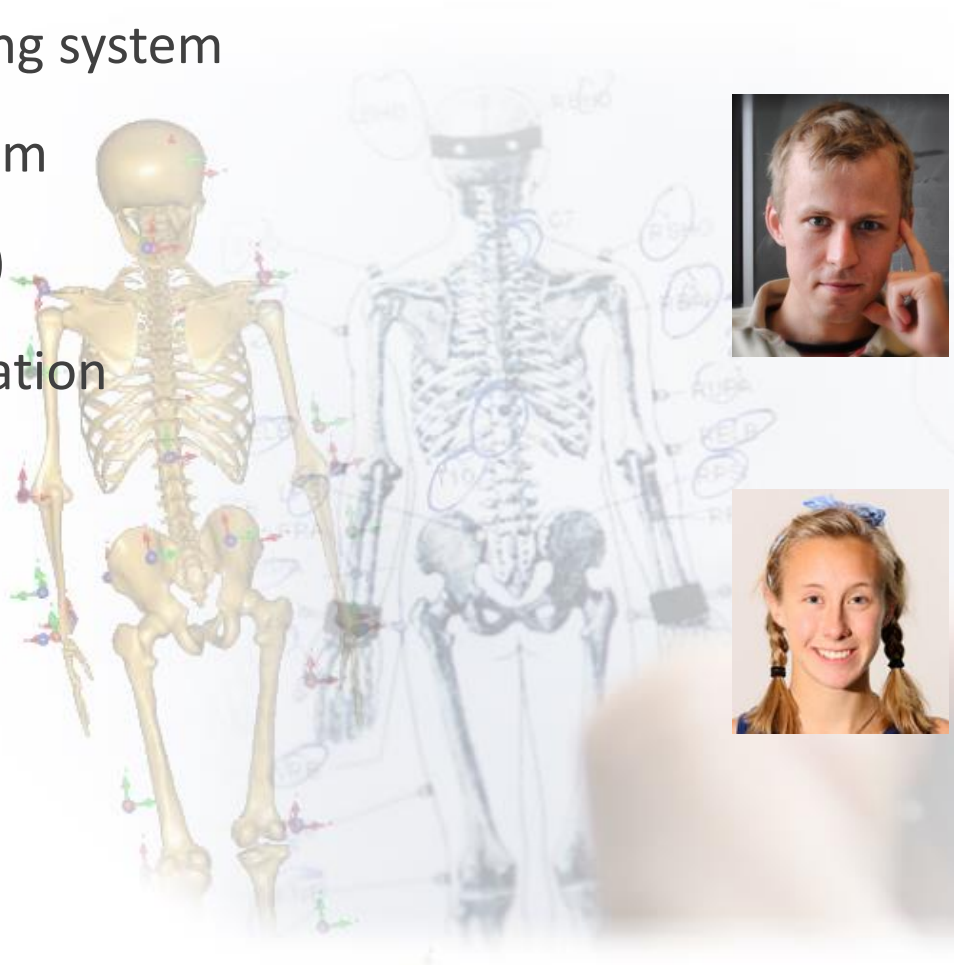
The webcast will start in a few minutes….

The new AnyBody Modeling System & Musculoskeletal Model Repository

TOUR AND OVERVIEW OF THE NEW **7.2** VERSION

Outline

- General introduction to the modeling system
- New features in the Modeling System
- New Model Repository (AMMR 2.2)
- New help resources and documentation
- Questions and answers



Morten Enemark Lund
Sr. R&D Engineer

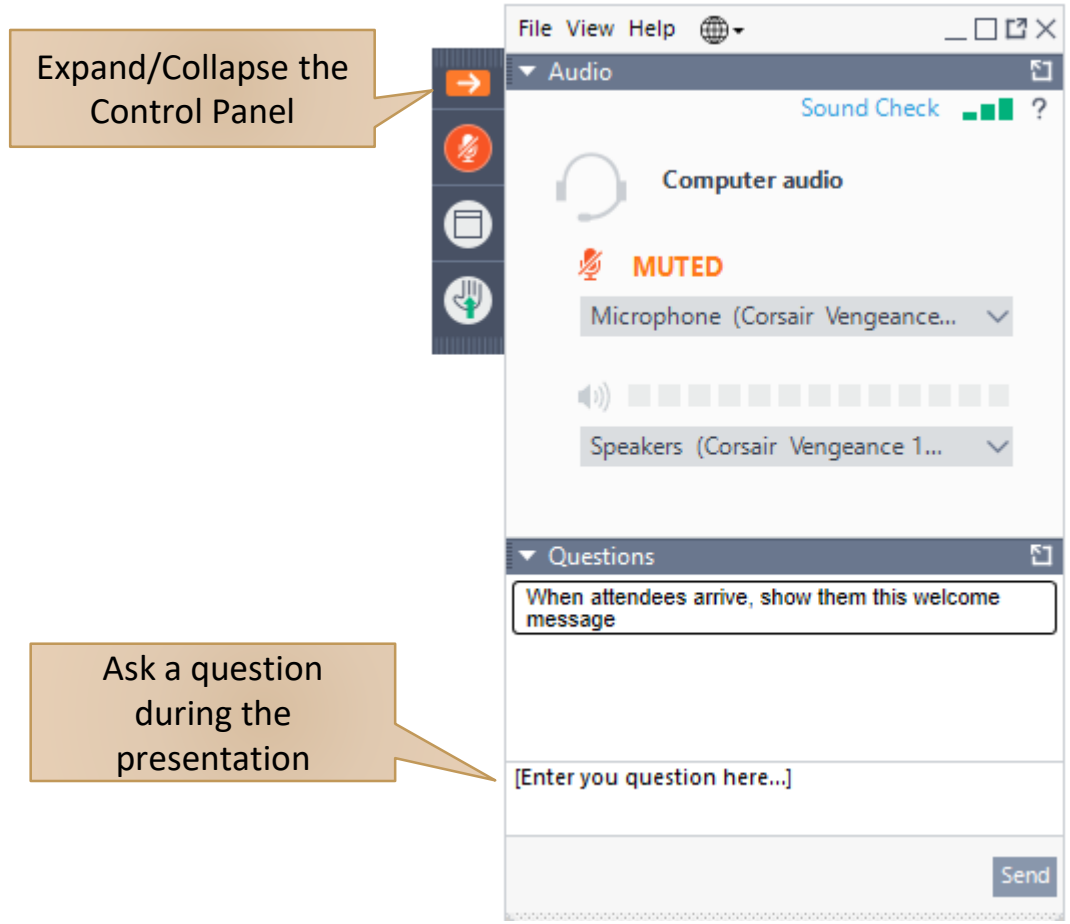
Christine Dzialo
R&D Engineer, Ph.D

Control Panel

The Control Panel appears on the right side of your screen.

Submit questions and comments via the Questions panel.

Questions will be addressed at the end of the presentation. If your question is not addressed we will do so by email.



Musculoskeletal Simulation

Motion data

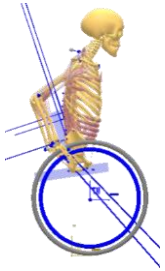
Kinematics + Forces

ANYBODY Modeling System

Body Loads

- Joint moments
- Muscle forces
- Joint reaction forces

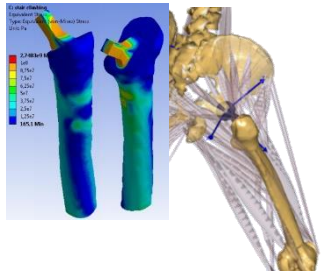
Movement Analysis



Product Design Optimization

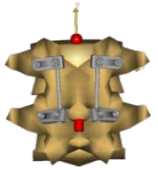
ANYBODY Modeling System

Ergonomic Analysis

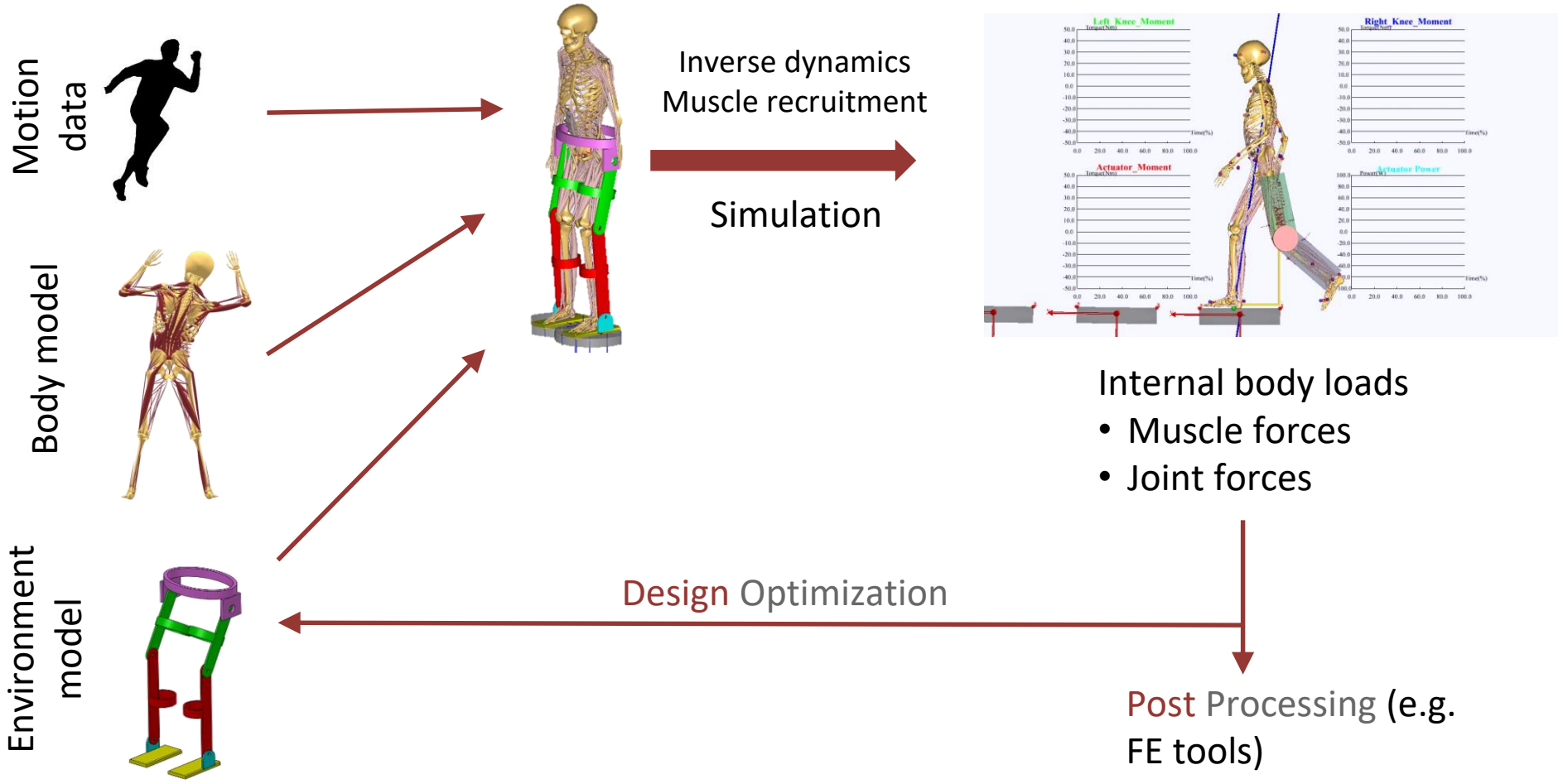


Load Cases for Finite Element Analysis

Surgical Planning and Outcome Evaluation

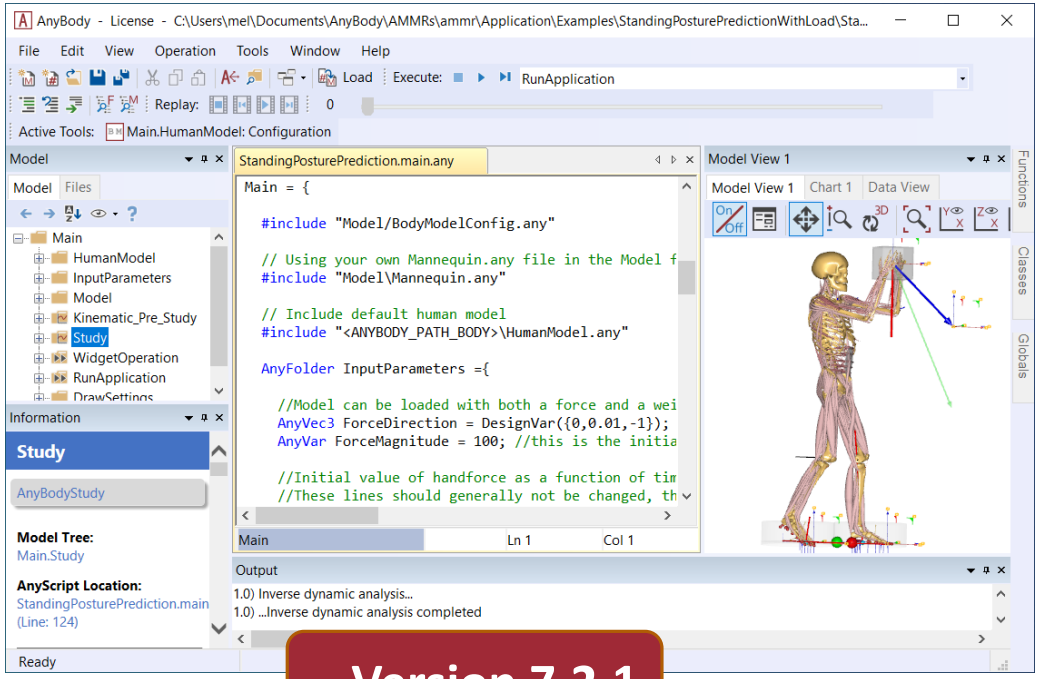


AnyBody Modeling System



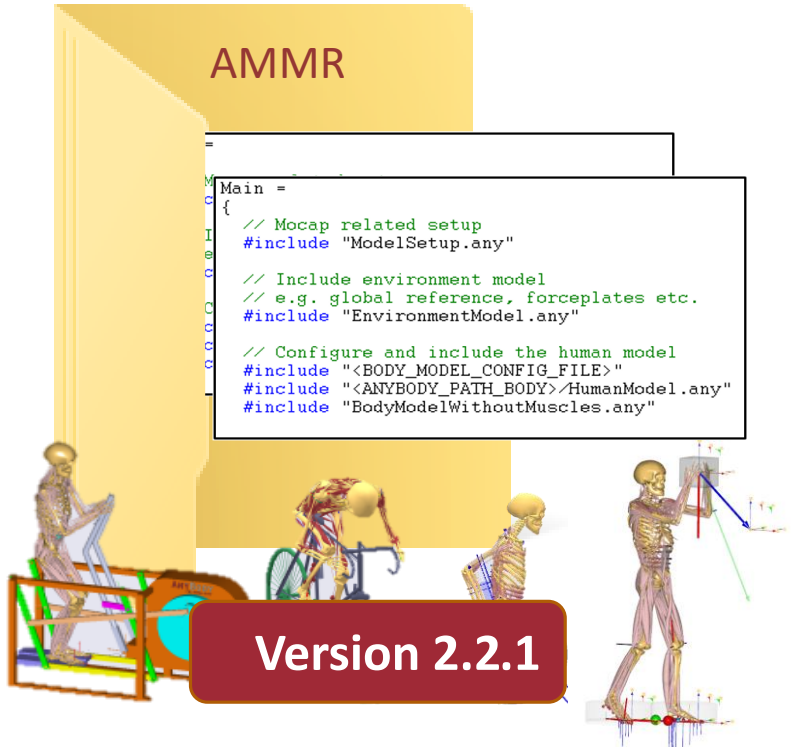
AnyBody Modeling System

AnyBody Modeling System



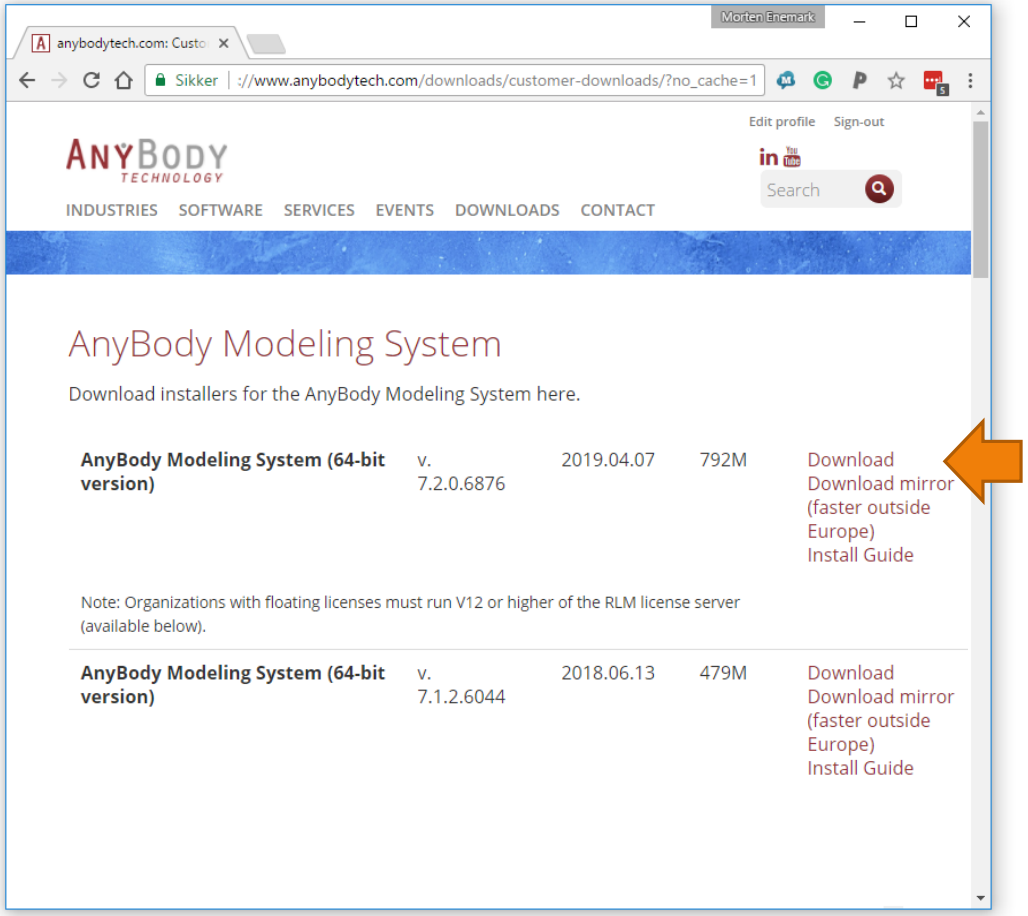
Version 7.2.1

Model Repository

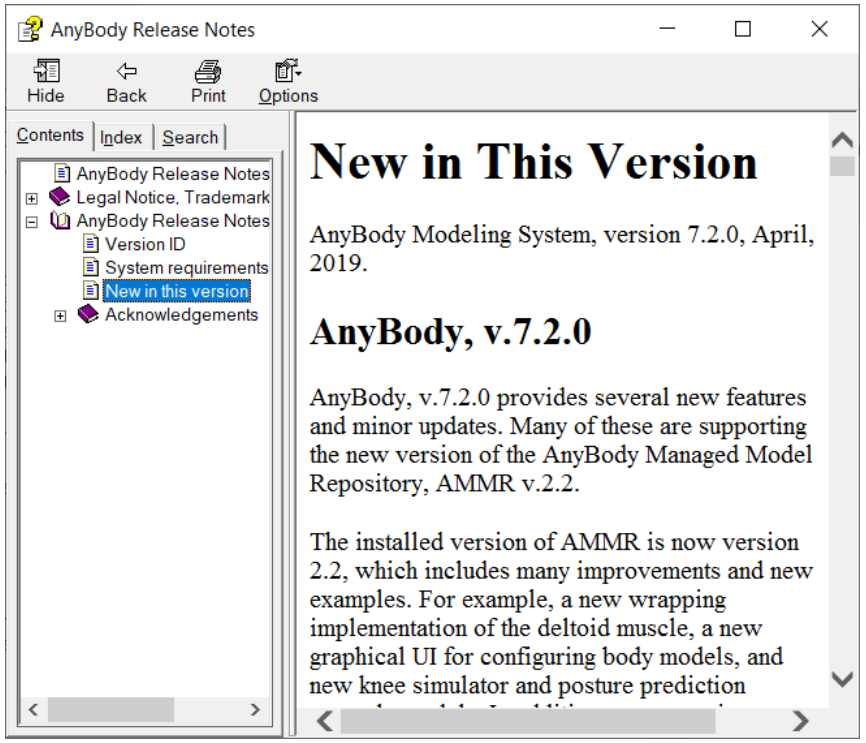


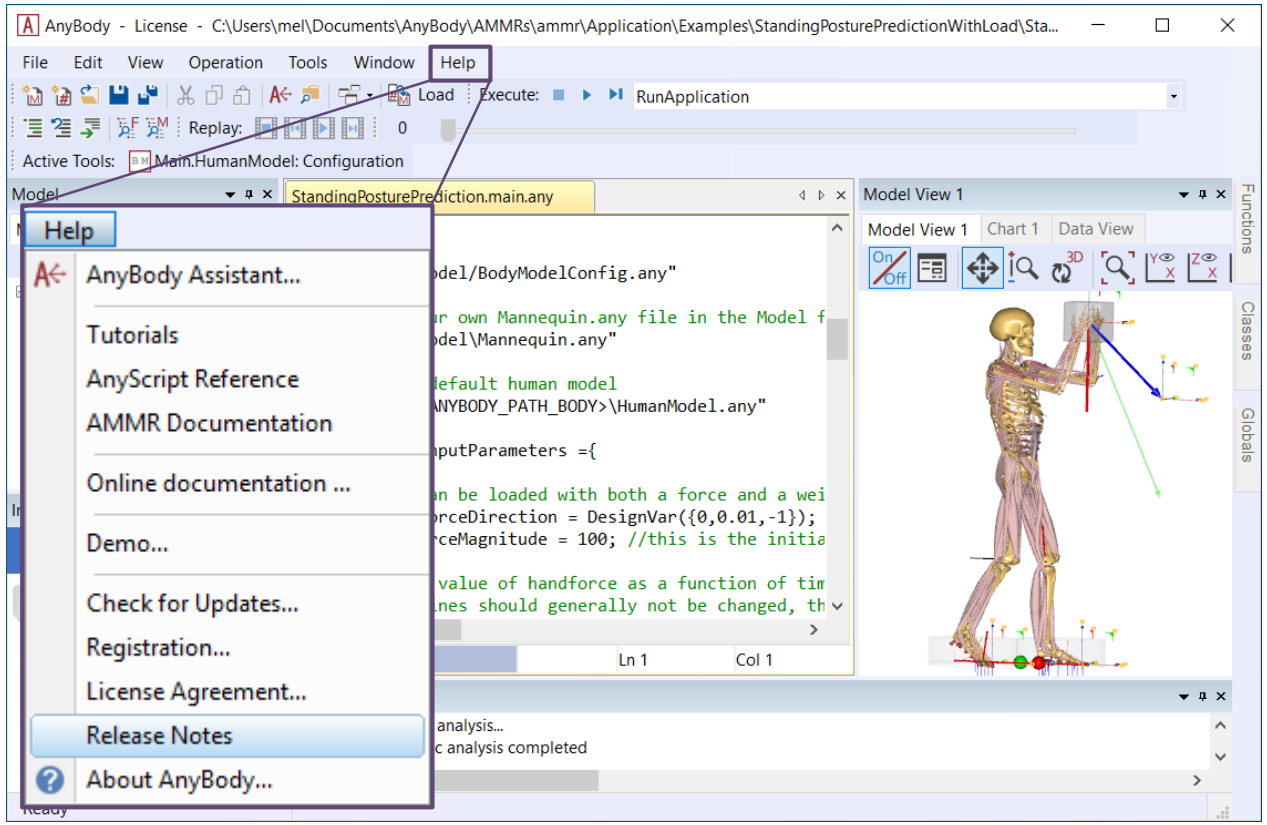
Version 2.2.1

How to get the new version



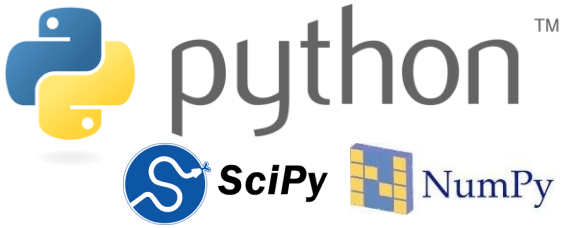
What is new?

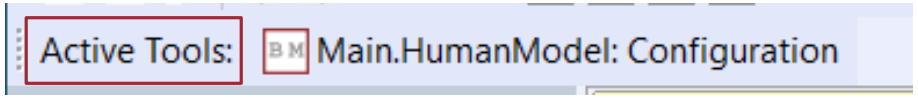

AnyBody Release Notes
Hide
Back
Print
Options
Contents
Index
Search
AnyBody Release Notes
Legal Notice, Trademark
AnyBody Release Notes
Version ID
System requirements
New in this version
Acknowledgements
New in This Version
AnyBody Modeling System, version 7.2.0, April, 2019.
AnyBody, v.7.2.0
AnyBody, v.7.2.0 provides several new features and minor updates. Many of these are supporting the new version of the AnyBody Managed Model Repository, AMMR v.2.2.
The installed version of AMMR is now version 2.2, which includes many improvements and new examples. For example, a new wrapping implementation of the deltoid muscle, a new graphical UI for configuring body models, and new knee simulator and posture prediction


AnyBody - License - C:\Users\mel\Documents\AnyBody\AMMRs\ammr\Application\Examples\StandingPosturePredictionWithLoad\Sta...
File
Edit
View
Operation
Tools
Window
Help
Load
Execute:
RunApplication
Replay:
Active Tools:
Main.HumanModel: Configuration
Model
StandingPosturePrediction.main.any
Model View 1
Chart 1
Data View
Help
AnyBody Assistant...
Tutorials
AnyScript Reference
AMMR Documentation
Online documentation ...
Demo...
Check for Updates...
Registration...
License Agreement...
Release Notes
About AnyBody...
Ln 1
Col 1
Functions
Classes
Globals

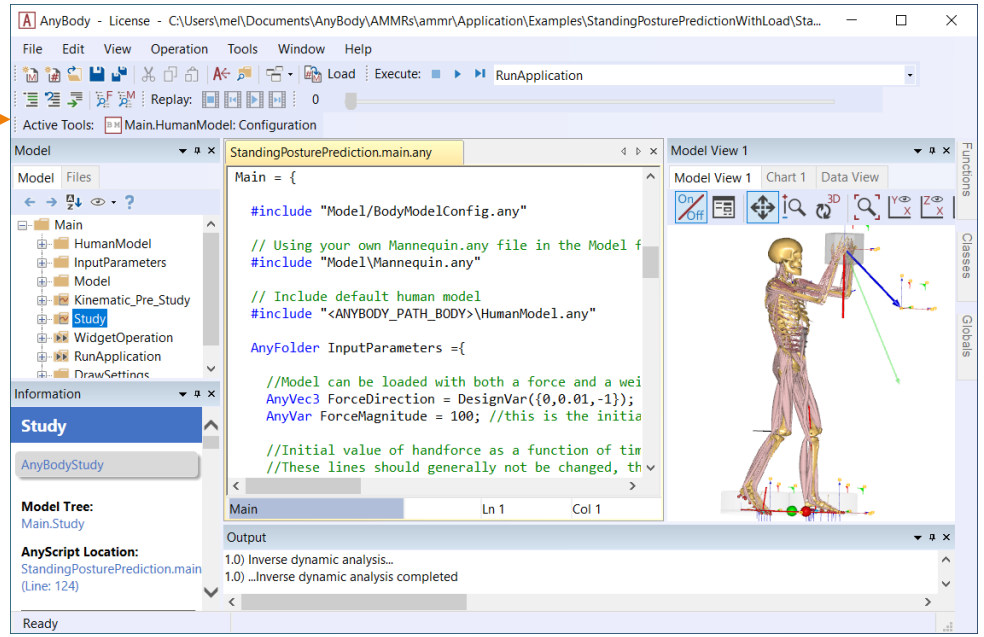
New in the Modeling System…

- New system for model plugins
- Built-in Python distribution





- New toolbar with plugins
- Belongs to the model
- Plugins are small Python applications



New Metabolism models

- What is it? -> A way to sum the energy expenditure
- Two new classes :
  - `AnyMetabModelU`
  - `AnyMetabModelB`
- Studies may specify a default **AnyMetabModel**
  - or controlled by individual muscles

Work in progress... Ready for academia and researchers

- Umberger et al. 2003[1] and 2010[2]
- Bhargava et al. 2004[3]

[1] Umberger, B. R., Gerritsen, K. G., & Martin, P. E. (2003). A model of human muscle energy expenditure. *Computer methods in biomechanics and biomedical engineering*, *6*(2), 99-111.

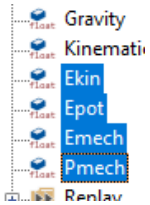
[2] Umberger, B. R. (2010). Stance and swing phase costs in human walking. *Journal of the Royal Society Interface*, *7*(50), 1329-1340.

[3] Bhargava, L. J., Pandy, M. G., & Anderson, F. C. (2004). A phenomenological model for estimating metabolic energy consumption in muscle contraction. *Journal of Biomechanics*, *37*(1), 81-88.

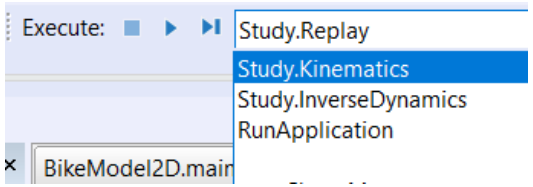
Contact us! If this is your research area...

Other improvements

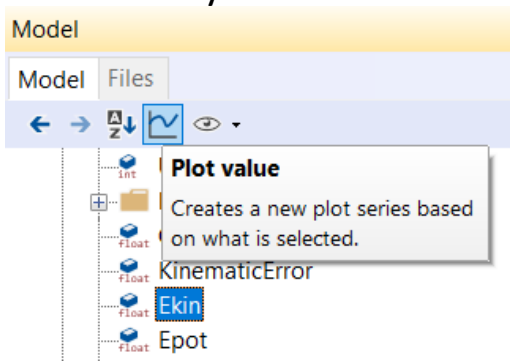
Multi selection in model tree

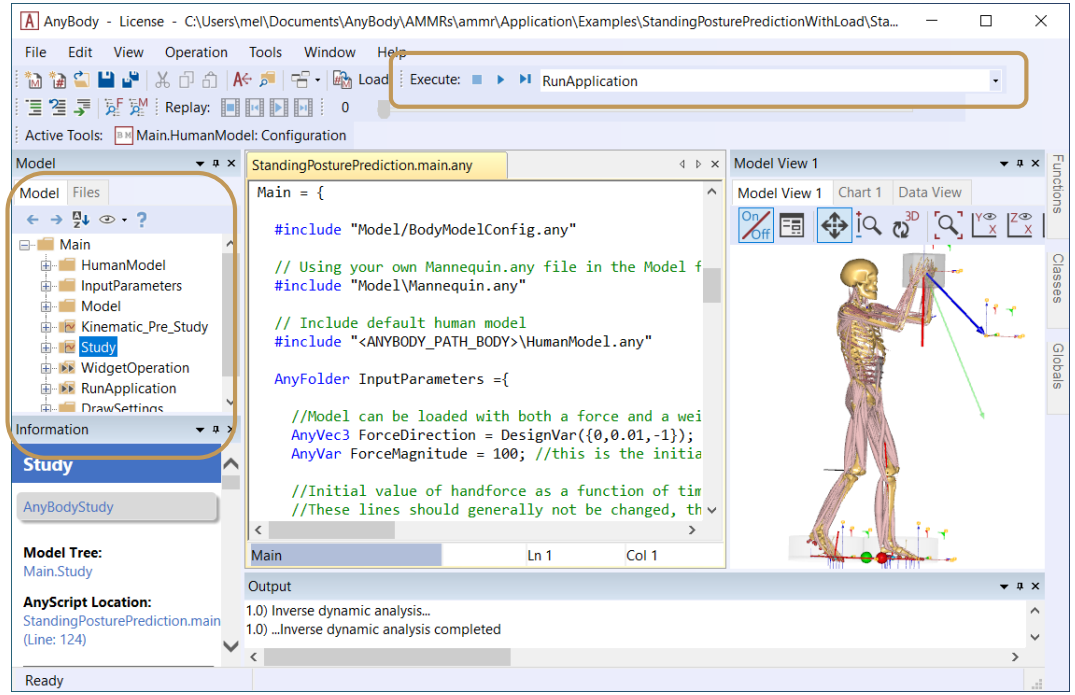


Improved operation control

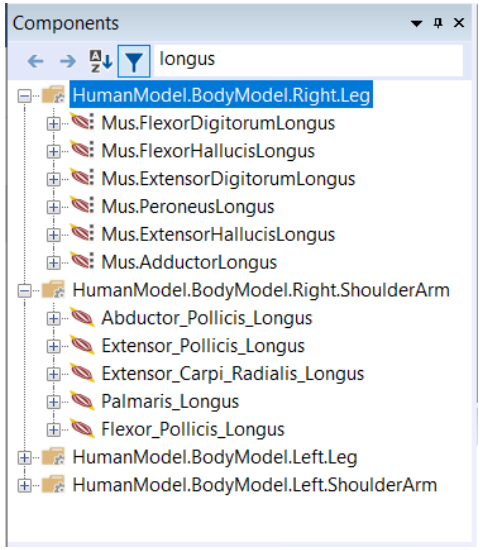


Plot directly from model tree





New: Component based view of the model with search...



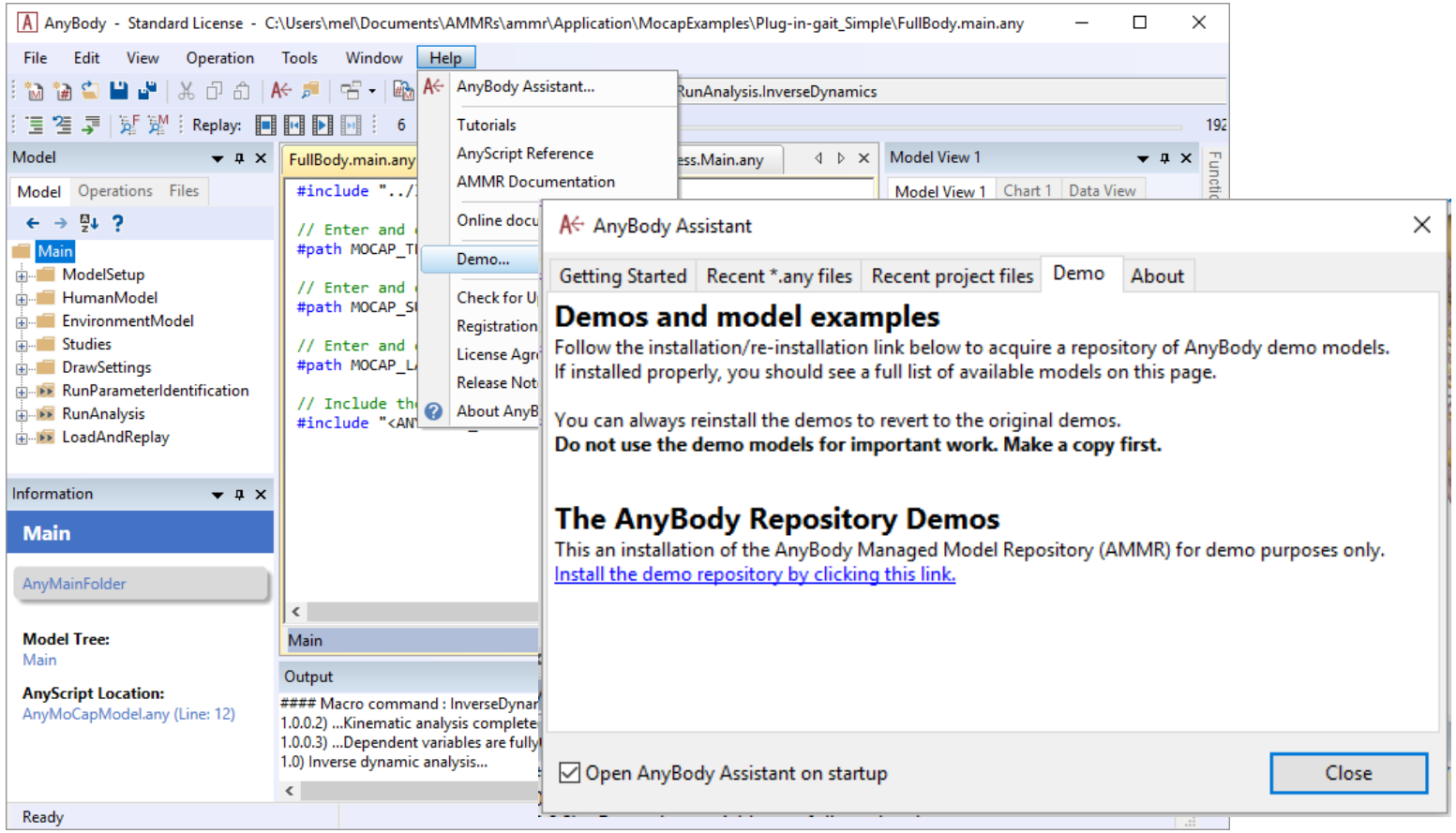
Experimental

Model Repository

- Updated body models
  - New deltoid implementation
  - New scapula-thorax contact mechanism.
  - Many improvements and fixes
- New BodyModel configuration plugin
- New model examples
  - Knee simulator
  - Standing model template
  - Standing posture prediction model

AnyBody **M**anaged **M**odel **R**epository

How do I get the new Model Repository?

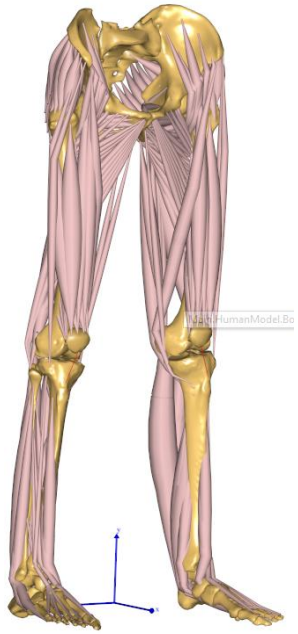


What is new?

anyscript.org/ammr-doc

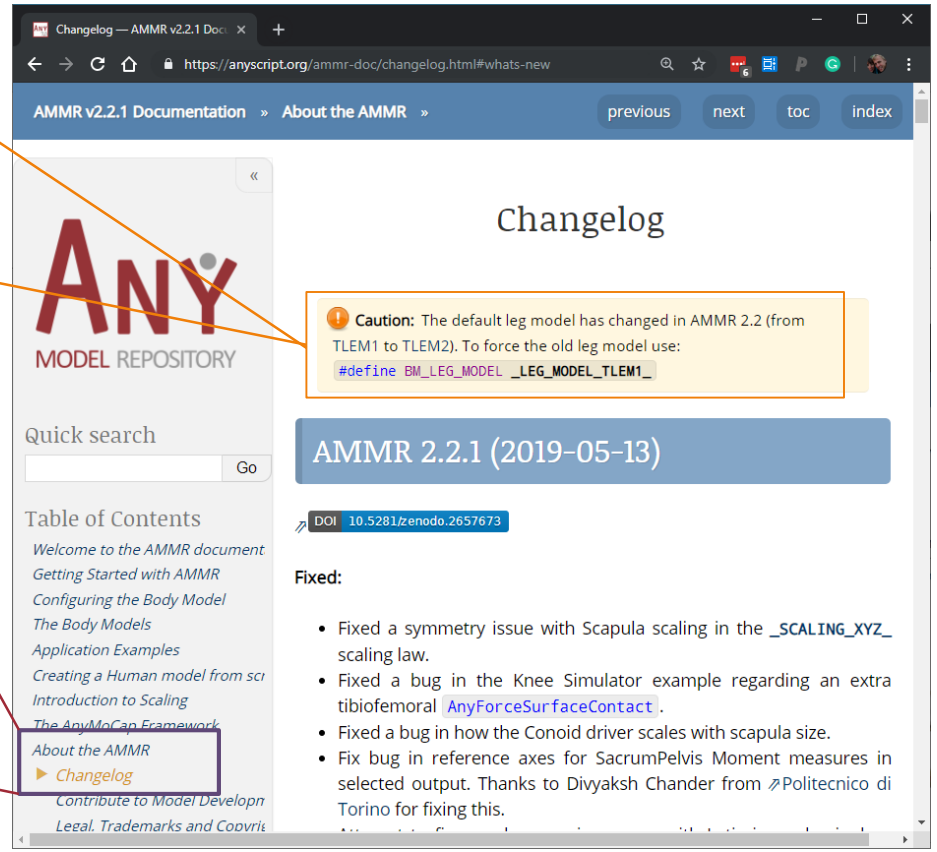
Caution: The default leg model has changed in AMMR 2.2 (from TLEM1 to TLEM2). To force the old leg model use:

```
#define BM_LEG_MODEL _LEG_MODEL_TLEM1_
```



About the AMMR

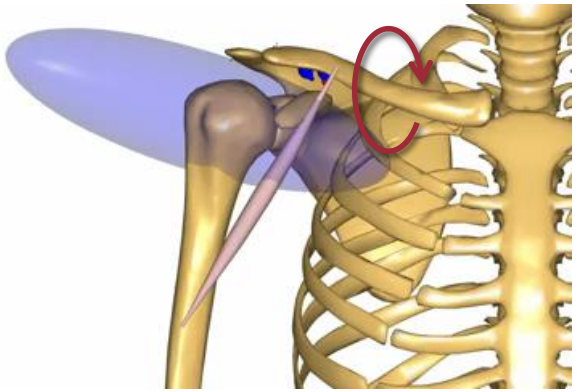
▶ *Changelog*



Shoulder improvements

- New deltoid wrapping implementation
  - The work of Marta Strzelczak from ETS in Montreal [Strzelczak et al. (2018)]
  - Old implementation can be enabled with:

```
#define BM_ARM_DELTOID_WRAPPING OFF
```



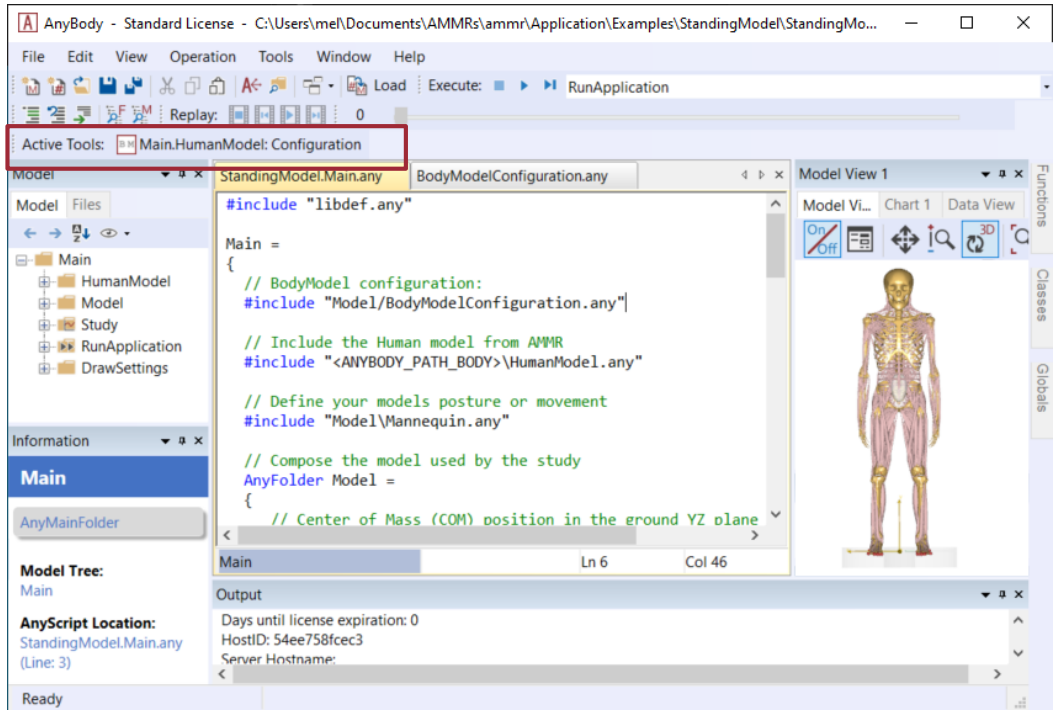
- Rhythm to control Sterno clavicular axial rotation

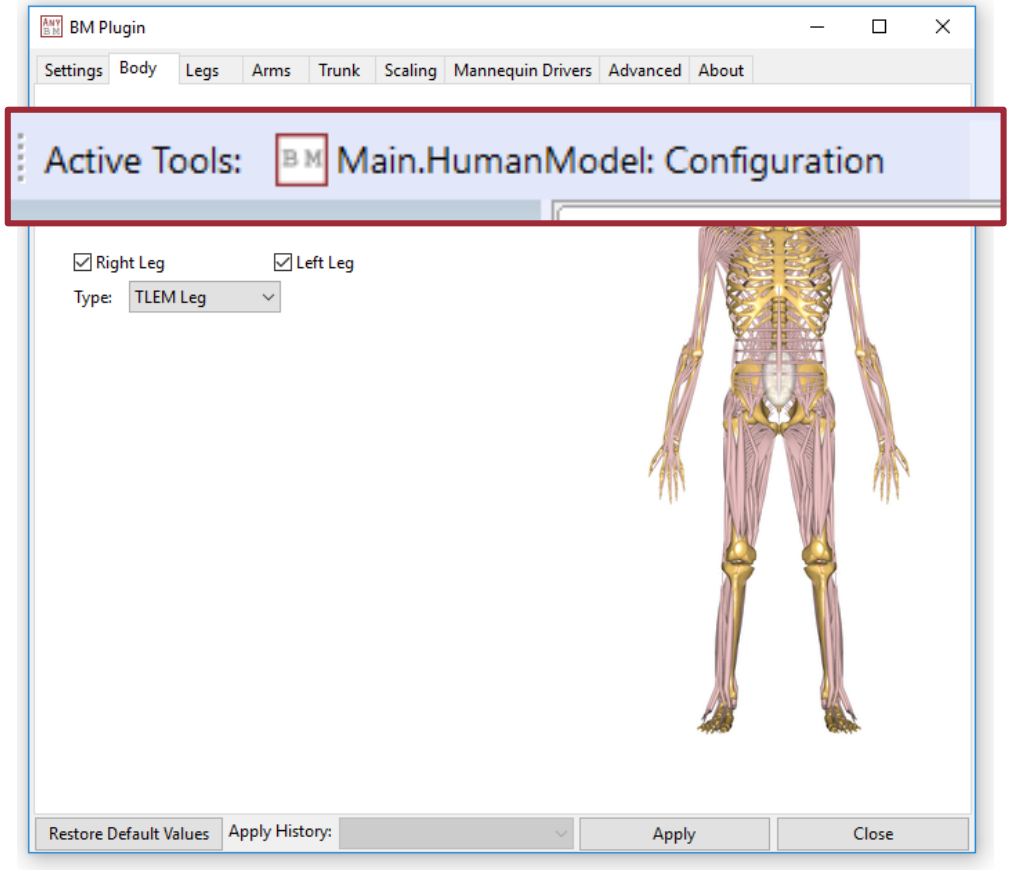
- New scapula-thorax kinematics
  - Still testing -> must be enabled explicitly.
  - Solves problem when ribs becomes individual segments.

```
#define BM_ARM_THORAX_SCAPULA_CONTACT _MULTIPLE_POINT_CONTACT_
```

Strzelczak, M., Lund, M. E., Sins, L., Mickael, B. & Hagemeister, N. A new wrapping approach for the deltoid muscle modelling. in The Proceedings of the 20th Biennial Meeting of theCanadian Society for Biomechanics (2018).

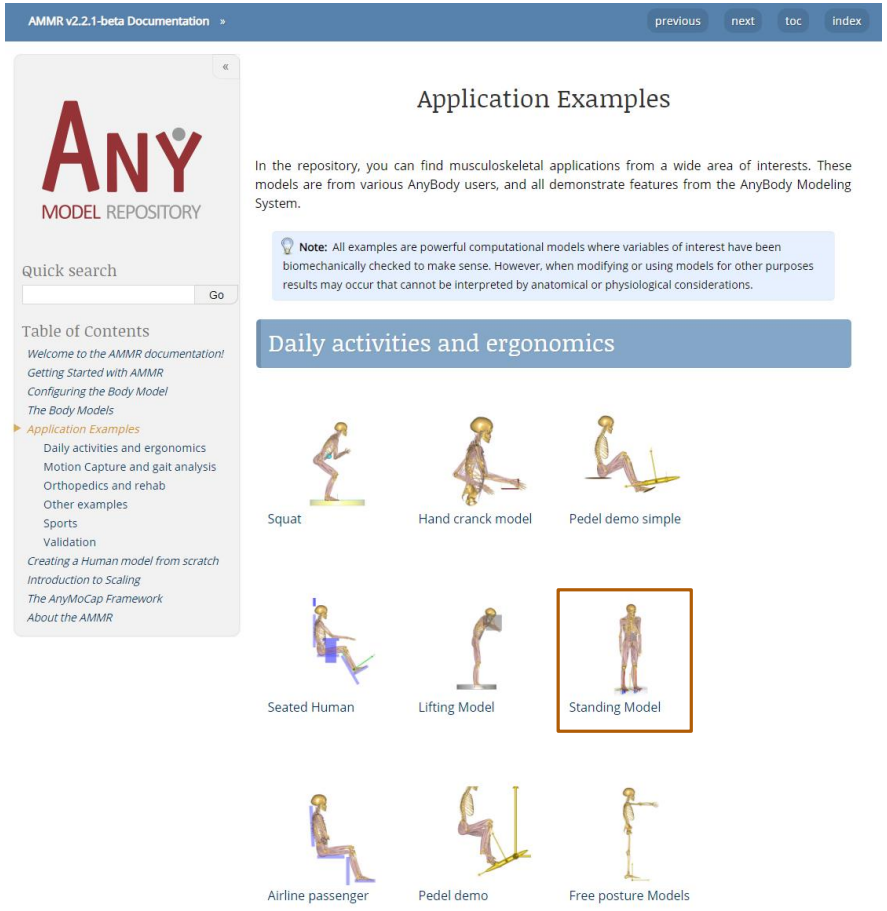
BodyModel Configuration plugin



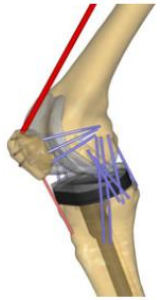


New Model Examples:

anyscript.org/ammr-doc



Standing Model



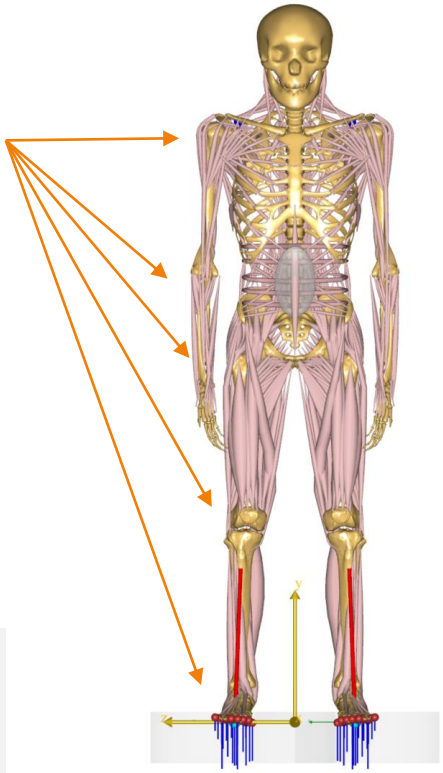
Knee Simulator Model

Posture Prediction Model

Updated Standing Model

Easy to configure

Posture controlled by soft Mannequin drivers



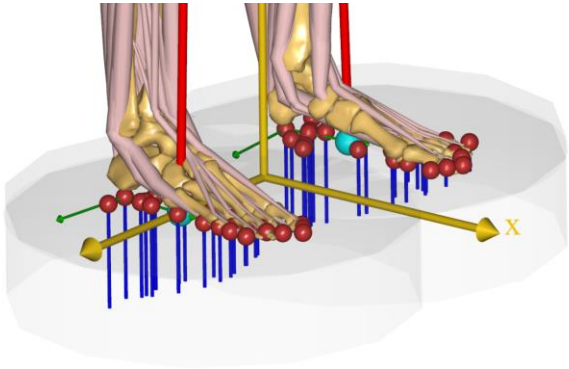
Easy control of foot position

```
// Positioning of the right and left feet.
// Ground-foot constraints can be excluded with:
// #define EXCLUDE_FOOT_CONSTRAINTS
Environment.GlobalRef.RightFootPrint = {
  AnyVec3 HeelPosition = {-0.08, 0, 0.14};
  AnyVec3 ToeDirection = {1, 0, 0.1};
};
```

Center of Mass balance driver

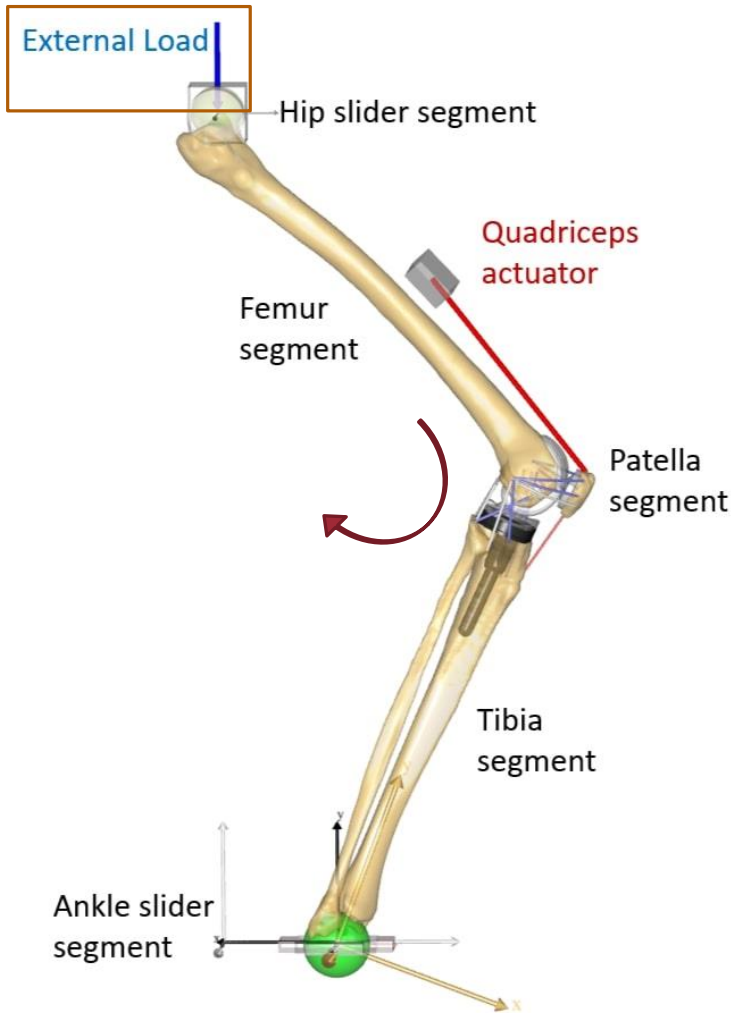
```
// Center of Mass (COM) position
// COM balance driver can be excluded with:
// #define EXCLUDE_COM_BALANCE_DRIVERS
AnyVector CenterOfMassXZ = {0,0};
```

Full Ground reaction Force Prediction



New Knee simulator example

****Long Run Time****



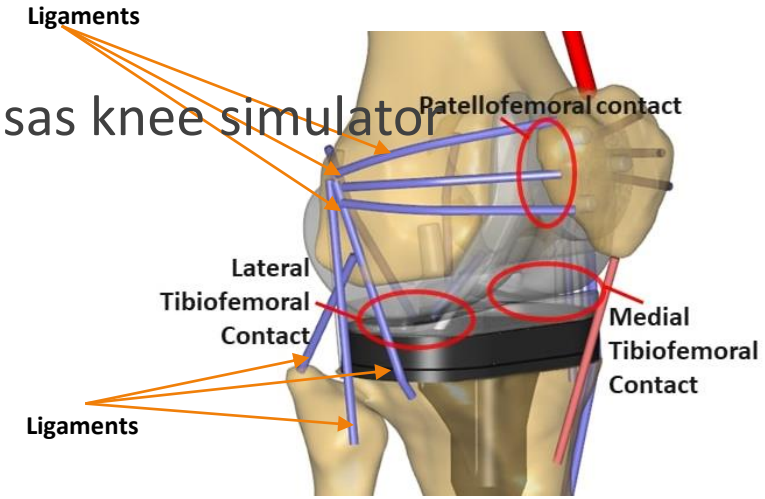
- 6th Grand Challenge dataset + Kansas knee simulator
- Uses force-dependent kinematics to simulate standalone knee implant model
- Movement governed by:
  - Contact surfaces
  - ligament structures

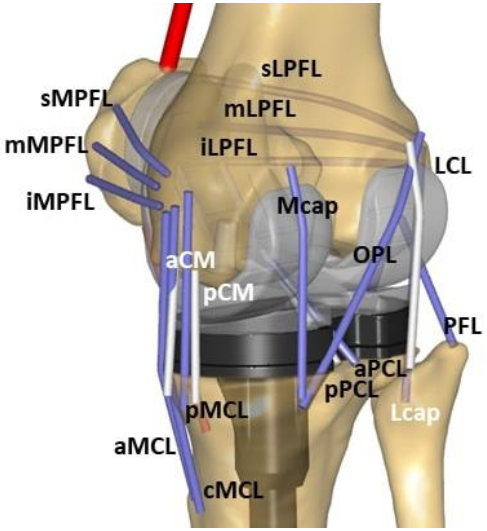
User defined settings

```
#define DEF_KNEE_FLEXION_MIN 10
#define DEF_KNEE_FLEXION_MAX 60

#define DEF_HIP_AXIAL_LOAD_MIN 200
#define DEF_HIP_AXIAL_LOAD_MAX 200

#include "Input/Ligament_Properties.any"
```

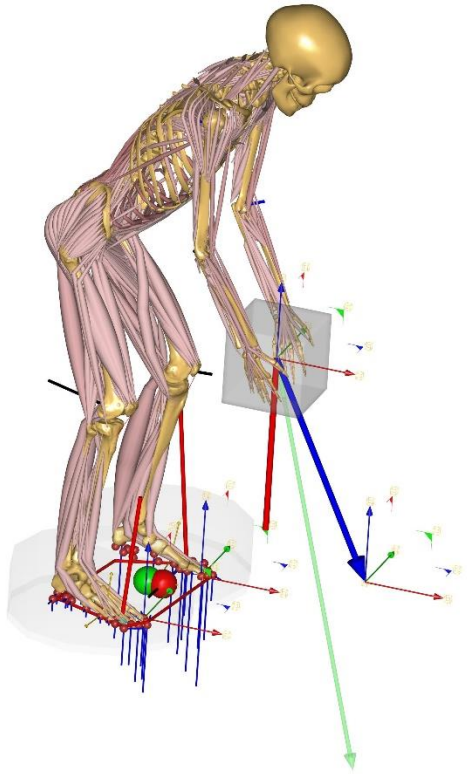
Ligament bundle properties

```
//stiffness (k_) in Newtons [N] and
//reference strains (er_)

#ifndef k_aPCL
#define k_aPCL 4800
#endif
#ifndef er_aPCL
#define er_aPCL 0.24
#endif
```





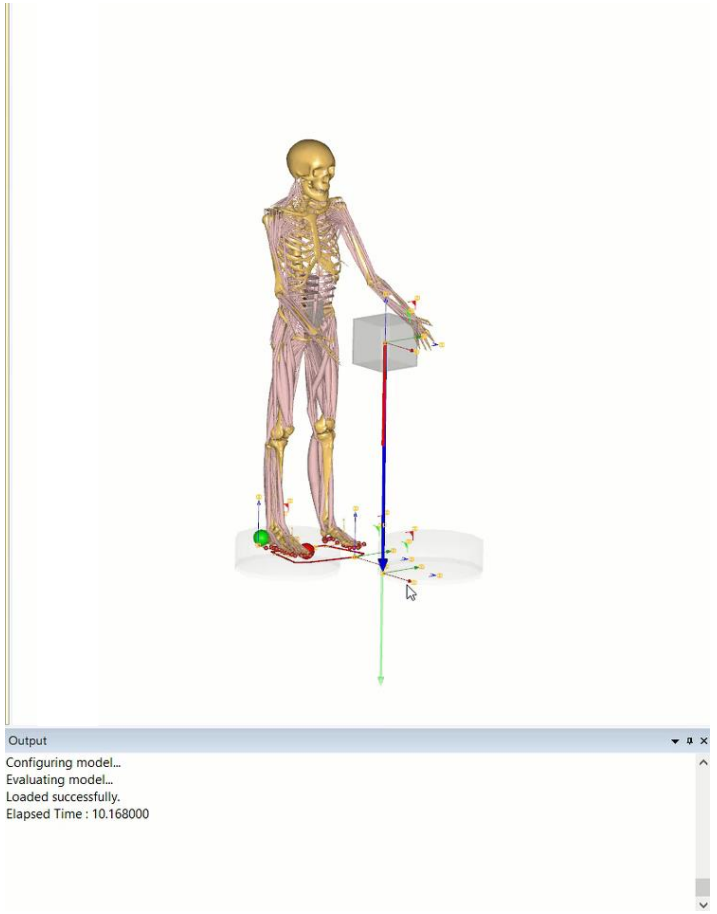
New Standing posture prediction



- Predicts posture based on external loads
- Fixed object weight or force vector

```
AnyVar ObjectWeight = 0;

#define LoadInRightHand 1
#define LoadInLeftHand  1
```

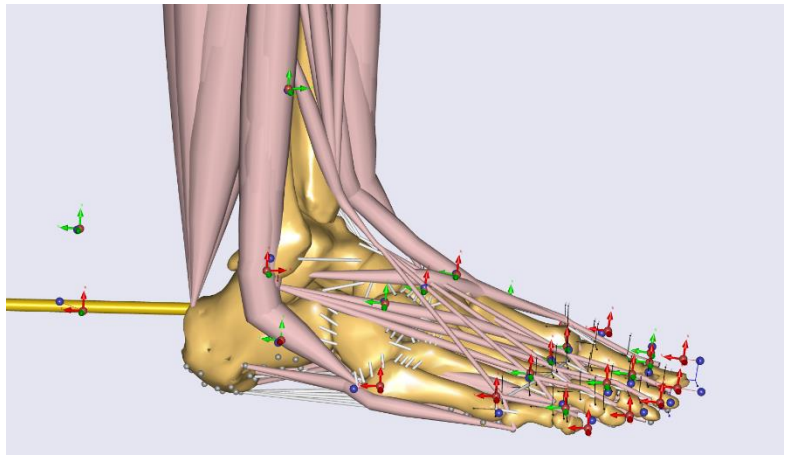
- Load model, click/drag widgets, release to run analysis:
  - Minimize joint torques
  - Balance drivers (keep CoP within foot stance area)



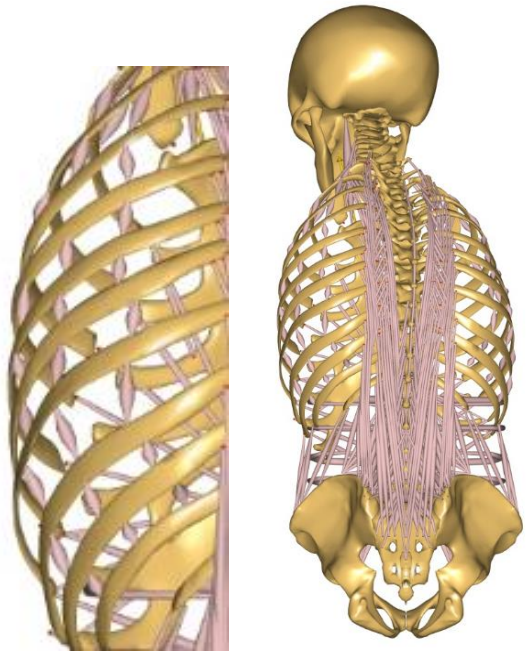
*** Please note the speed of the video was increased for viewing purposes.**

What can you expect in 2019?

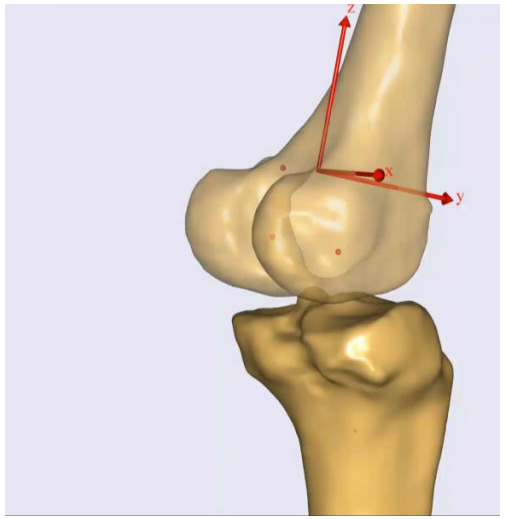
Updated Glasgow-Maastricht Foot Model with MoCap



Thoracic model



Moving axis knee Addon



Teaser: Moving-Axis Knee model

Contents lists available at ScienceDirect

Journal of Biomechanics

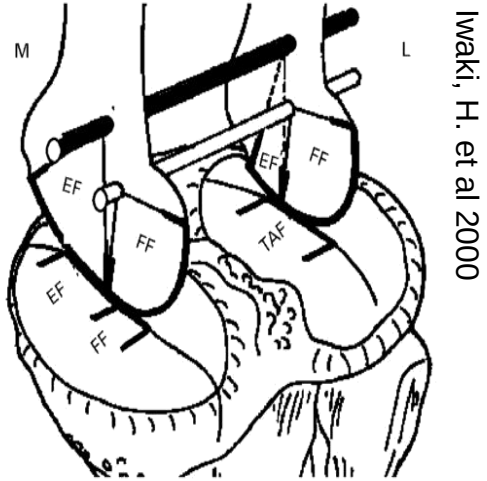
journal homepage: www.elsevier.com/locate/jbiomech
www.JBiomech.com

Development and validation of a subject-specific moving-axis tibiofemoral joint model using MRI and EOS imaging during a quasi-static lunge

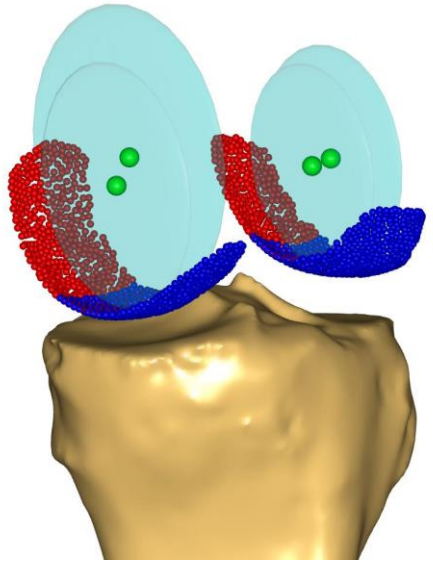
C.M. Dzialo [a,*], P.H. Pedersen [b], C.W. Simonsen [c], K.K. Jensen [c], M. de Zee [d], M.S. Andersen [a]

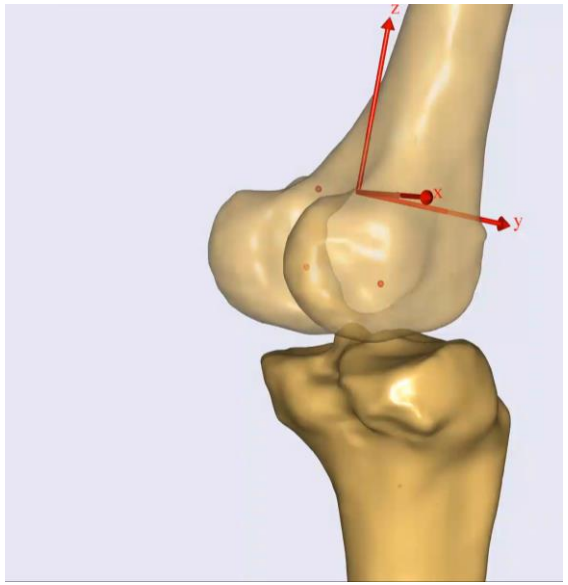
[a] Department of Materials and Production, Aalborg University, Fibigerstræde 16, DK-9220 Aalborg, Denmark
[b] Department of Orthopedic Surgery, Aalborg University Hospital, Hobrovej 18-22, DK-9000 Aalborg, Denmark
[c] Department of Radiology, Aalborg University Hospital, Hobrovej 18-22, DK-9000 Aalborg, Denmark
[d] Department of Health Science and Technology, Aalborg University, Fredrik Bajers Vej 7D, DK-9220 Aalborg, Denmark

```
//---Insert the following before <ANYMOCAP_MODEL>-----------------
// Define right/left/both knee joints
#define BM_JOINT_TYPE_KNEE_RIGHT _JOINT_TYPE_USERDEFINED_
#define BM_JOINT_TYPE_KNEE_LEFT _JOINT_TYPE_USERDEFINED_

// Include Moving-axis knee joint Addon
#include "<ANYBODY_PATH_MODELUTILS>/MovingAxisKnee/AddOnKnee.any"
//-----------------------------------------------------------------
```



Iwaki, H. et al 2000





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- Events, dates, publication list, ...

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- Wiki, Forum, Repositories

Events:

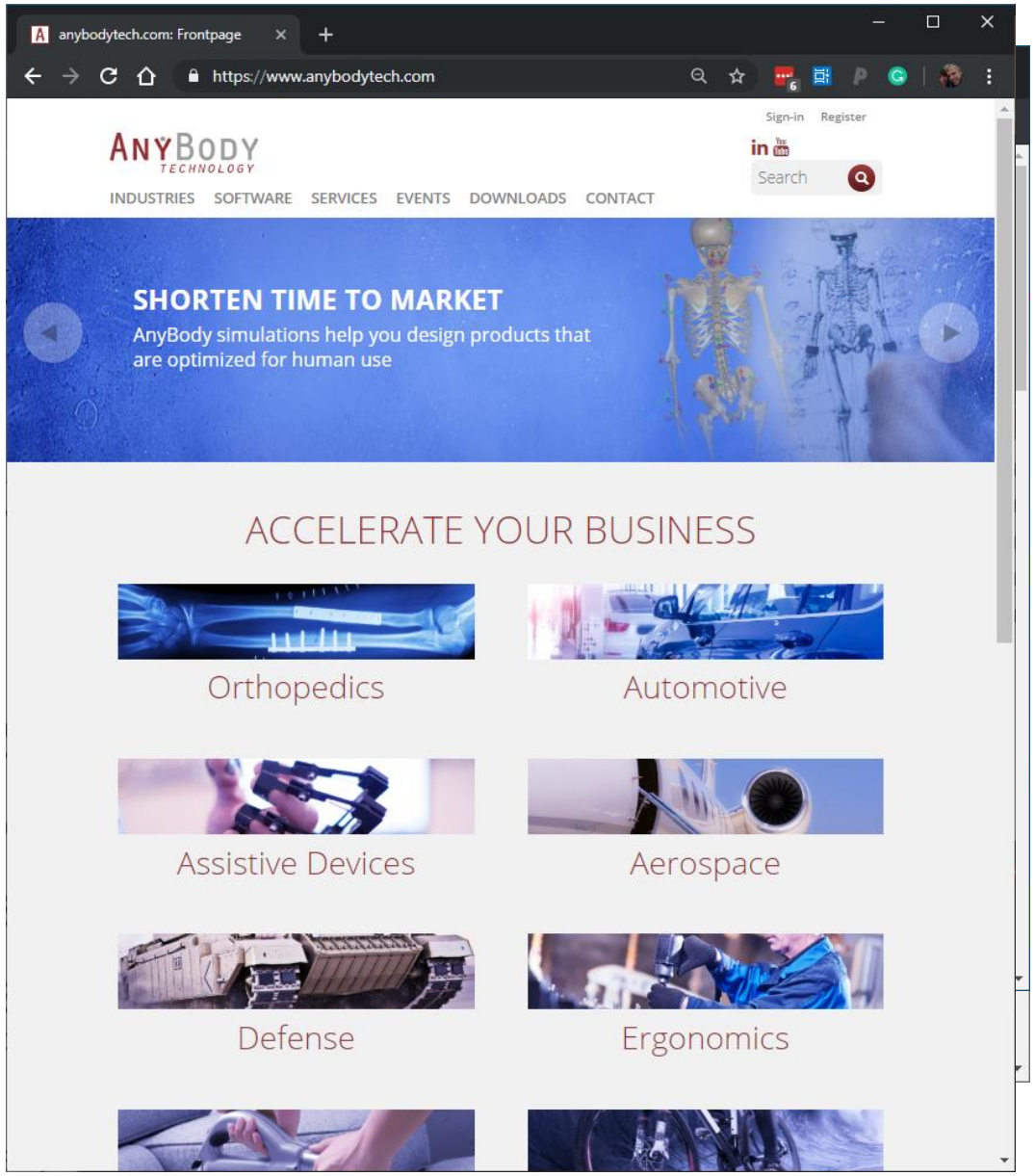
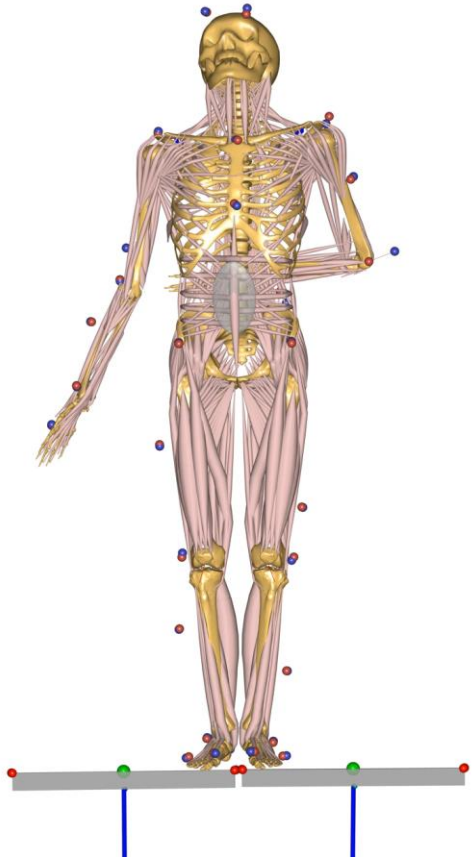
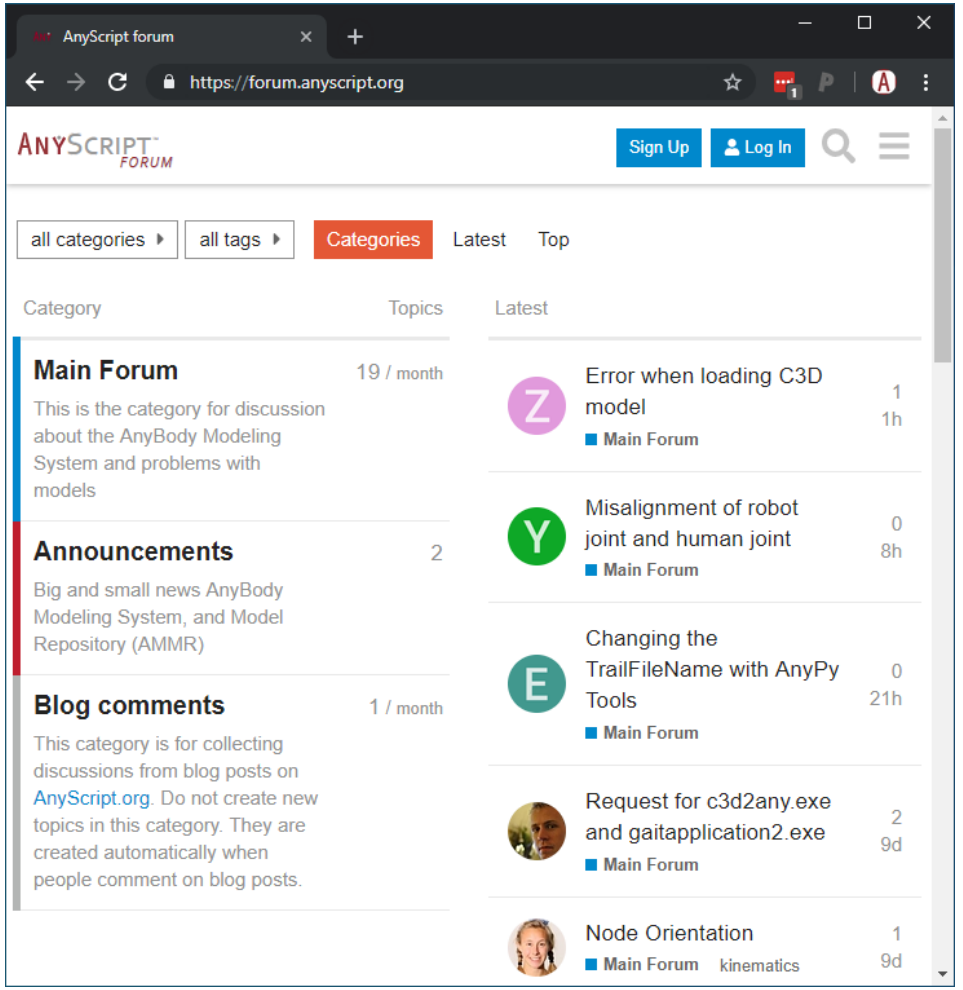
Now: ICRA 2019, Montreal, Canada

23-24 May: Seminar - From Mimics segmentation to MSM modeling

28 Jul: TGCS 2019 – ISB satellite conference
Workshop on knee osteoarthritis and knee cartilage mechanic

31 Jul- 4 Aug: International Society of Biomechanics 2019 - Calgary, Canda.

Meet us? Send email to sales@anybodytech.com



Time for questions: