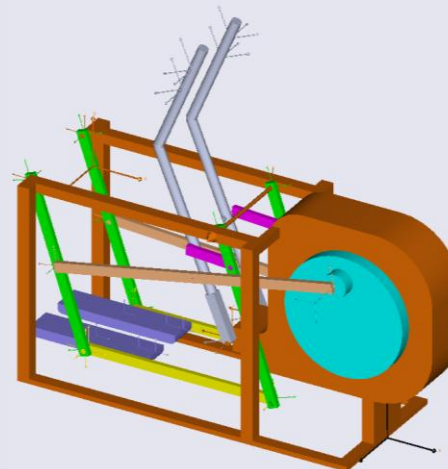
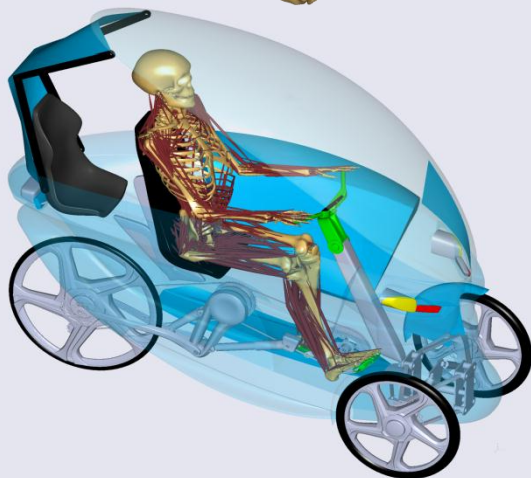
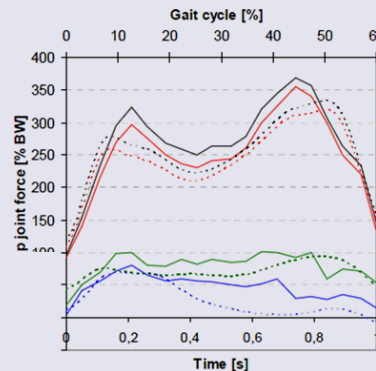
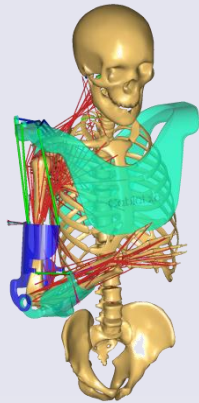


SolidWorks2AnyBody: A new powerful SolidWorks add-in application

Moonki Jung
mj@anybodytech.com

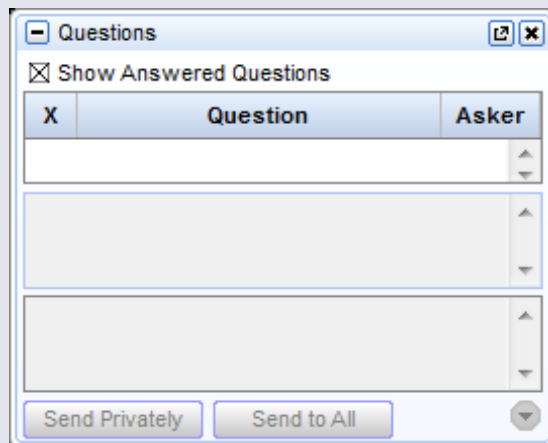
The web cast will start in a few minutes....



ANYBODY
TECHNOLOGY

Agenda & Presenters

- AnyBody Modeling System (AMS)
- AnyBody Model Repository
- Solidworks2AnyBody Translator
 - Layout
 - Function
 - Applications
- Q & A (submit questions anytime)



Moonki Jung
(Presenter)



Amir Al-Munajjed
(Host/Panelist)

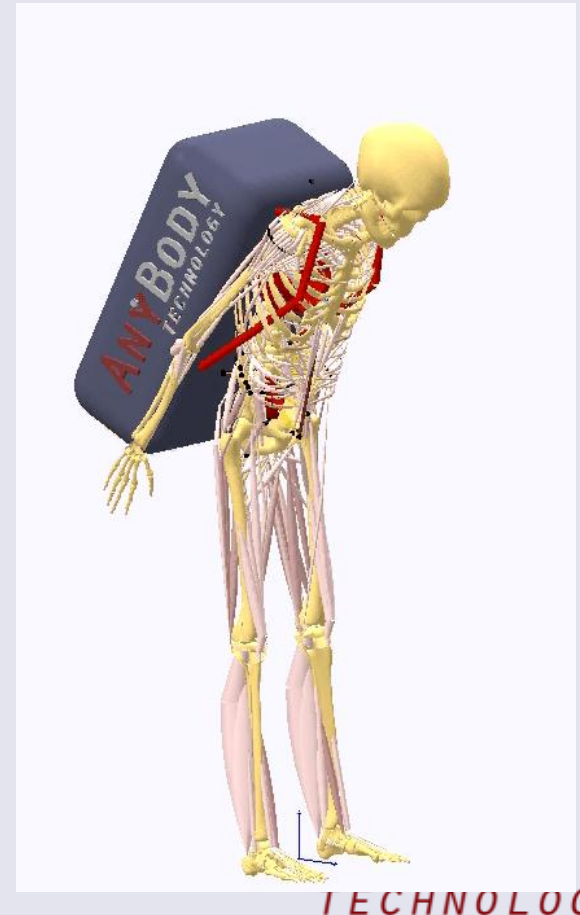


Michael Damsgaard
(Panelist)

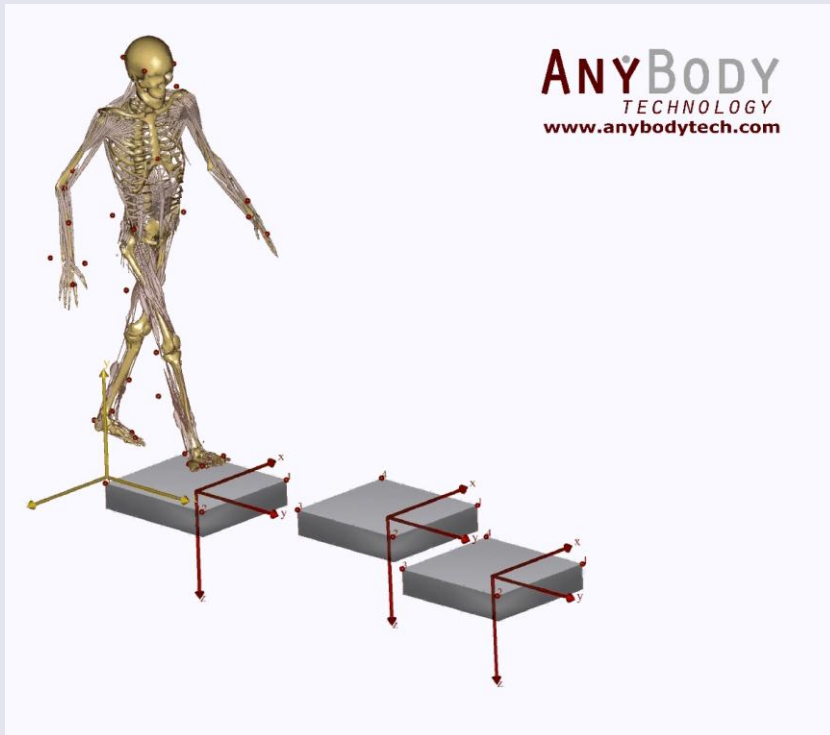


AnyBody Modeling System

- Developed in-house for musculoskeletal analysis
- Self-contained system
- Interfacing to
 - motion capture
 - image-based bone and muscle data
 - finite-element software
 - CAD software
 - office systems
- Open body model
- Broad and deep model validation
- API for imbedded use

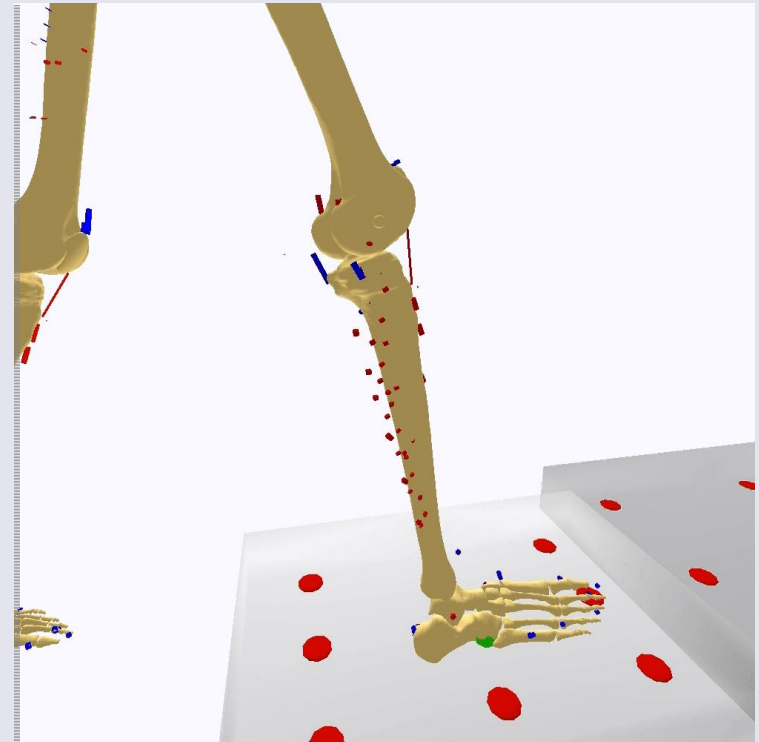


AnyBody Modeling System



Motion & ext Forces as Input:

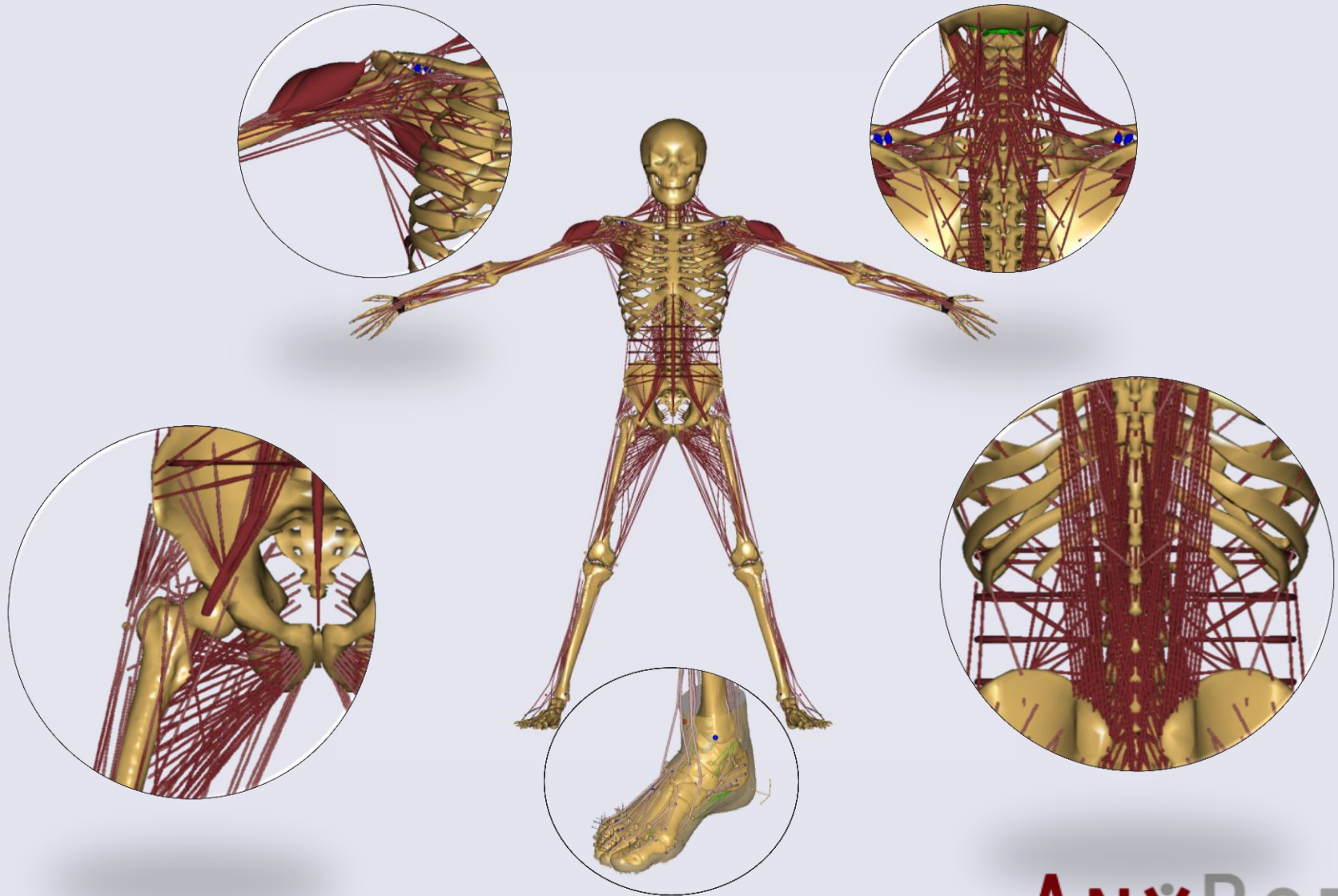
- Motion Capture (Vicon, Qualisys, ...)
- Joint Angle Input



Forces as Output:

- Muscle Forces (activations)
- Joint Reaction Forces

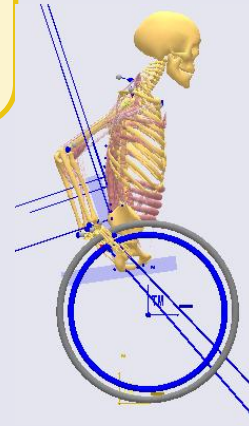
The AnyBody Managed Model Repository™





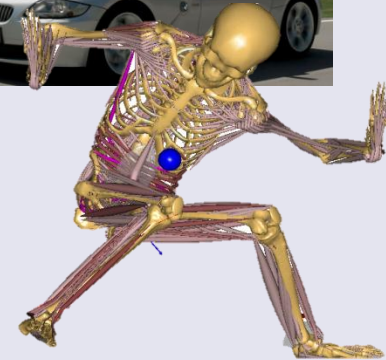
Gait Application
AnyGait

Product Design
Optimization

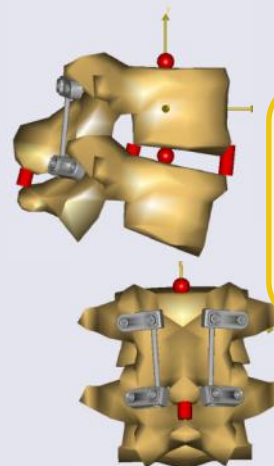
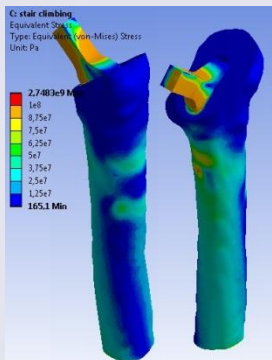


Ergonomic
Analysis and
Documentation

ANYBODY Modeling System



Physiological Load
Cases for Finite
Element Analysis



Surgical Planning, -
Evaluation & -Failure
Analysis

ANYBODY
TECHNOLOGY

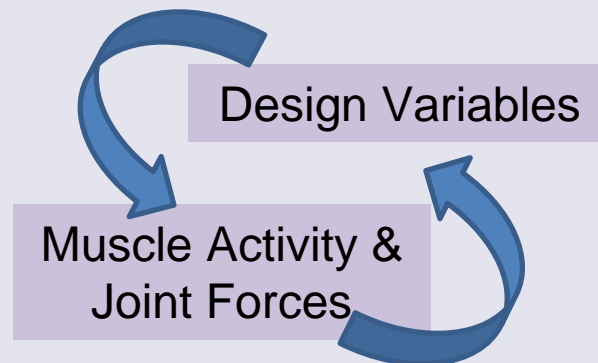
SolidWorks2AnyBody: Motivation

For design of products with man-machine interface, the optimization of design variables is essential for their function.

- Physical experiments in Labs require a lot of time and effort
- Manufacturing of prototypes is very cost intensive
- Computer Aided Design and Simulation is reducing costs and time

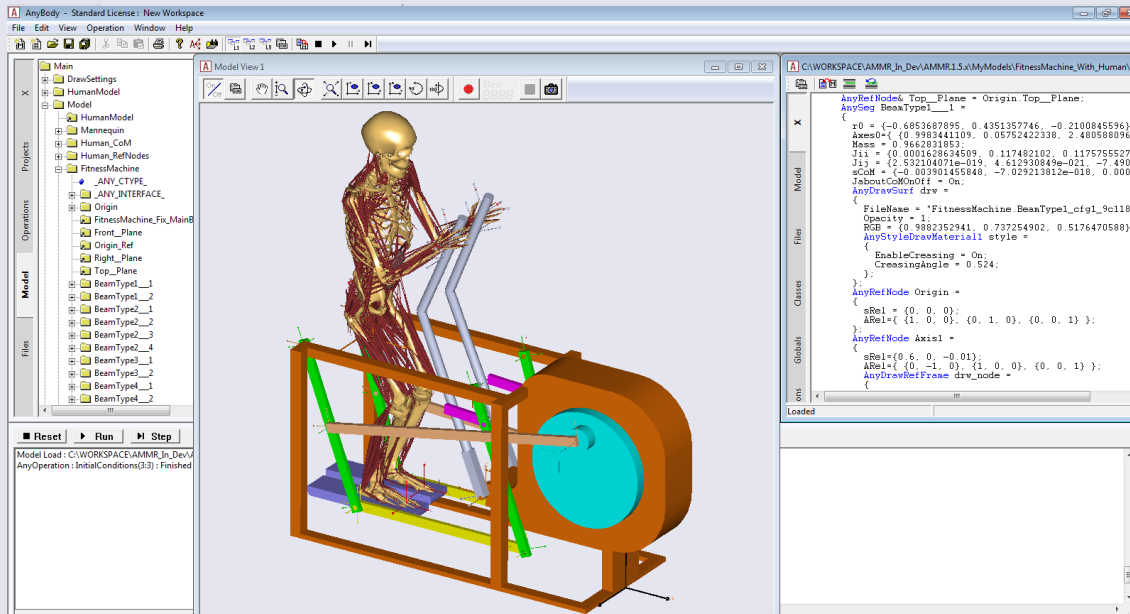
Objective:

- Create short loop between CAD models and musculoskeletal analysis



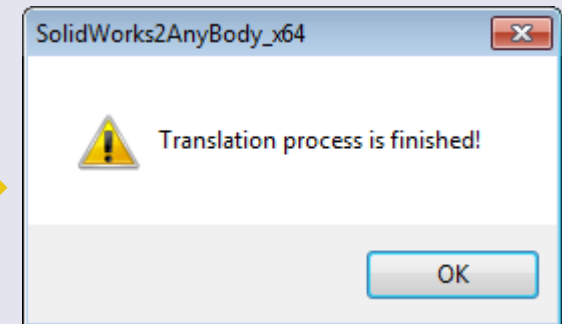
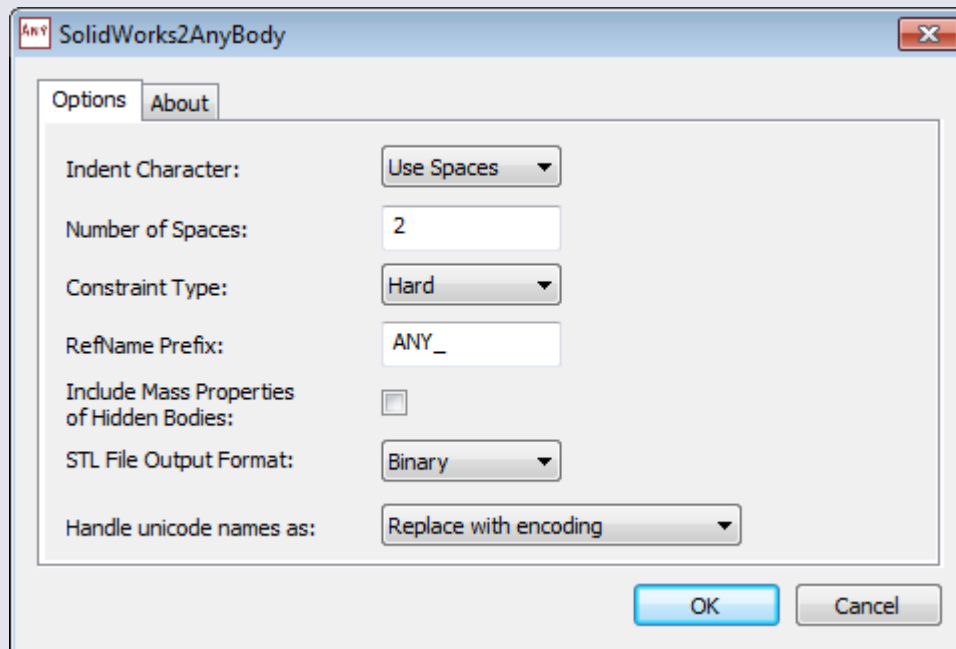
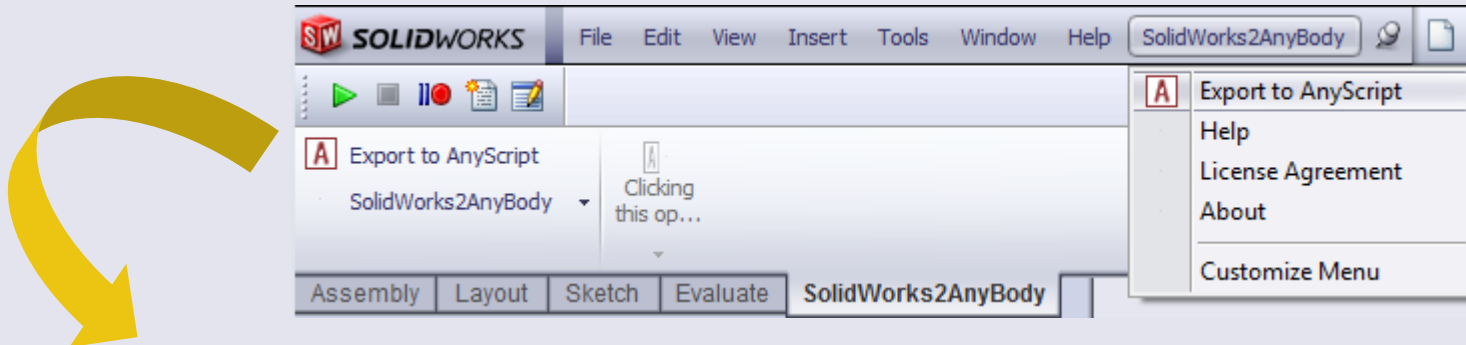
SolidWorks2AnyBody: A new powerful SolidWorks add-in to translate your CAD model

- Translate your CAD model into AnyBody automatically
 1. Geometry (STL file)
 2. Mass properties
 3. Initial position and rotation
 4. Mate types
 5. Reference geometries



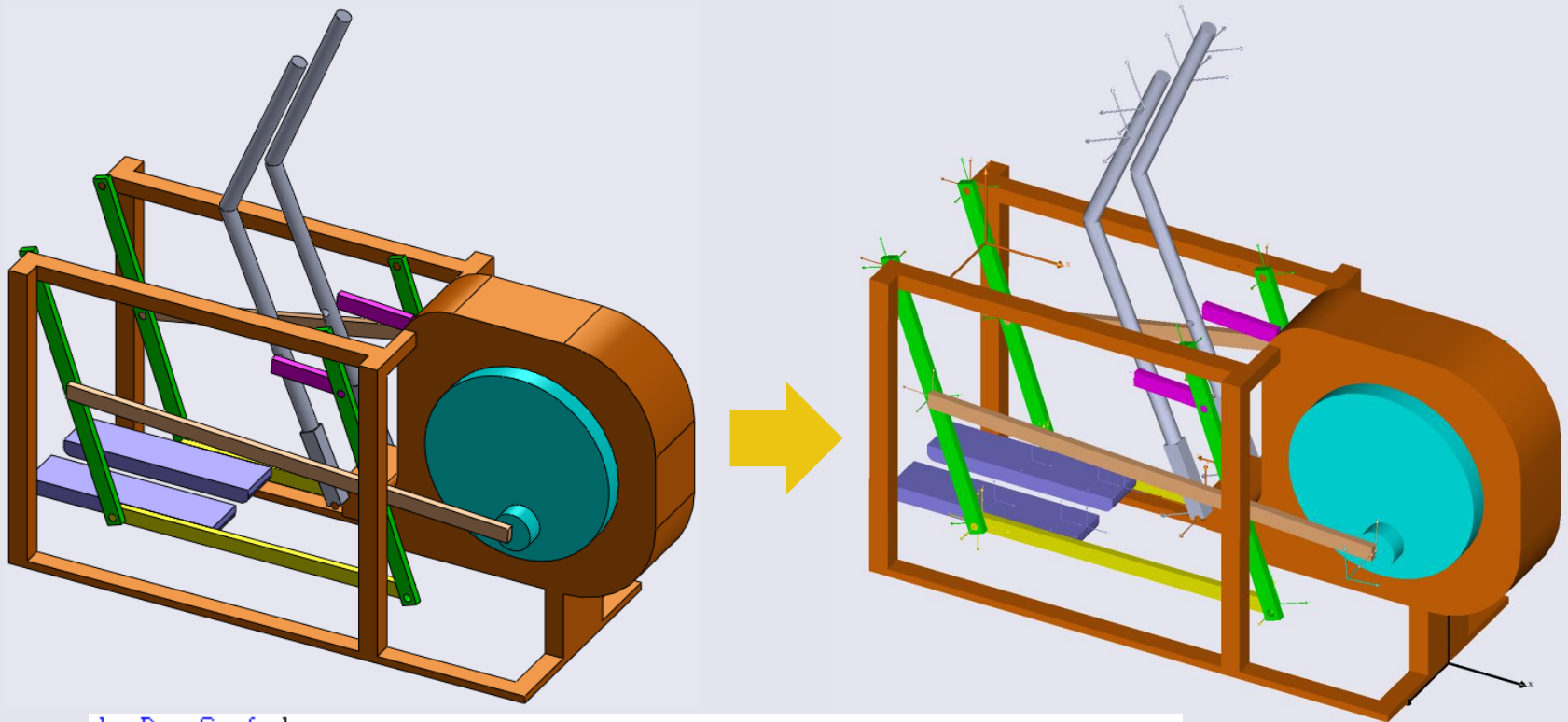
User interface for SolidWorks2AnyBody

- An add-in application which can be used in SolidWorks



What will be translated: 1. Geometry (STL)

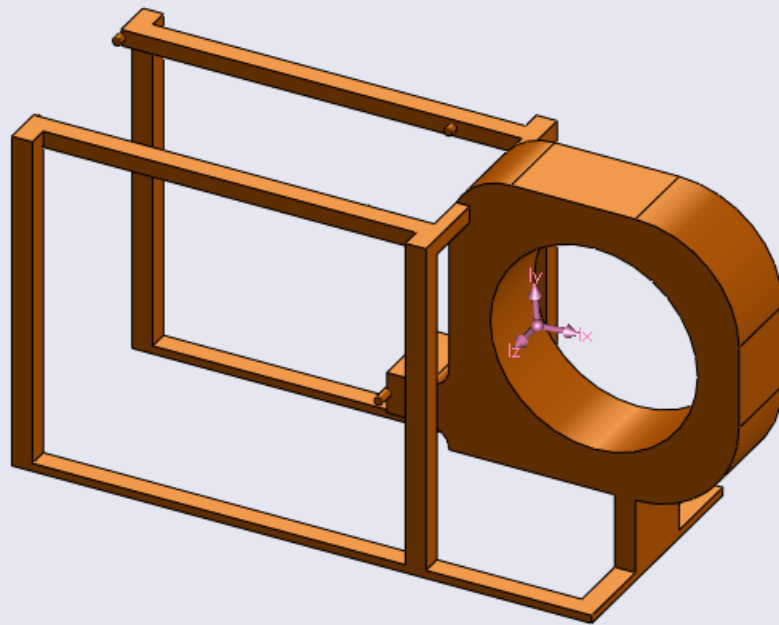
- Individual STL files for each part can be generated



```
AnyDrawSurf drw =  
{  
  FileName = "FitnessMachine.MainCylinder_cfg0_9c1185a5c5e9fc546128.stl";  
  Opacity = 1;  
  RGB = {0, 1, 1};  
  AnyStyleDrawMaterial1 style =  
  {  
    EnableCreasing = On;  
    CreasingAngle = 0.524;  
  };  
};
```

What will be translated: 2. Mass Properties

- Mass, center of mass and moments of inertia values



Mass properties of MainBase (Part Configuration - Default)

Output coordinate System: -- default --

Density = 1000.00000000 kilograms per cubic meter

Mass = 73.11799280 kilograms

Volume = 0.07311799 cubic meters

Surface area = 2.99065993 square meters

Center of mass: (meters)
X = -0.18990690
Y = -0.04988091
Z = 0.00001942

Principal axes of inertia and principal moments of inertia: (kilograms * square meters)
Taken at the center of mass.

Ix = (0.99680585, 0.07986301, -0.00005817)	Px = 6.17565192
Iy = (-0.07986302, 0.99680583, -0.00017447)	Py = 13.40049353
Iz = (0.00004406, 0.00017856, 0.99999998)	Pz = 17.11071686

Moments of inertia: (kilograms * square meters)
Taken at the center of mass and aligned with the output coordinate system.

Lxx = 6.22173273	Lxy = 0.57515458	Lxz = -0.00058241
Lyx = 0.57515458	Lyy = 13.35441288	Lyz = -0.00069607
Lzx = -0.00058241	Lzy = -0.00069607	Lzz = 17.11071671

Moments of inertia: (kilograms * square meters)
Taken at the output coordinate system.

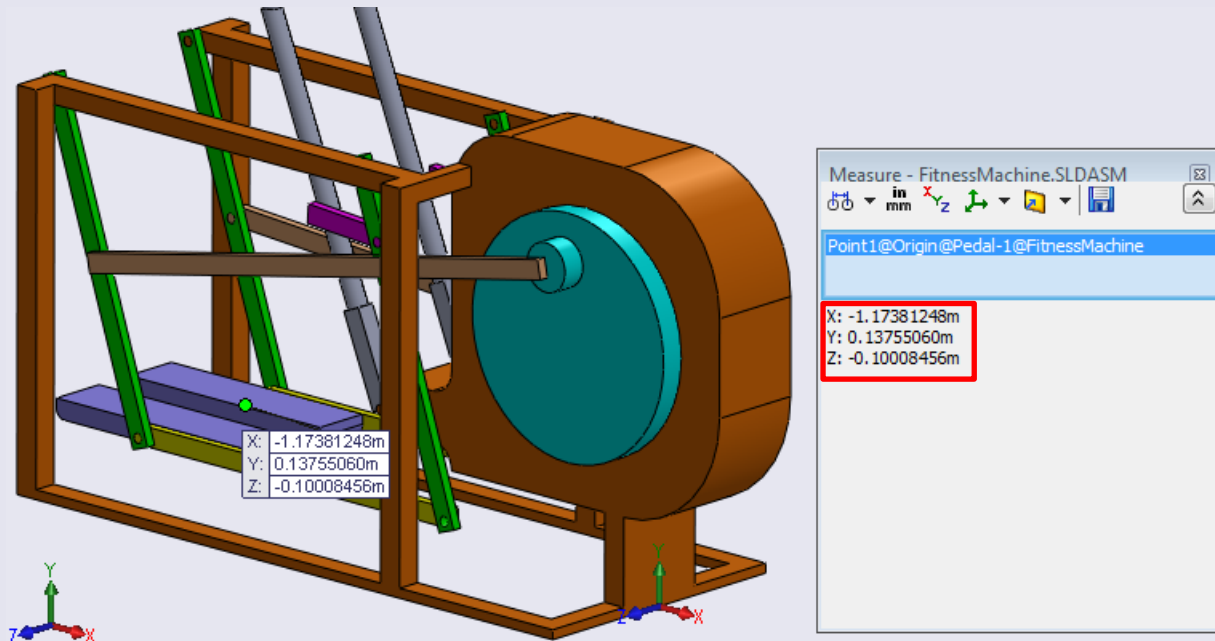
Ixx = 6.40365800	Ixy = 1.26778148	Ixz = -0.00085212
Iyx = 1.26778148	Iyy = 15.99138620	Iyz = -0.00076691
Izx = -0.00085212	Izy = -0.00076691	Izz = 19.92961525



```
A C:\WORKSPACE\CAD\[Tutorial]\FitnessTrainer_New\AnyScript3\FitnessMachine.any - Loaded
AnySeg MainBase__1 =
{
  r0 = {-0.1, 0.55, -8.455958313e-005};
  Axes0 = { {1 0 0}, {0 1 0}, {0 0 1} };
  Mass = 73.1179928;
  Jii = {6.221732725, 13.35441288, 17.11071671};
  Jij = {0.5751545834, -0.0006960674174, -0.0005824144636};
  sCoM = {-0.189906896, -0.04988090848, 1.942340762e-005};
  JaboutCoMOnOff = On;
}
```


What will be translated: 3. Initial Position & Rotation

- Initial position and rotation values

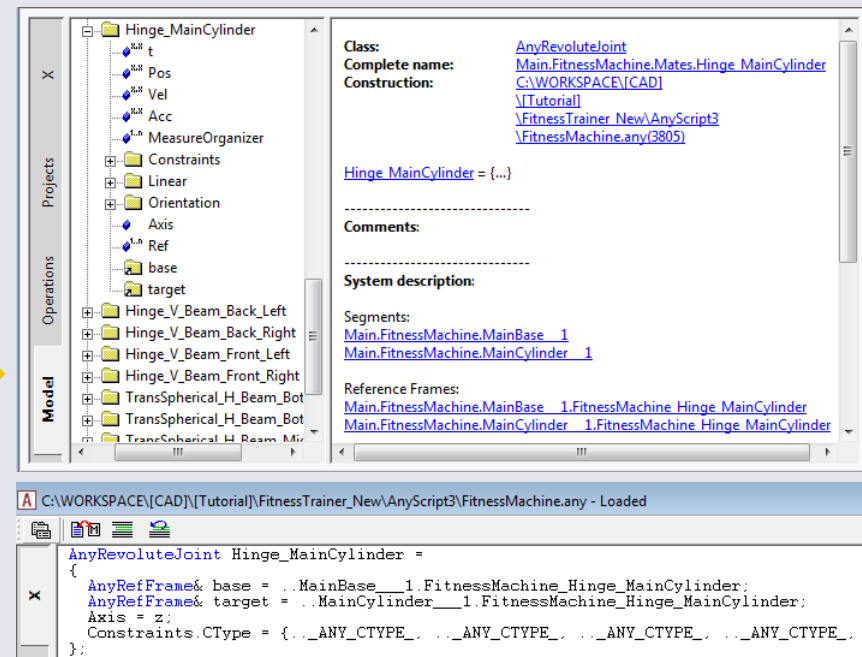
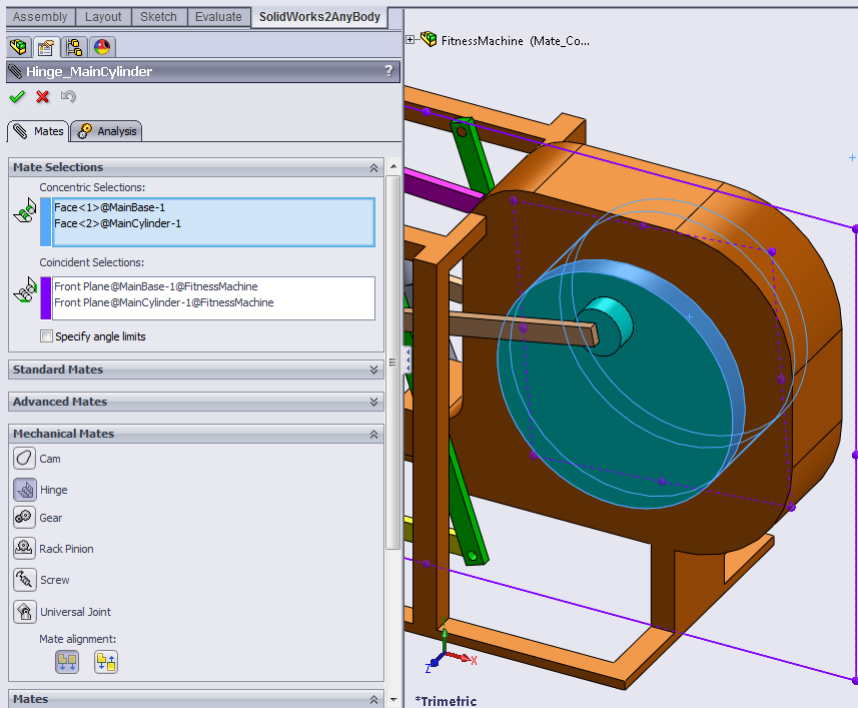


```
C:\WORKSPACE\CAD\[Tutorial]\FitnessTrainer_New\AnyScript3\FitnessMachine.any - Loaded  
  
AnySeg Pedal__1 =  
{  
  r0 = {-1.173812483, 0.1375506003, -0.1000845596};  
  Axes0={ {1, 0, 0}, {0, 1, 0}, {0, 0, 1} };  
  Mass = 2.379398224;  
  Jii = {0.003169974655, 0.05161298372, 0.04907240264};  
  Jij = {-1.031451443e-019, 8.718483656e-020, 0};  
  sCoM = {5.334118853e-018, 0.0001344877864, 0};  
  JaboutCoMOnOff = On;  
}
```



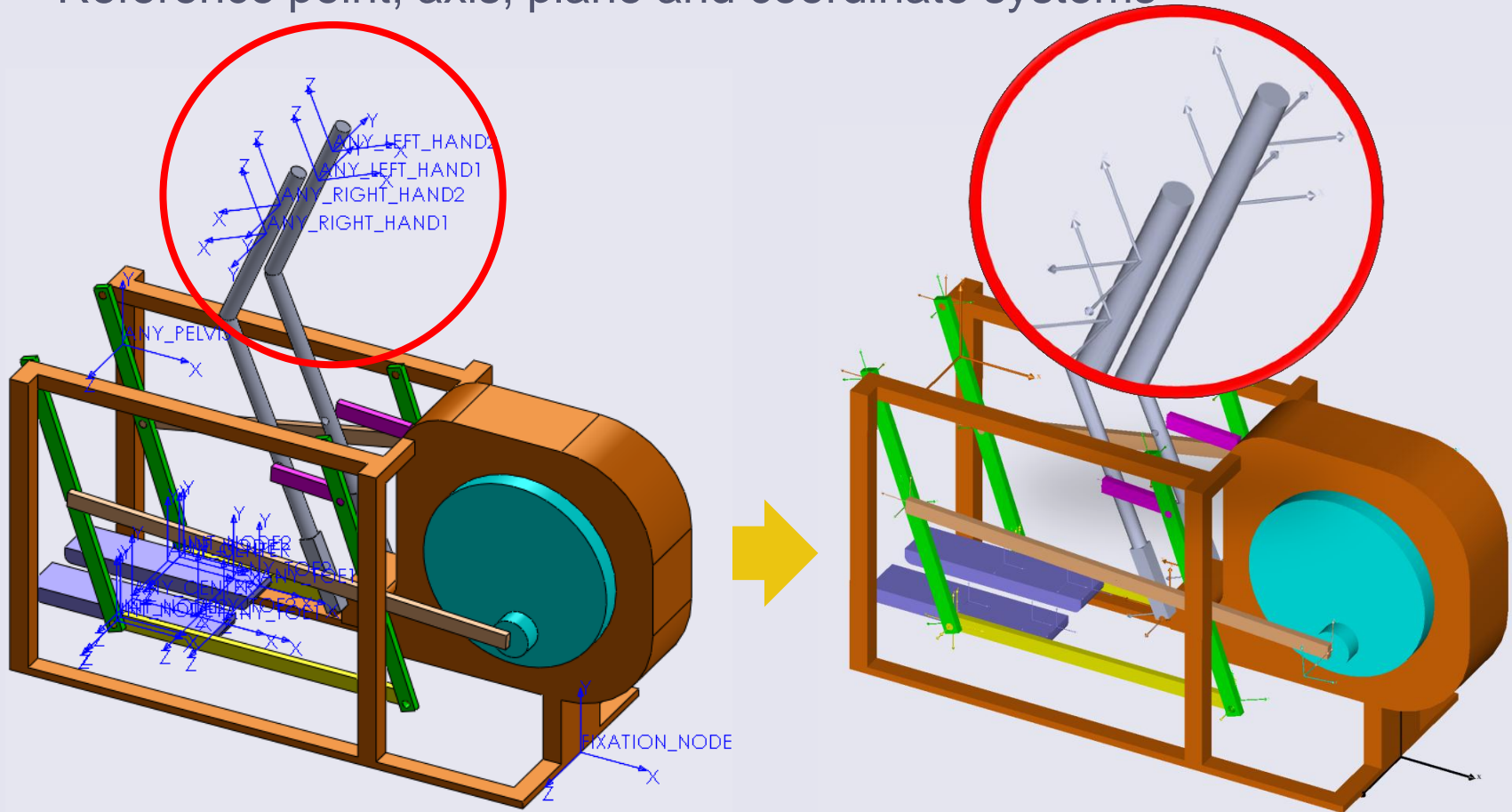
What will be translated: 4. Mates

- Mates will be transformed to AnyBody joint or constraint objects

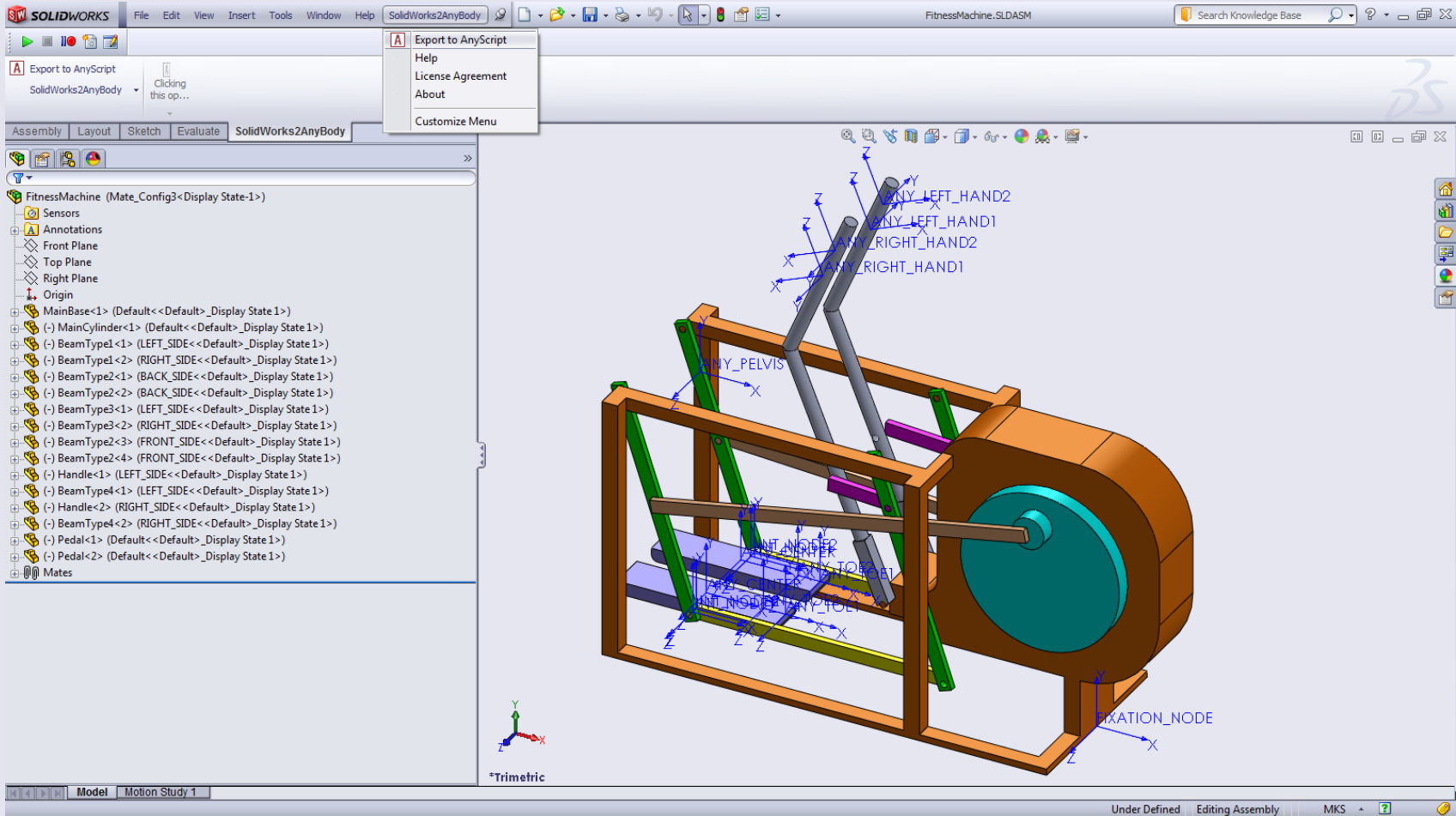


What will be translated: 5. Reference Geometry

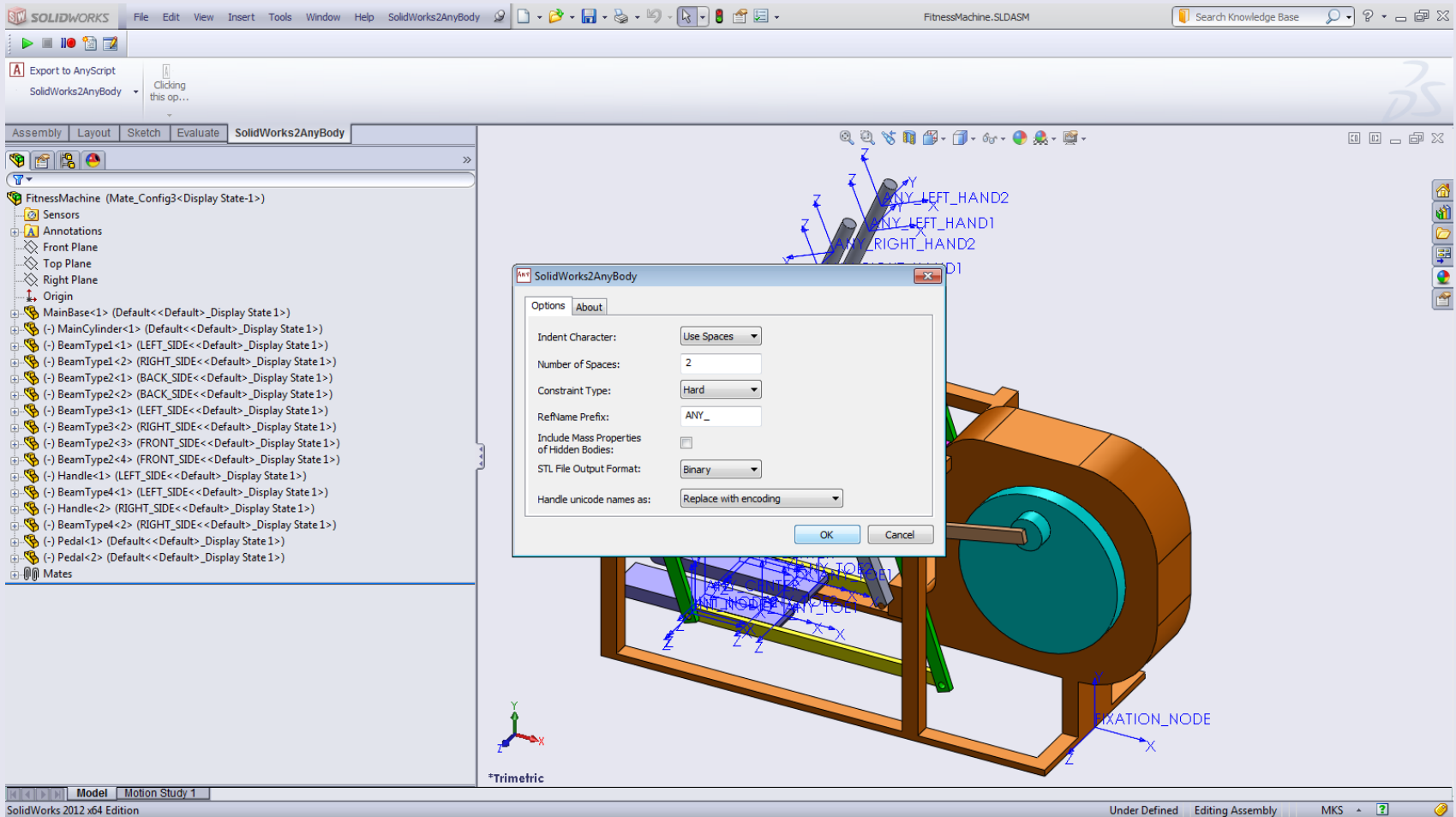
- Reference point, axis, plane and coordinate systems



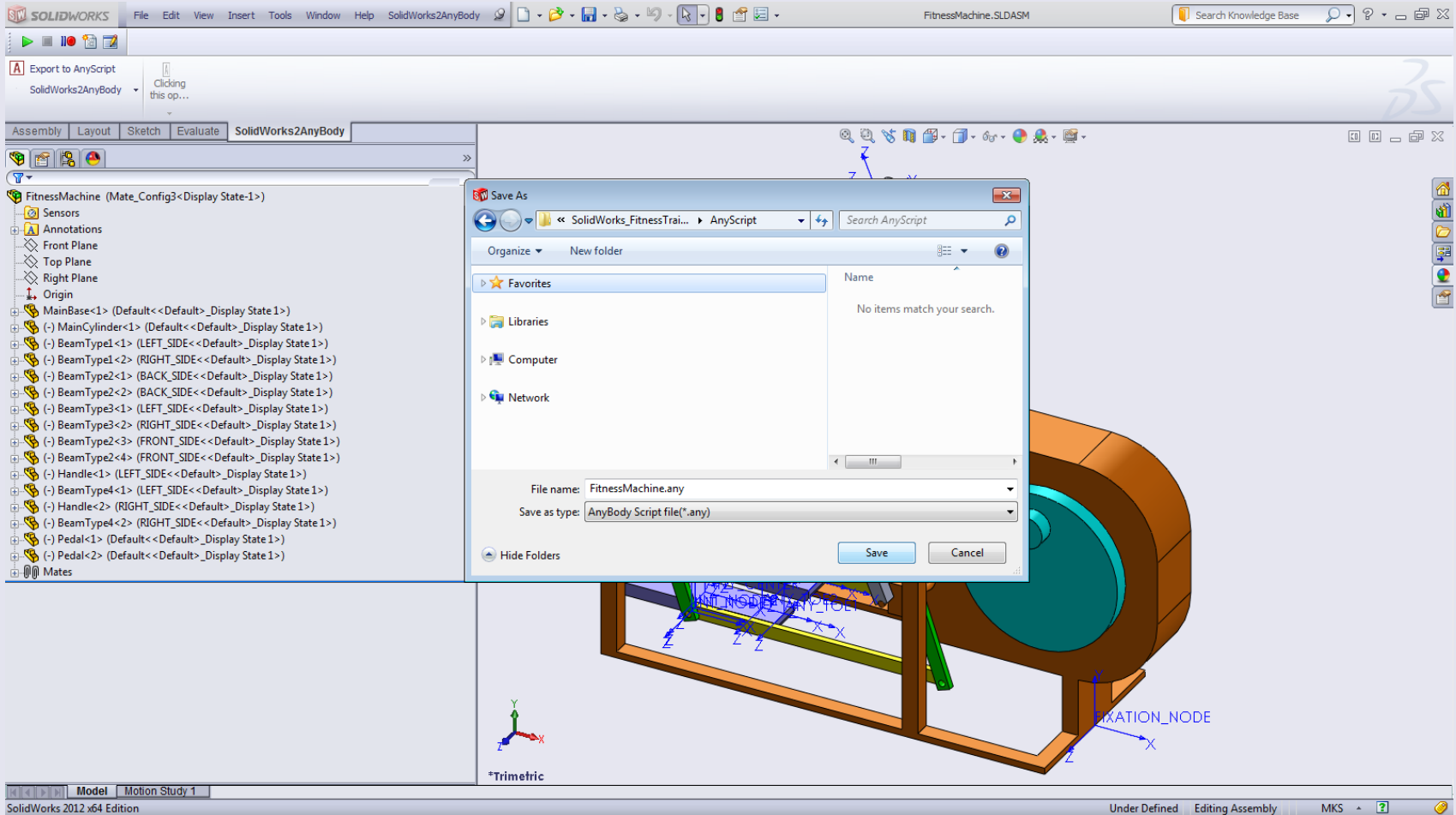
SolidWorks2AnyBody Demo Process



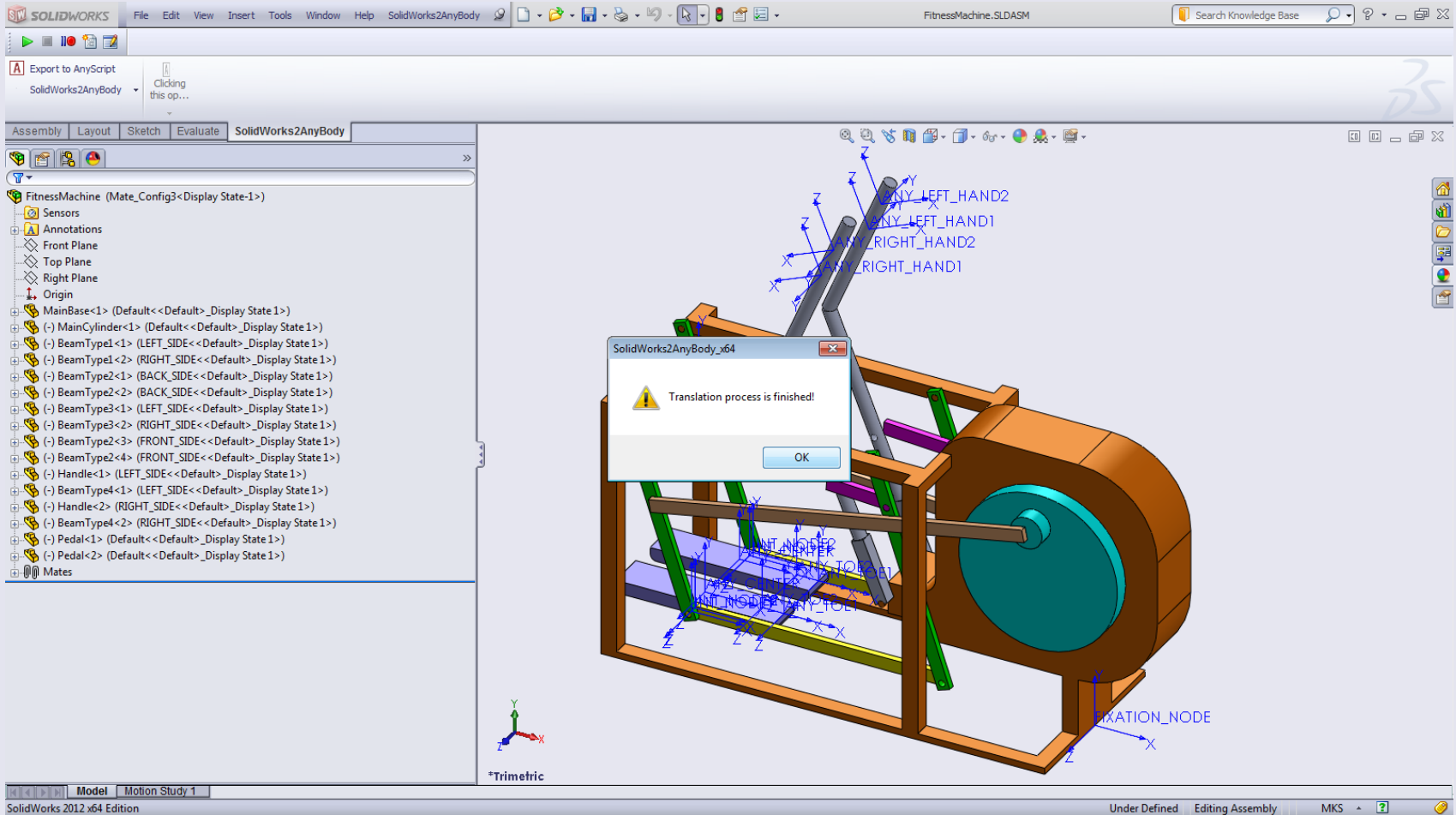
SolidWorks2AnyBody Demo Process



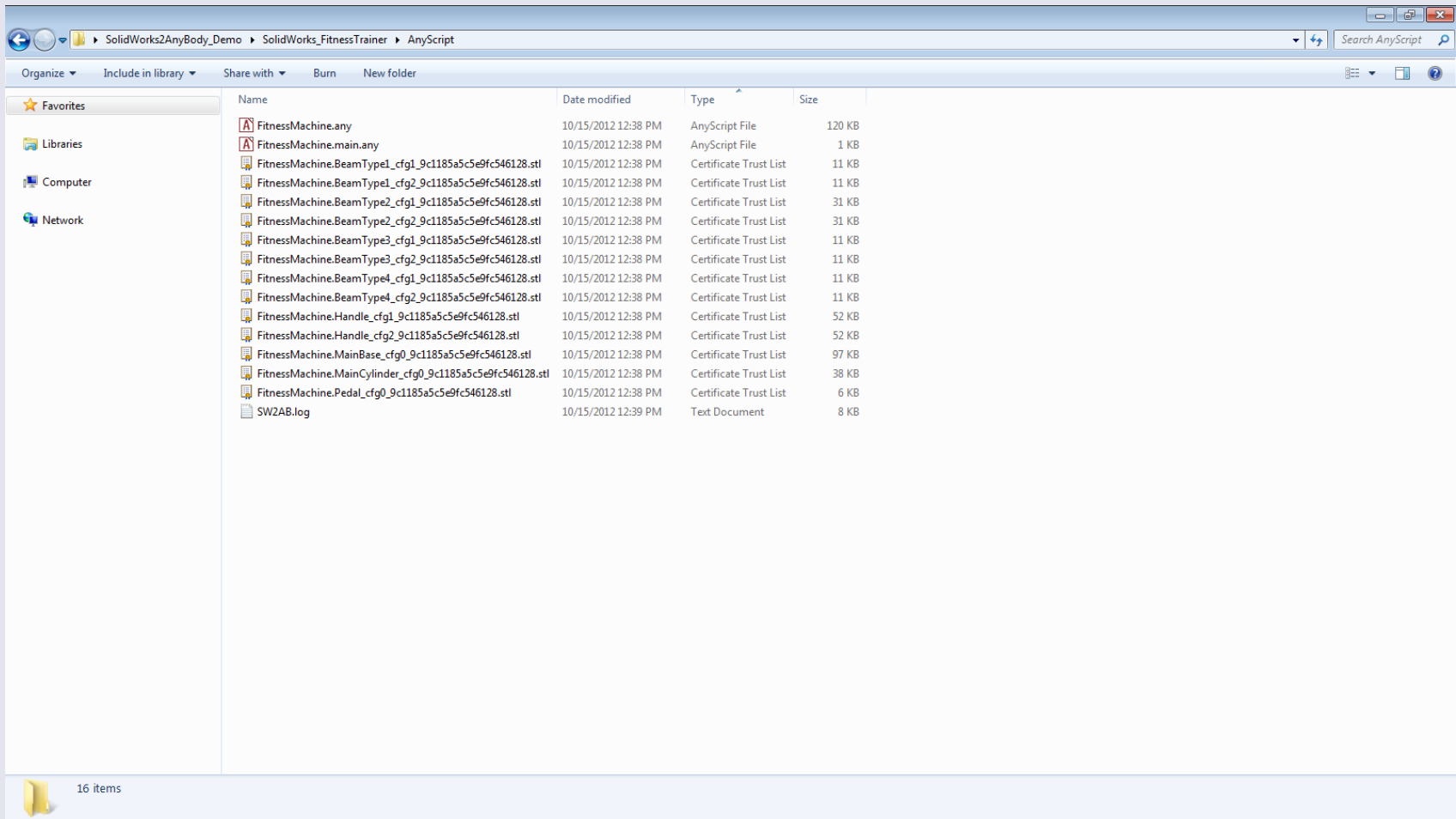
SolidWorks2AnyBody Demo Process



SolidWorks2AnyBody Demo Process



SolidWorks2AnyBody Demo Process



SolidWorks2AnyBody Demo Process

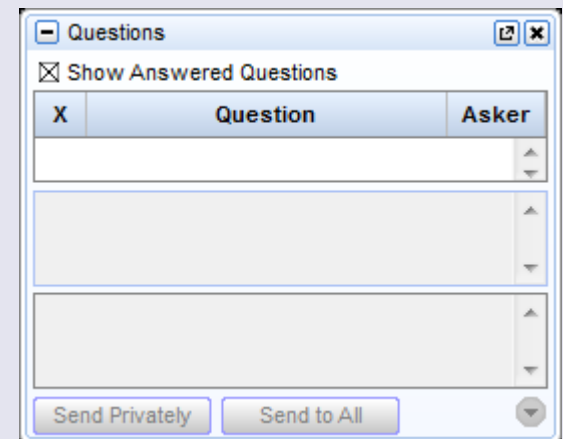
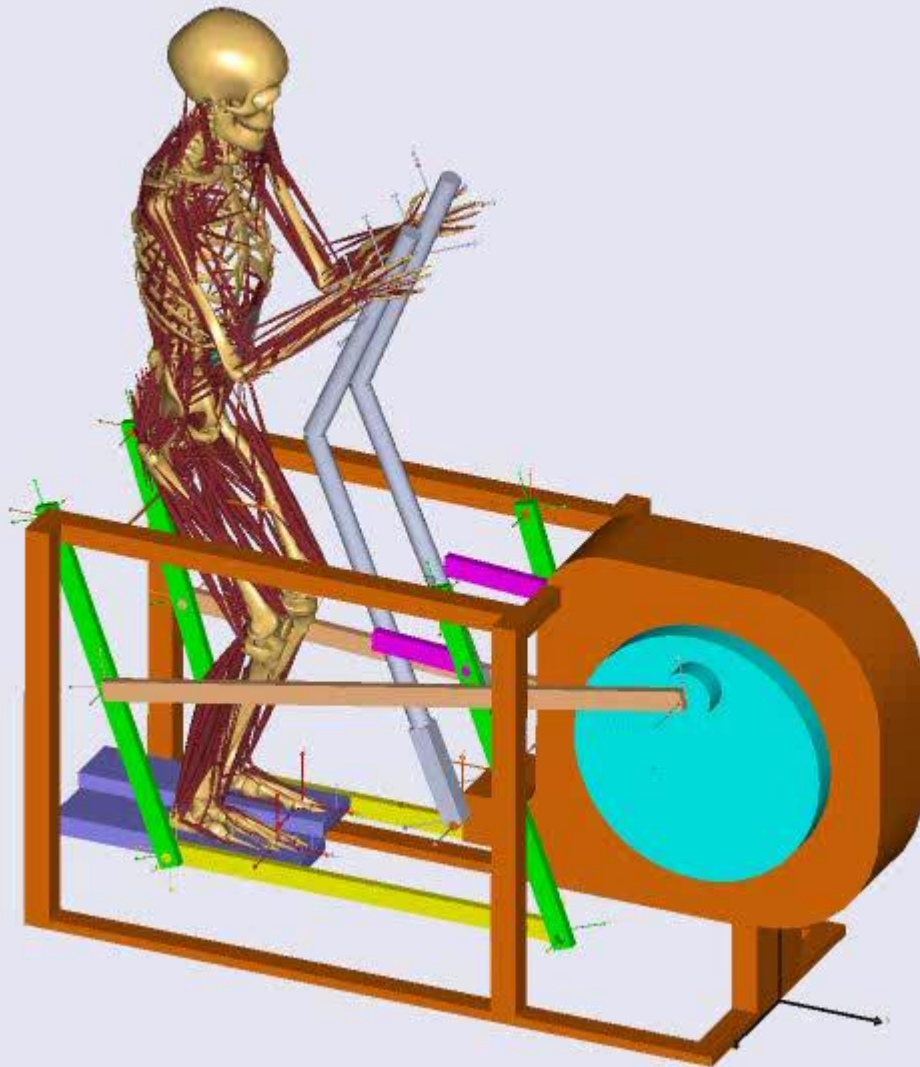
The screenshot displays the AnyBody software interface with the following components:

- Project Tree (Left):** A hierarchical list of components including BeamType2_4, BeamType3_1, BeamType2_2, BeamType4_1, BeamType4_2, Handle_1, Handle_2, MainBase_1, MainCylinder_1, Pedal_1, Pedal_2, Mates, Fix_MainBase, Fix_Pedal_Left, Fix_Pedal_Right, Hinge_H_Beam_Bot, Hinge_H_Beam_Mic, Hinge_H_Beam_Smi, Hinge_Handle_Left, Hinge_Handle_Right, Hinge_MainCylindr, Hinge_V_Beam_BacL, Hinge_V_Beam_Fror, Hinge_V_Beam_Smi, TransSpherical_H_B, and TransSpherical_H_Bi.
- Class Description (Middle-Left):**
 - Class:** AnySeg
 - Complete name:** Main.FitnessMachine.Ped
 - Construction:** C:\Users\mj\Desktop\Soli (3483)
 - Comments:** Pedal_2 = (...)
 - System description:** Configuration dependencies: (empty)
 - Class Operations:** Object Description (Enabled), Dump (Enabled), Dump All (Enabled)
- Model View (Center):** A 3D visualization of a mechanical assembly, likely a pedal mechanism, with various colored components (orange, green, blue, yellow, purple) and a large cyan circular element.
- Script Editor (Right):** A text editor showing the AnyBody script for the pedal component. The script includes definitions for nodes, frames, and segments, such as:

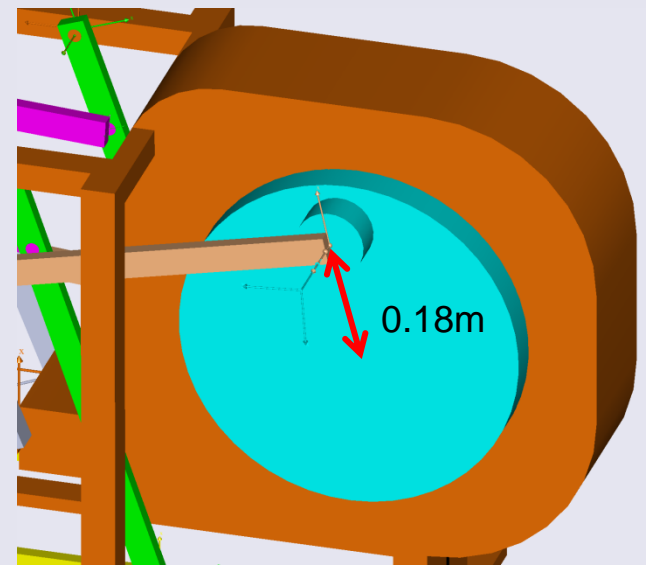
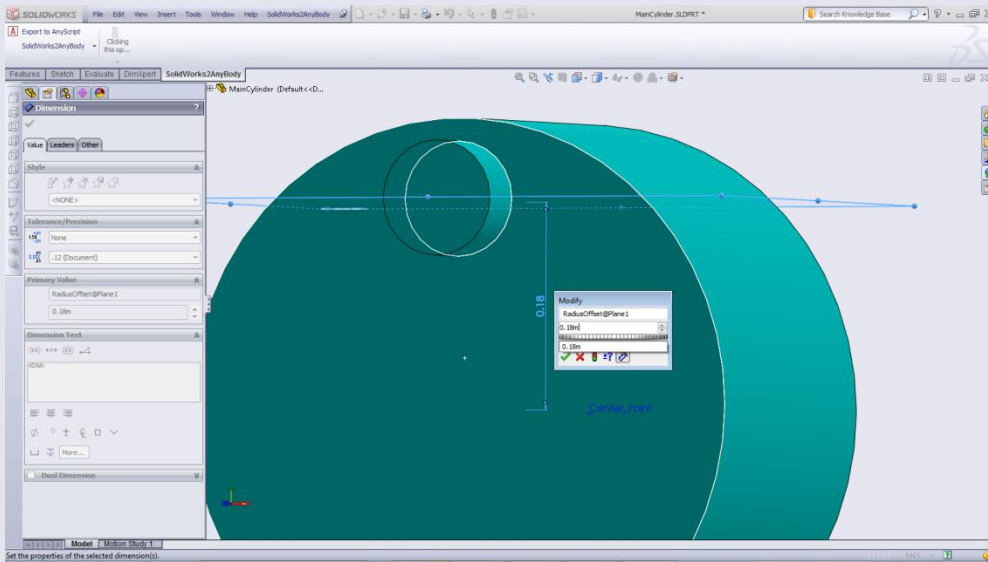
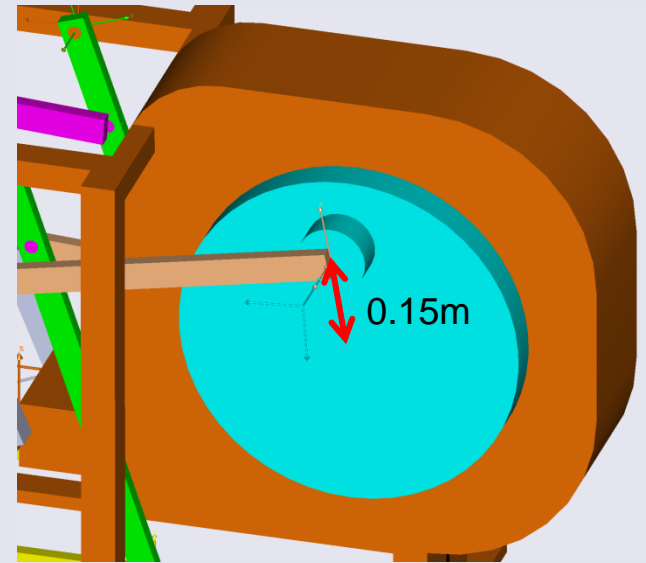
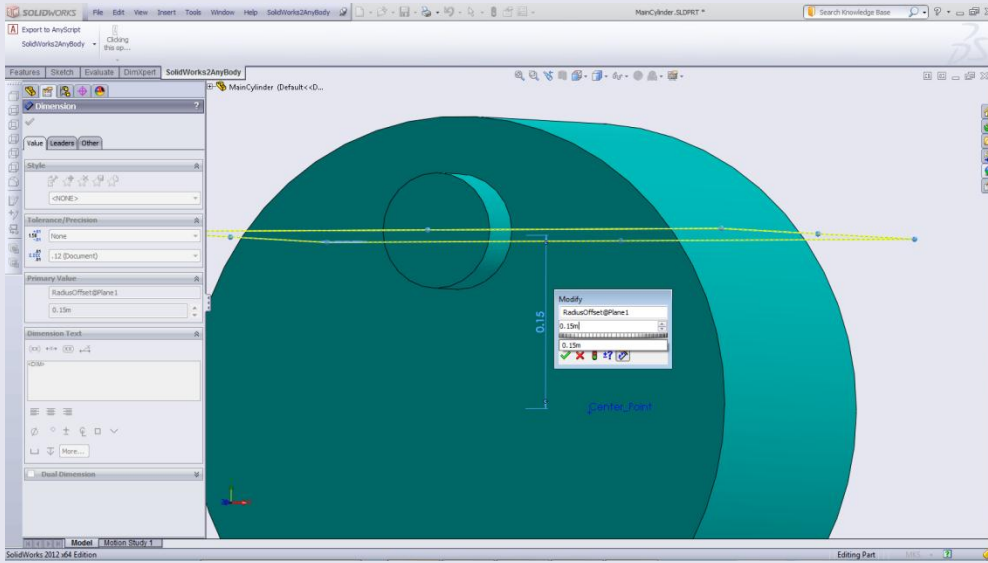
```
ScaleXYZ = {0.004, 0.004, 0.004};
Visible = Off;
};
AnyRefNode Point4 =
{
  sRel={0.18, 0.02, 7.228014483e-018};
  ARel={ {1, 0, 0}, {0, 1, 0}, {0, 0, 1} };
  AnyDrawNode drw_node =
  {
    RGB = {0.5882352941, 0.5607843137, 1};
    Opacity = 1;
    ScaleXYZ = {0.004, 0.004, 0.004};
    Visible = Off;
  };
};
AnyRefNode Right__Plane =
{
  sRel={0, 0, 0};
  ARel={ {-0, 0, 1}, {-0, 1, 0}, {-1, 0, 0} };
  AnyDrawRefFrame drw_node =
  {
    RGB = {0.5882352941, 0.5607843137, 1};
    Opacity = 1;
    ScaleXYZ = {0.05157518783, 0.05157518783, 0.05157518783};
    Visible = Off;
  };
};
AnyRefNode Top__Plane =
{
  sRel={0, 0, 0};
  ARel={ {1, 0, 0}, {0, 0, 1}, {0, -1, 0} };
  AnyDrawRefFrame drw_node =
  {
    RGB = {0.5882352941, 0.5607843137, 1};
    Opacity = 1;
    ScaleXYZ = {0.05157518783, 0.05157518783, 0.05157518783};
    Visible = Off;
  };
};
AnySeg Pedal__2 =
```
- Command Line (Bottom):** Shows the execution of the model load process:

```
Model Load : C:\Users\mj\Desktop\SolidWor
Converting STL file 'C:\Users\mj\Desktop\SolidWorks2AnyBody_Demo\SolidWorks_FitnessTrainer\AnyScript\FitnessMachine.MainCylinder_cfg0_9c1185a5c5e9fc546128.stl' to ANYSURF file 'C:\Users\mj\Desktop\SolidWorks2AnyBody_Demo\SolidWor
Converting STL file 'C:\Users\mj\Desktop\SolidWorks2AnyBody_Demo\SolidWorks_FitnessTrainer\AnyScript\FitnessMachine.Pedal_cfg0_9c1185a5c5e9fc546128.stl' to ANYSURF file 'C:\Users\mj\Desktop\SolidWorks2AnyBody_Demo\SolidWorks_Fitne
Converting STL file 'C:\Users\mj\Desktop\SolidWorks2AnyBody_Demo\SolidWorks_FitnessTrainer\AnyScript\FitnessMachine.Pedal_cfg0_9c1185a5c5e9fc546128.stl' to ANYSURF file 'C:\Users\mj\Desktop\SolidWorks2AnyBody_Demo\SolidWorks_Fitne
Evaluating model...
Loaded successfully.
Elapsed Time : 0.749000
```

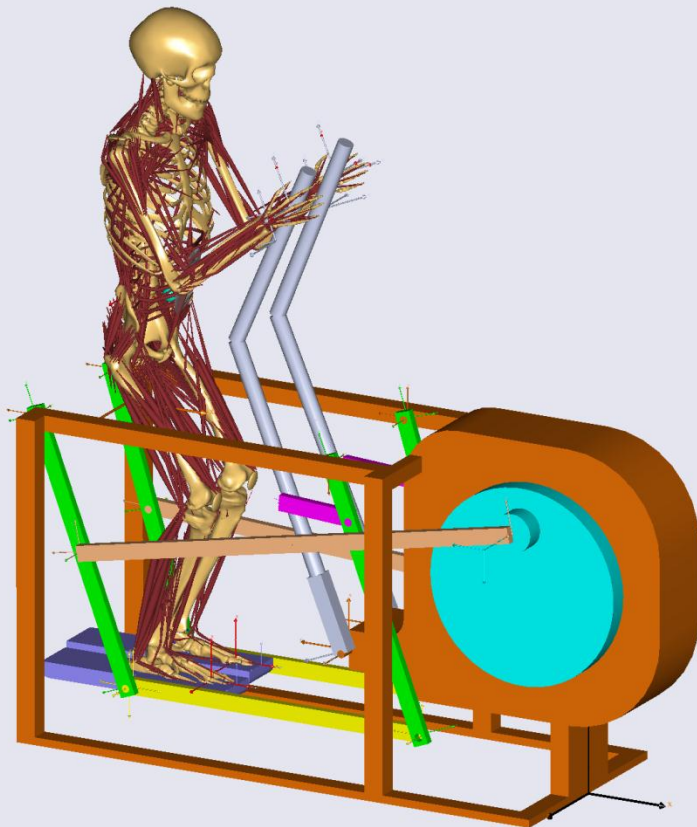
SolidWorks2AnyBody Demo Process



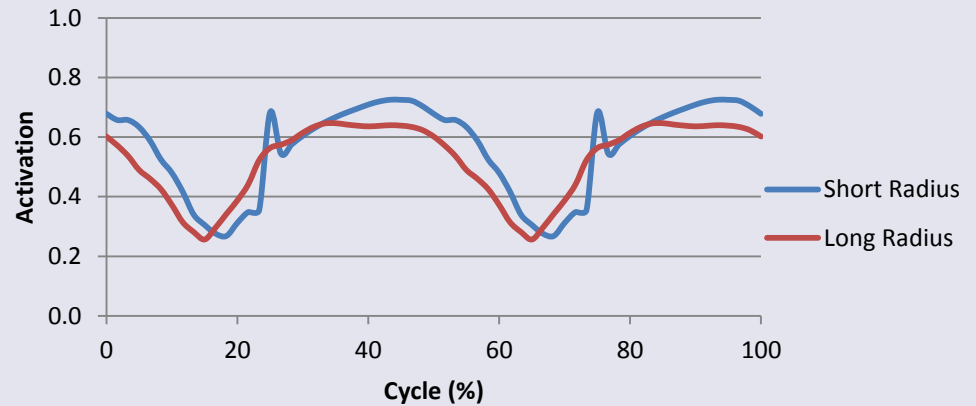
Effect of design alterations: change of radius



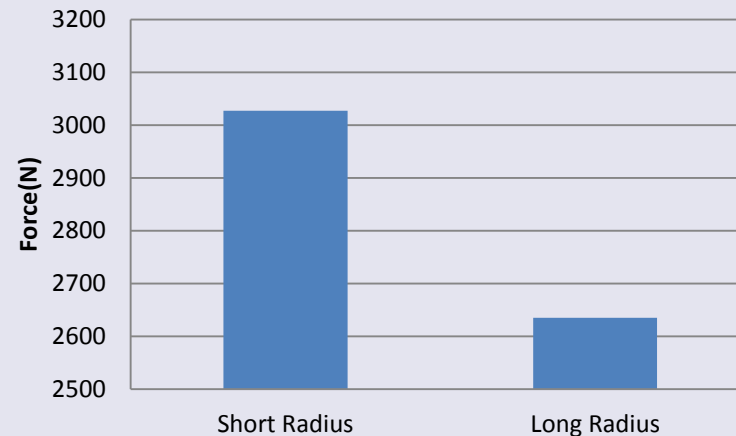
Effect of design alterations: change of radius



Max. Muscle Activation



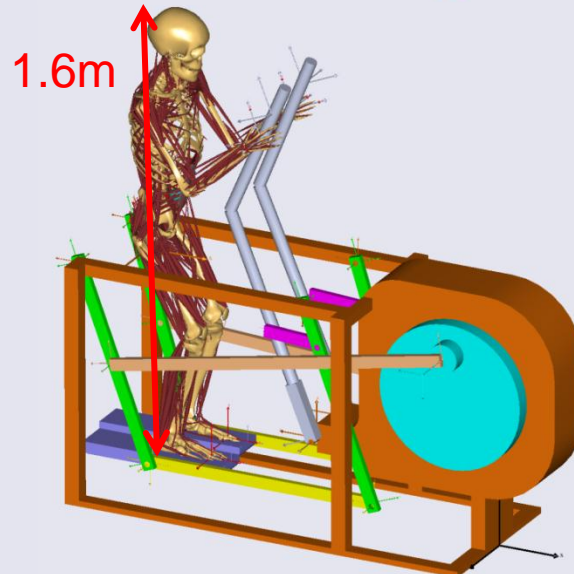
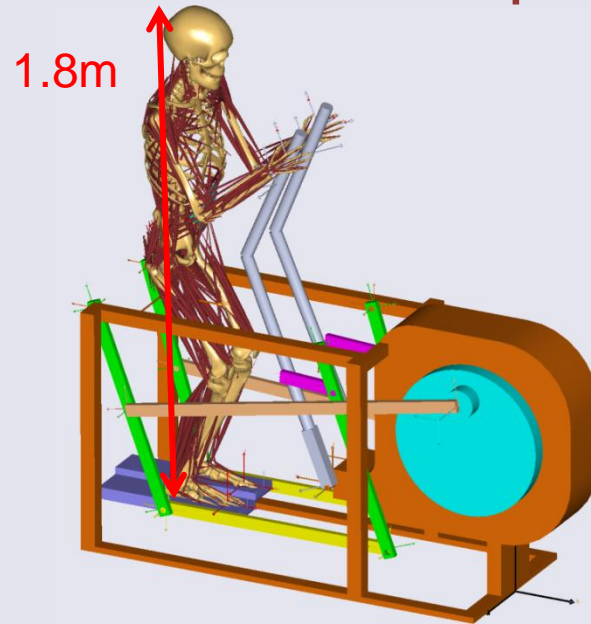
Max. Knee Force



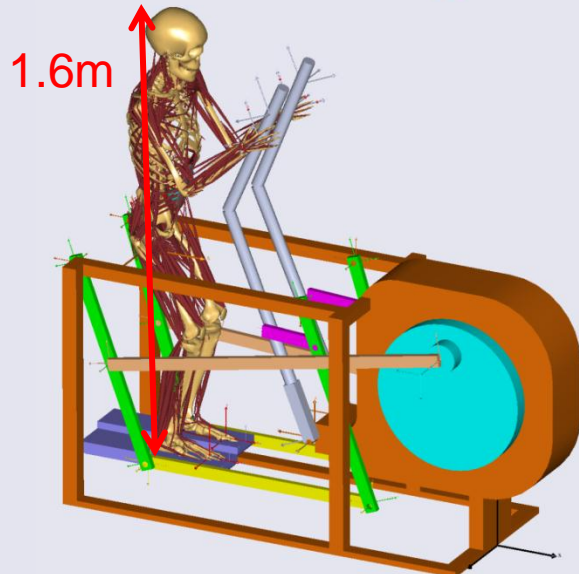
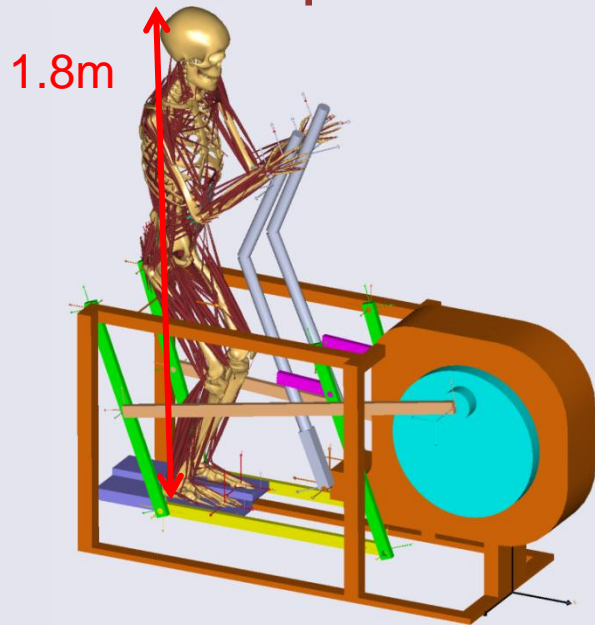
Adaptation to different Anthropometry



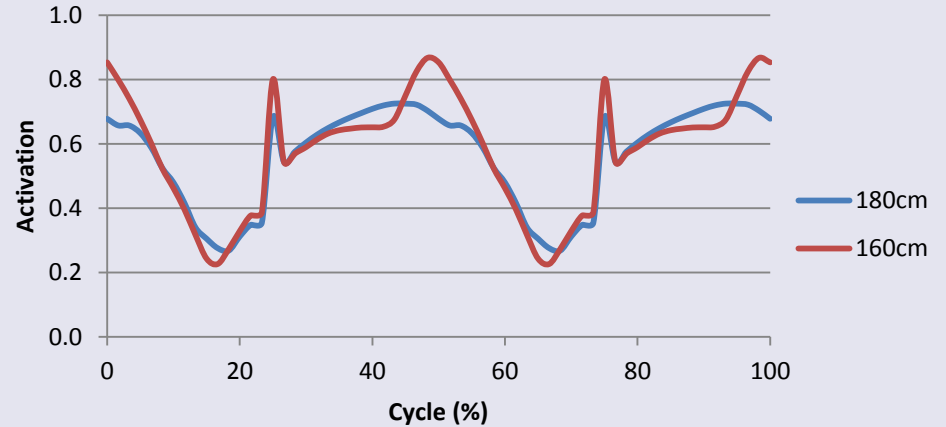
See previous Webcast on Anthro Scaling
Rasmussen(19. March, 2009)



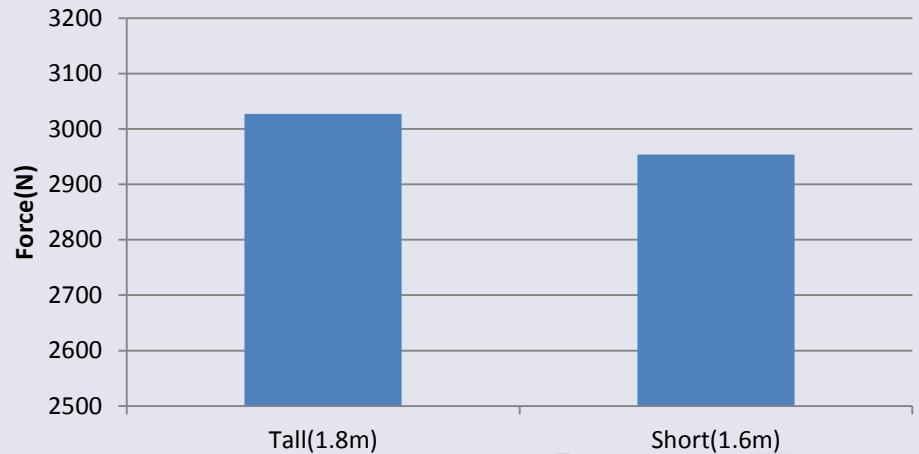
Adaptation to different Anthropometry



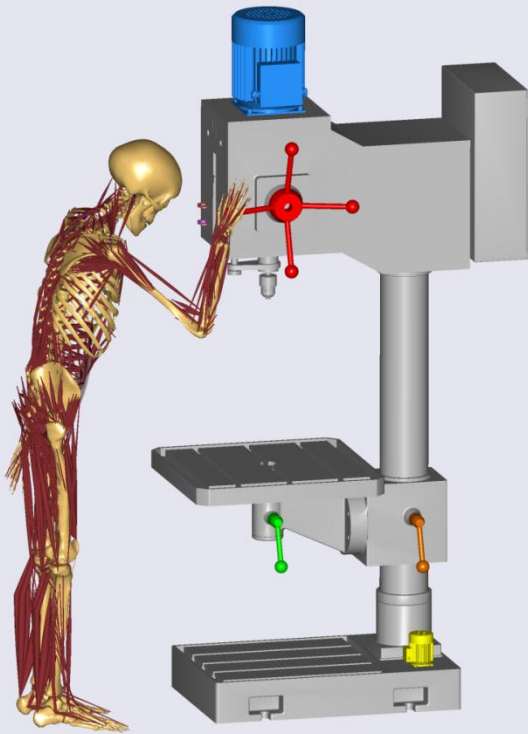
Max. Muscle Activation



Max. Knee Force

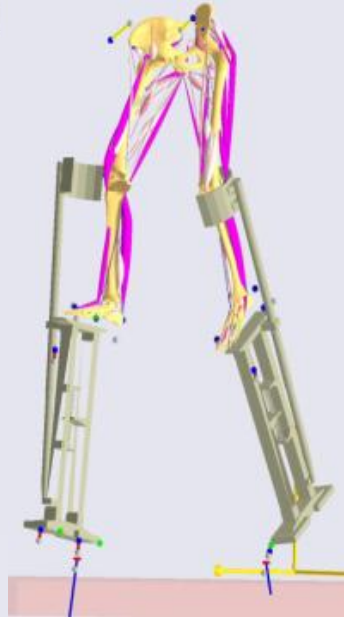


Field of Applications: Work Ergonomics

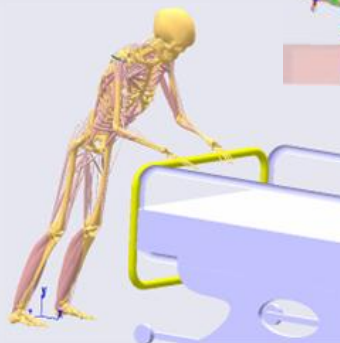


Selected Examples:

- Optimal design of drill machine to reduce loads in spine or shoulder
- Optimal design of hospital beds to ensure easy handling
- Analyzing work environment on stilts



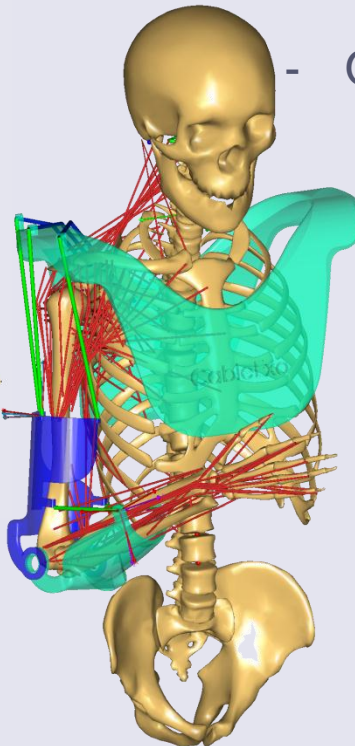
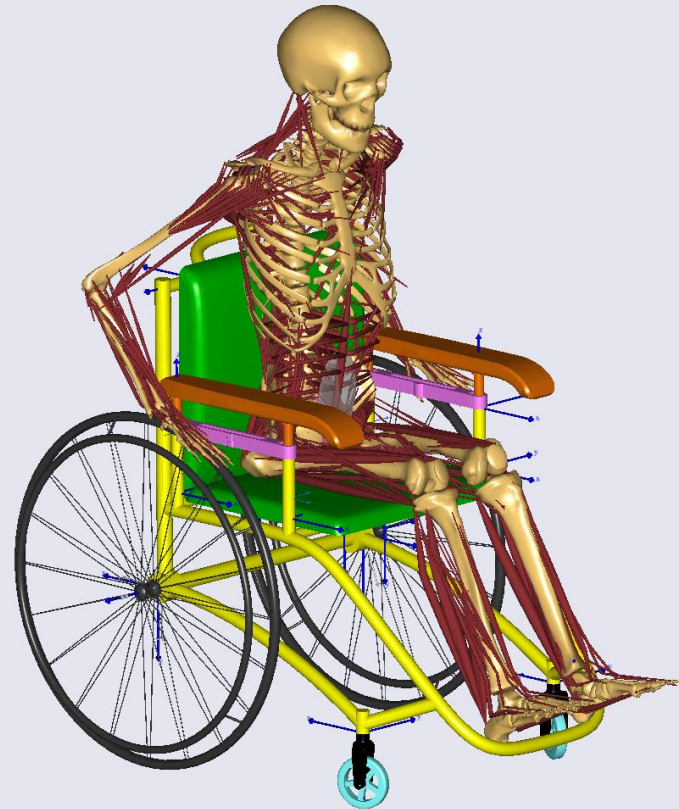
Wu et al 2008



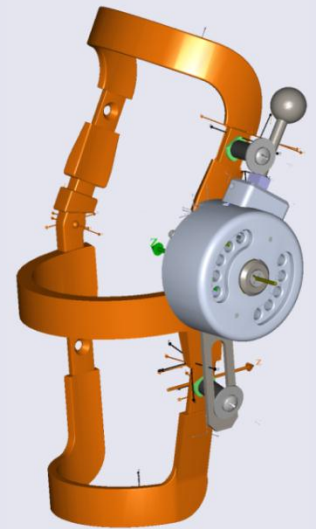
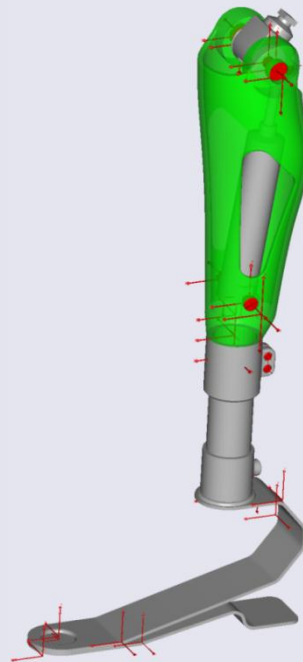
Field of Applications: Rehabilitation

Selected Examples:

- Optimal position of wheelchair axis to reduce loads shoulder
- Optimal design of exoskeletons
- Optimal design/function of amputees



Lelai et al 2012

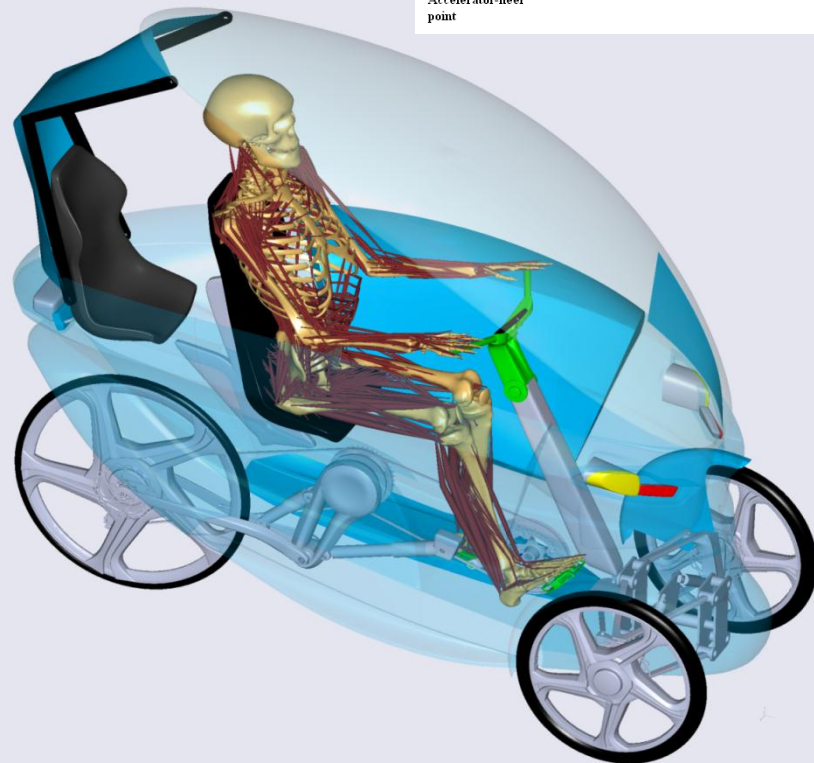
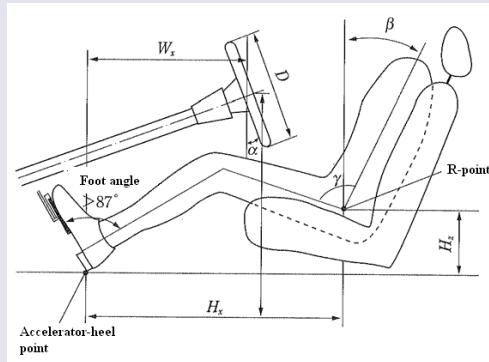


ANYBODY
TECHNOLOGY

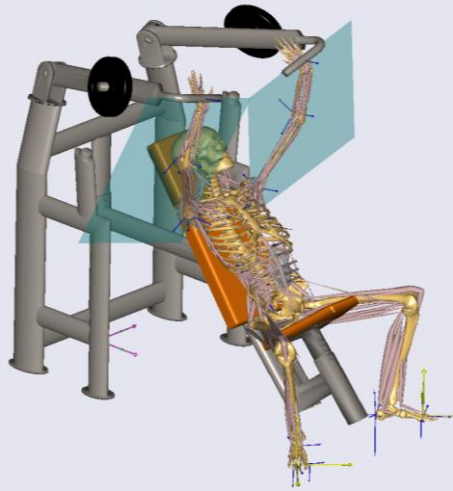
Field of Applications: Vehicle Design

Selected Examples:

- Optimal positions of seat and steering wheel
- Optimal functionality of handbrake or pedals
- Optimal positions of seat height
- Optimal position of pedals



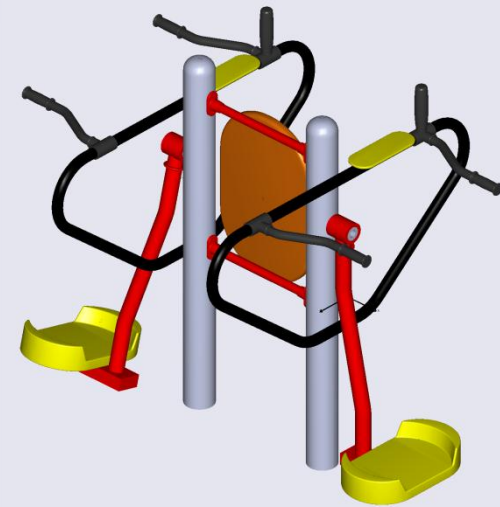
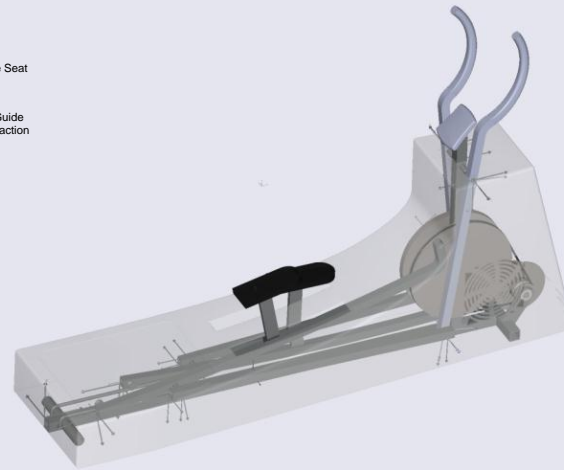
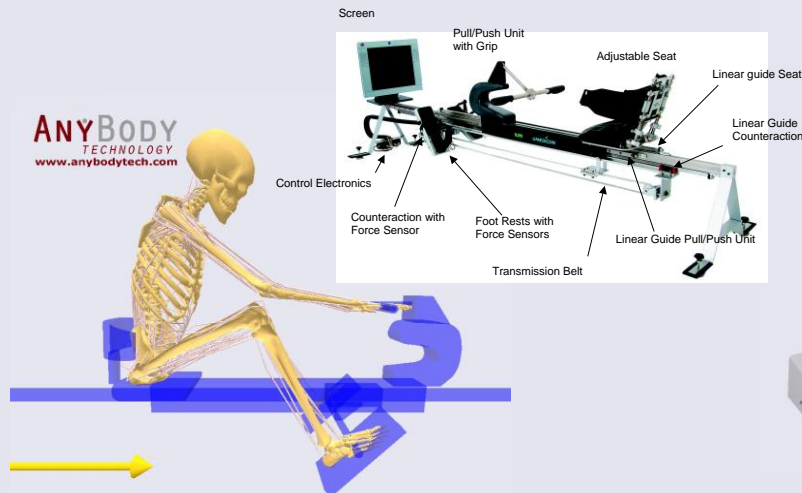
Field of Applications: Sports & Performance



Jung et al 2011

Selected Examples:

- Optimization of dimensions
- Analysis of joint reaction force
- Analysis of metabolic energy consumption



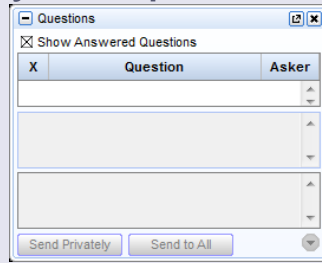
Summary

SolidWorks2AnyBody Translator

- Short-cut between CAD and musculoskeletal model
 - Geometry, mass properties, mates and references translated
 - AnyScript files are generated automatically
- Closer integration of AnyBody into design process
- Effect of small design changes immediately visible
 - Changes in Joint Reaction Forces
 - Changes in Muscle Activations
- SolidWorks2AnyBody translator is included in AnyBody Modeling System version 5.3
- An additional license is required
 - Please contact sales@anybodytech.com

Q & A

You can write your questions in the Q&A panel.



X	Question	Asker

Send Privately Send to All

Don't miss our next webinar:

- 7th Nov: Orthopedic Applications in the Spine

Meet AnyBuddies at:

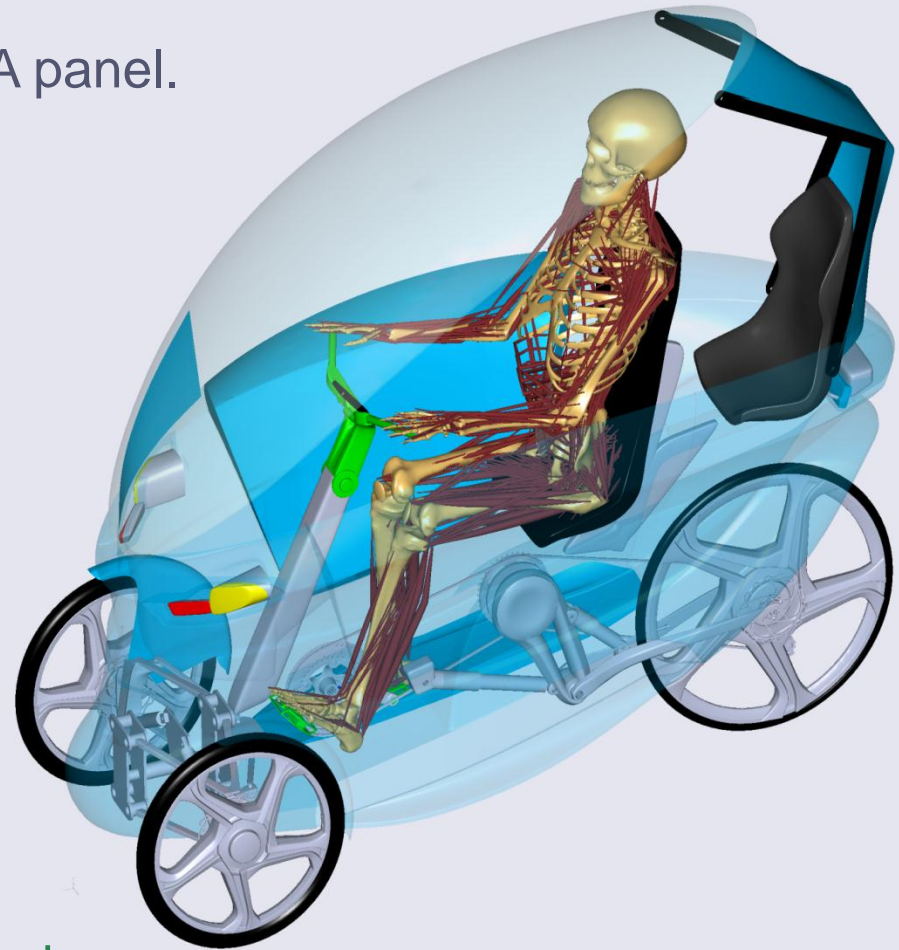
- 24-27 Oct: NASS 2012, Dallas, TX
- 02-04 Nov: AAHKS, Dallas, TX

YouTube channel of AnyBody:

<http://www.youtube.com/user/anybodytech>

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