven	Center of mass drivers	Mannequin driven	Driven by environment and mannequin
GearStick								X
Gait3D				X				
WheelChair- Rancho				X				
FreePosture	X						X	
FreePostureMove	X						X	
BikeModel- FullBody	X							X
ConditionalPedal		X	X					X
Egress	X							X
StandingModel						X	X	X
GaitUniMiamiTD					x			
GaitUniMiami				x	x			
SeatedHuman	X	X						X

ANYBODY TECHNOLOGY

GaitUniMiamiTD

This is a new variation of the GaitUniMiami model, running with the Twente leg model.

The motion is optimized using an external application named “gaitapplication2” which optimize the marker location, segment lengths etc. to give the best possible match with the recorded motion.

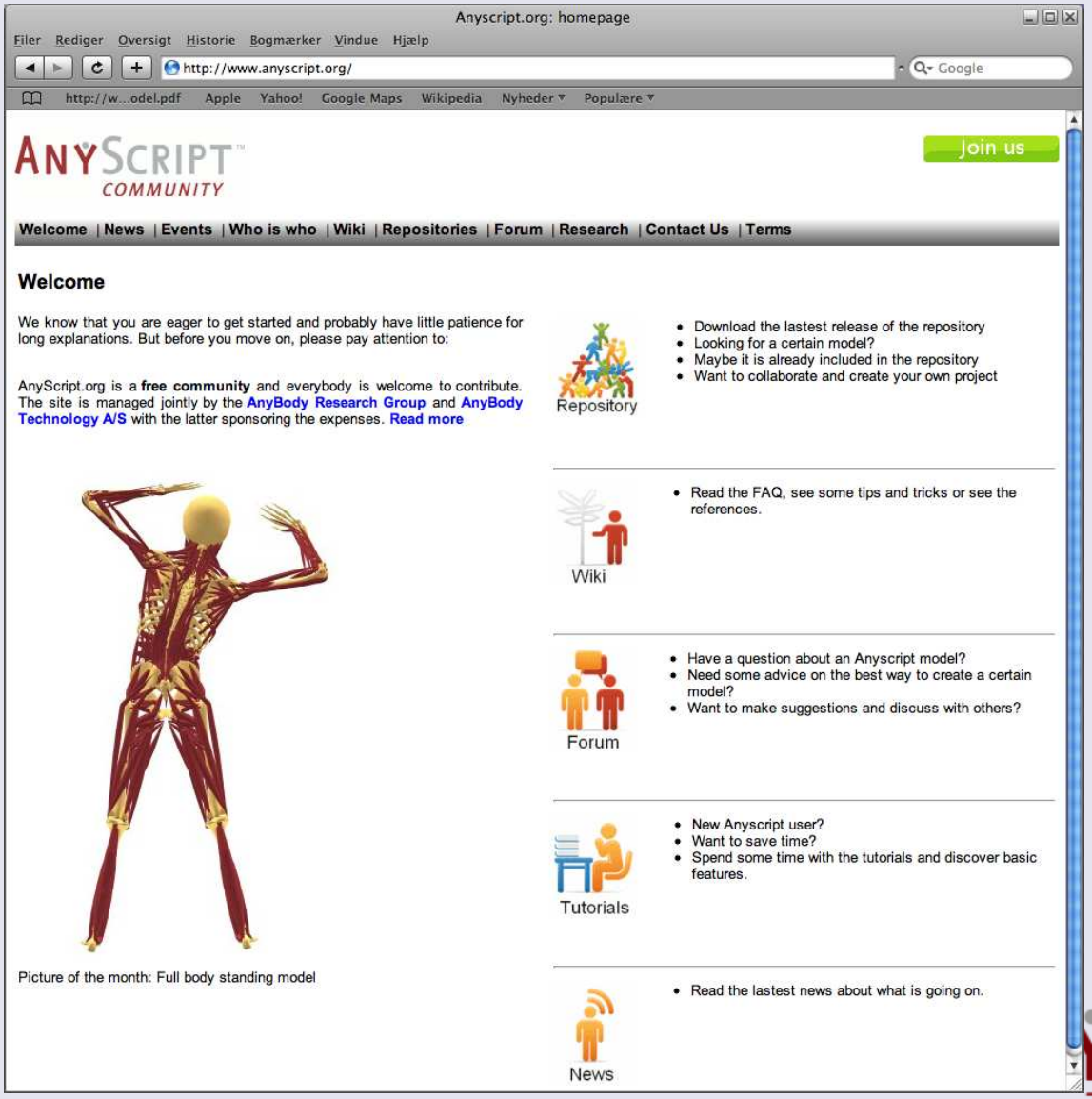
The models displays the necessary steps need to come from a C3D file to a finished inverse dynamic model, it is a fifteen step procedure.

We are working on building this functionality into AnyBody this will make it easier.

This model also comes in a version using only the right leg GaitUniMiamiTDRightLeg.

The latest v. 1.8 of the gaitapplication2 can be found at http://forge.anyscript.org/gf/project/gaitapplication/

Where to get the models



License terms

The repository now comes in two versions both available from www.anyscript.org

AnyBody Model Repository This collection of models are distributed under very liberal terms named as **Self-supported license** and correspond pretty much to the body repository previously distributed from **www.anybody.aau.dk** until April 2009. The most important issue to consider here is that AnyBody Technology A/S will not put free manpower into supporting and developing these models.

AnyBody Managed Model Repository. This free collection of models is distributed under the terms named **Professional license** and is the model collection in which the professional supporters from AnyBody Technology A/S are investing their efforts. This work strives to keep the models well structured and functional, introducing new body parts, making sure that all parts are scalable, introducing new applications, introducing new user-friendly output, etc.

Read all details at http://www.anyscript.org/index.php?id=33

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Thank you!

Please feel free to ask questions!

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