



Introduction to the OpenSim GUI

OpenSim Workshop

Navigating the OpenSim GUI

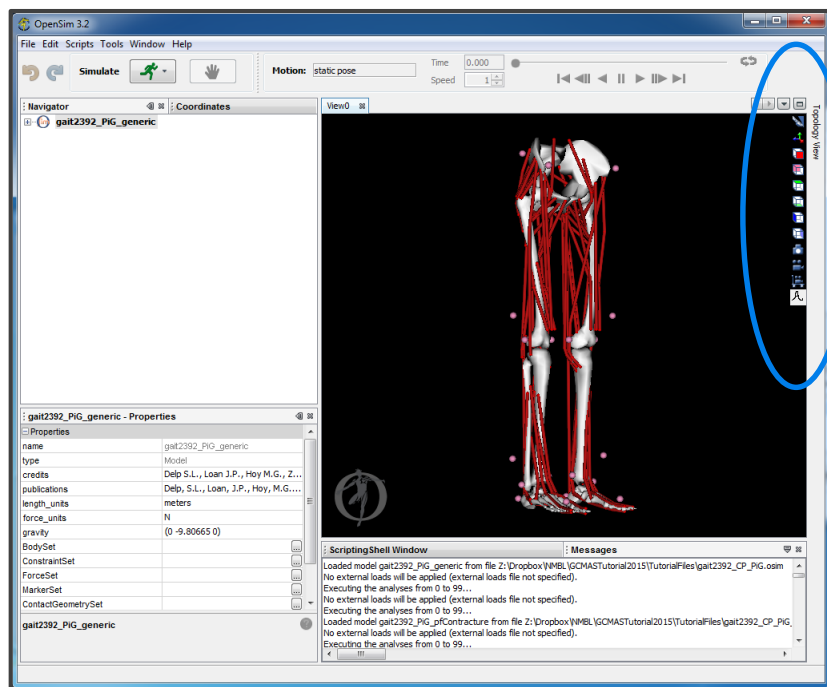
- Launch OpenSim
- From **File** menu, select **Close Model** to close any existing models
- From **File** menu, select **Open Model**
- Navigate to folder **HandsOnMaterial> Introduction**, select **gait2392.osim**

Using the View window

ROTATE: **left** mouse button, drag mouse

TRANSLATE: **middle** mouse button, drag mouse

ZOOM: **right** mouse button, drag mouse

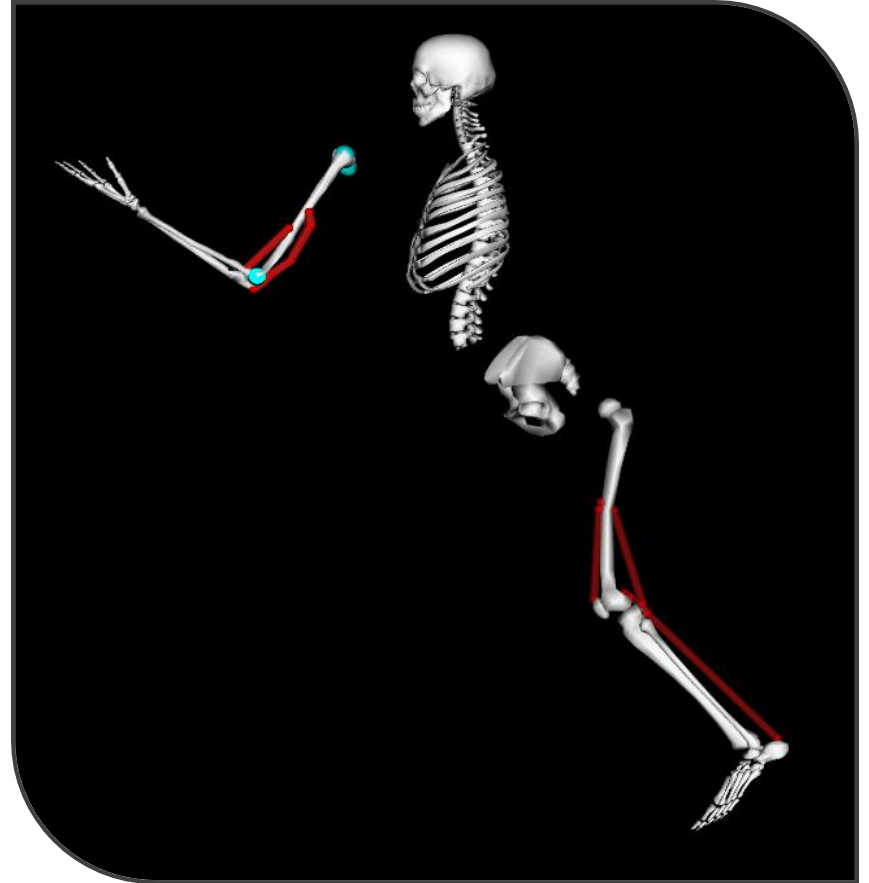


orienting icons

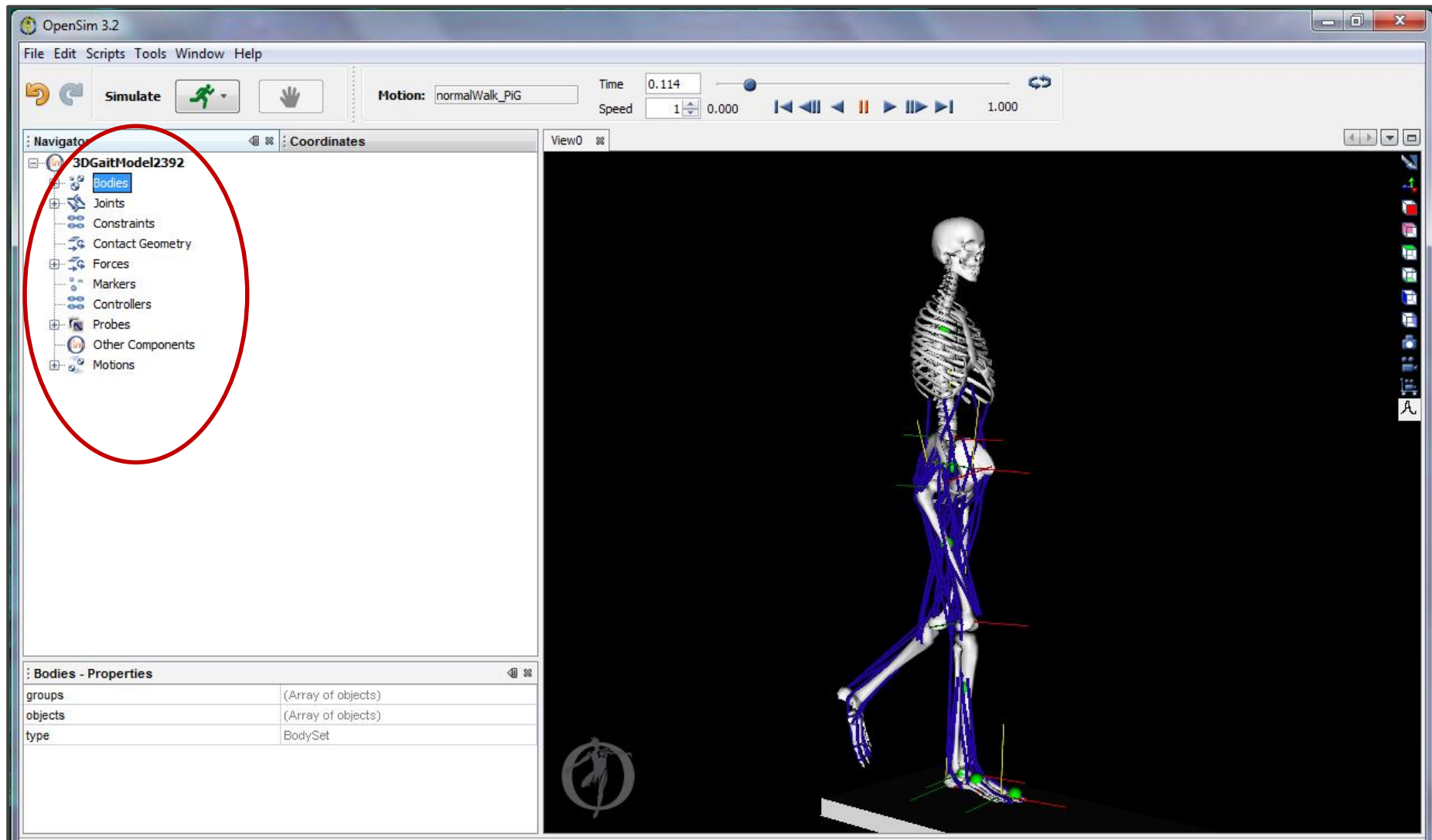
What is an OpenSim model?

OSIM files specify:

- **Bodies**
- **Joints**
- Constraints
- Contact Geometry
- **Forces**
- **Markers**
- Controllers
- Probes
- Other Components



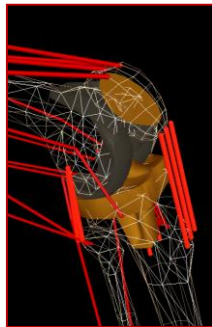
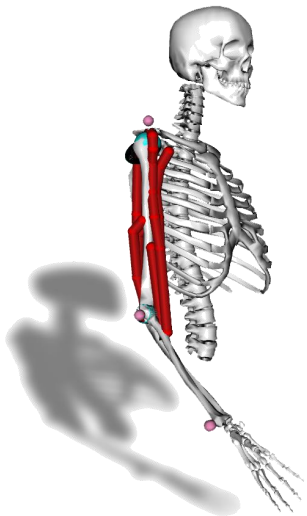
Navigator window shows model components



A few details ...

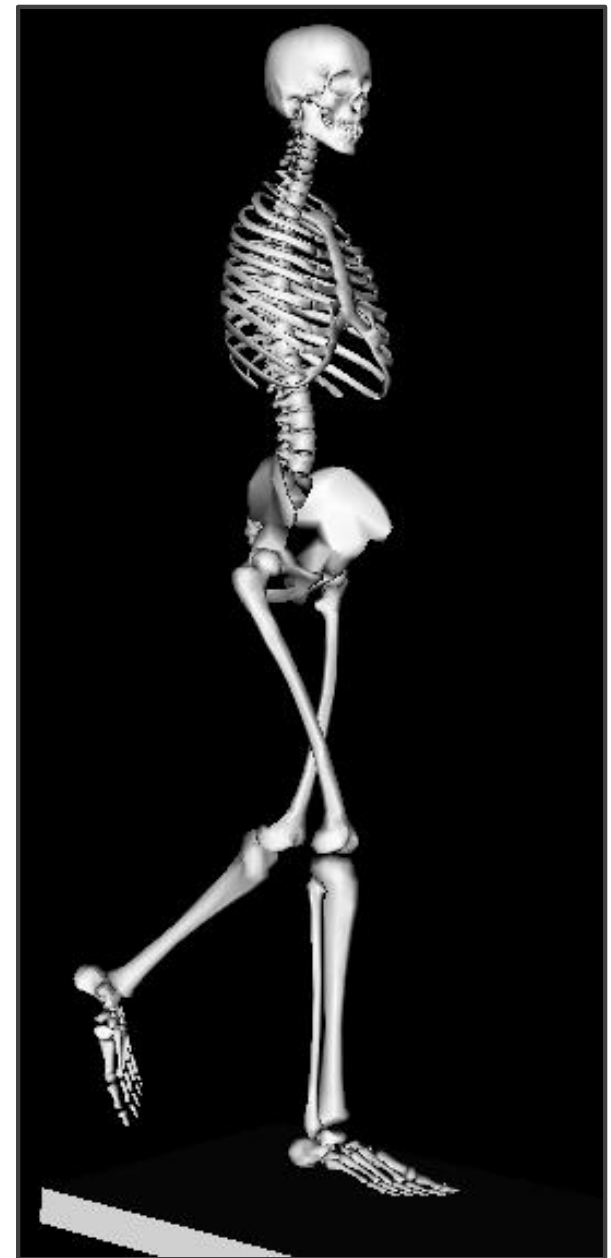
Each BODY:

- is assumed to be **rigid**
- has an associated **reference frame**
- often has **mass, inertial properties**
- often has associated **visual objects**

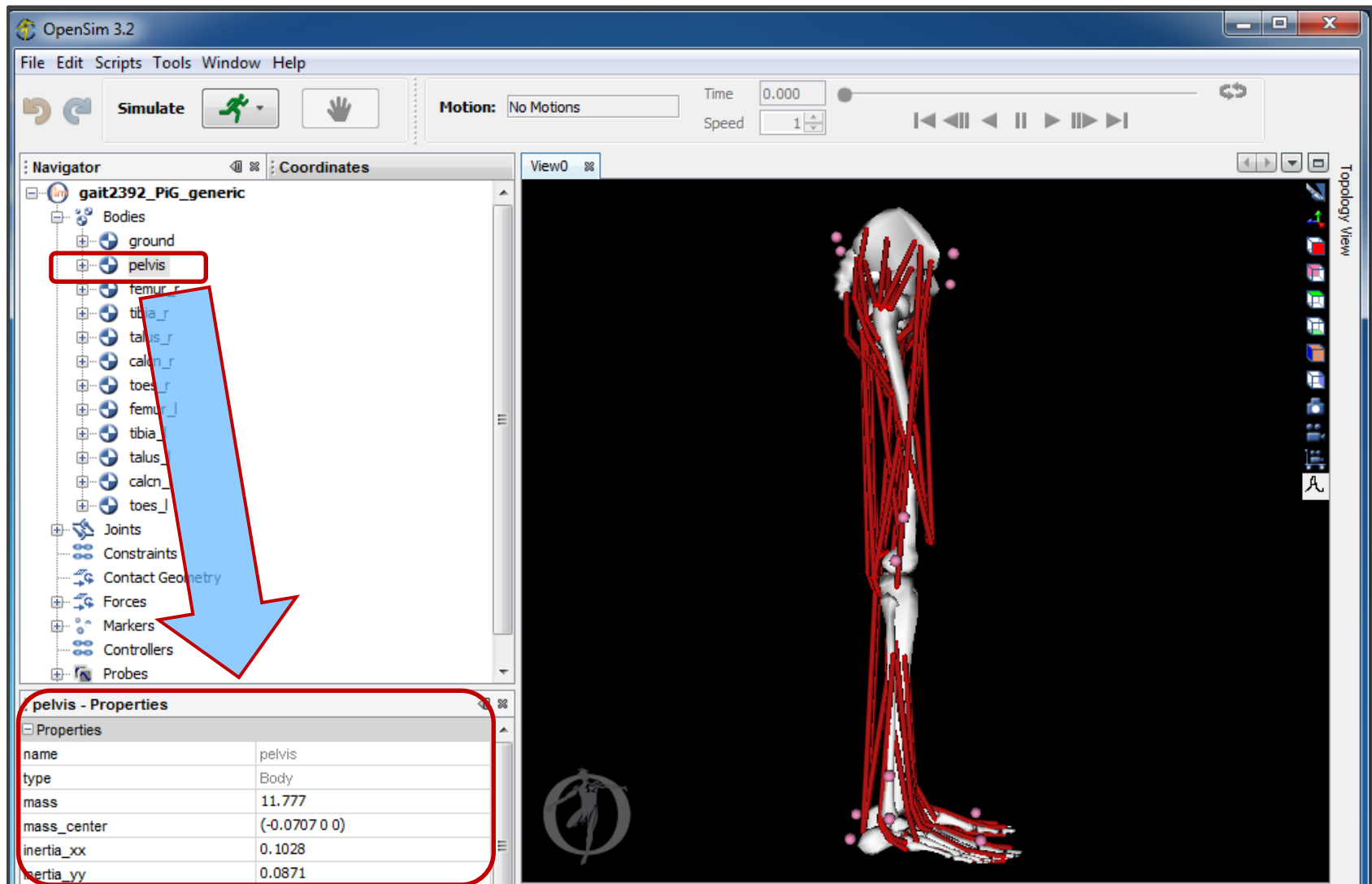


Files:

OpenSim 3.3 -> Geometry



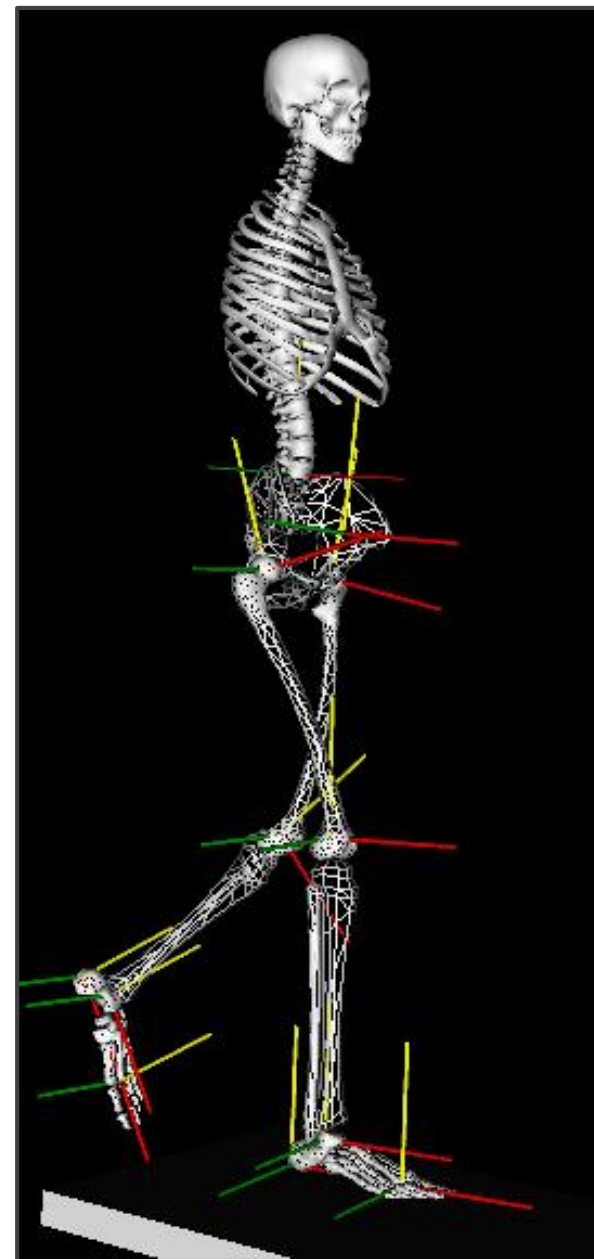
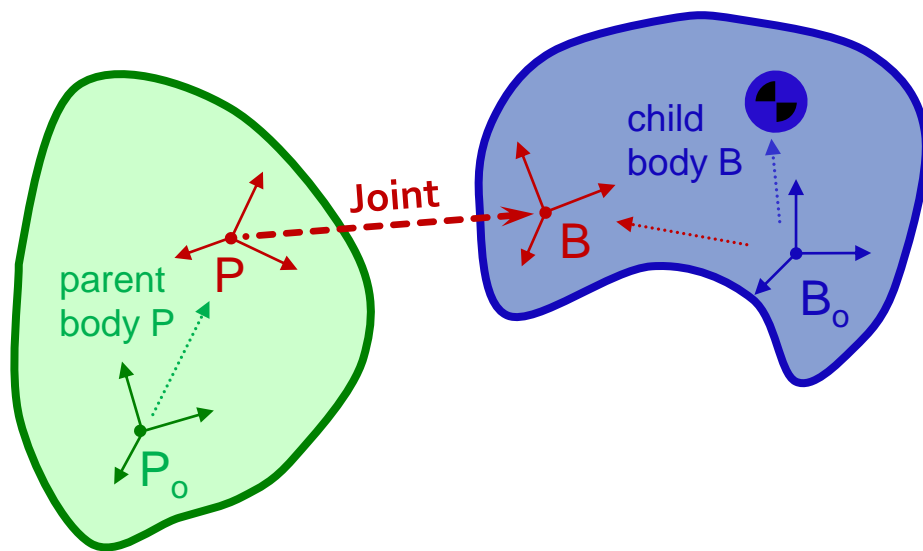
Properties window for bodies



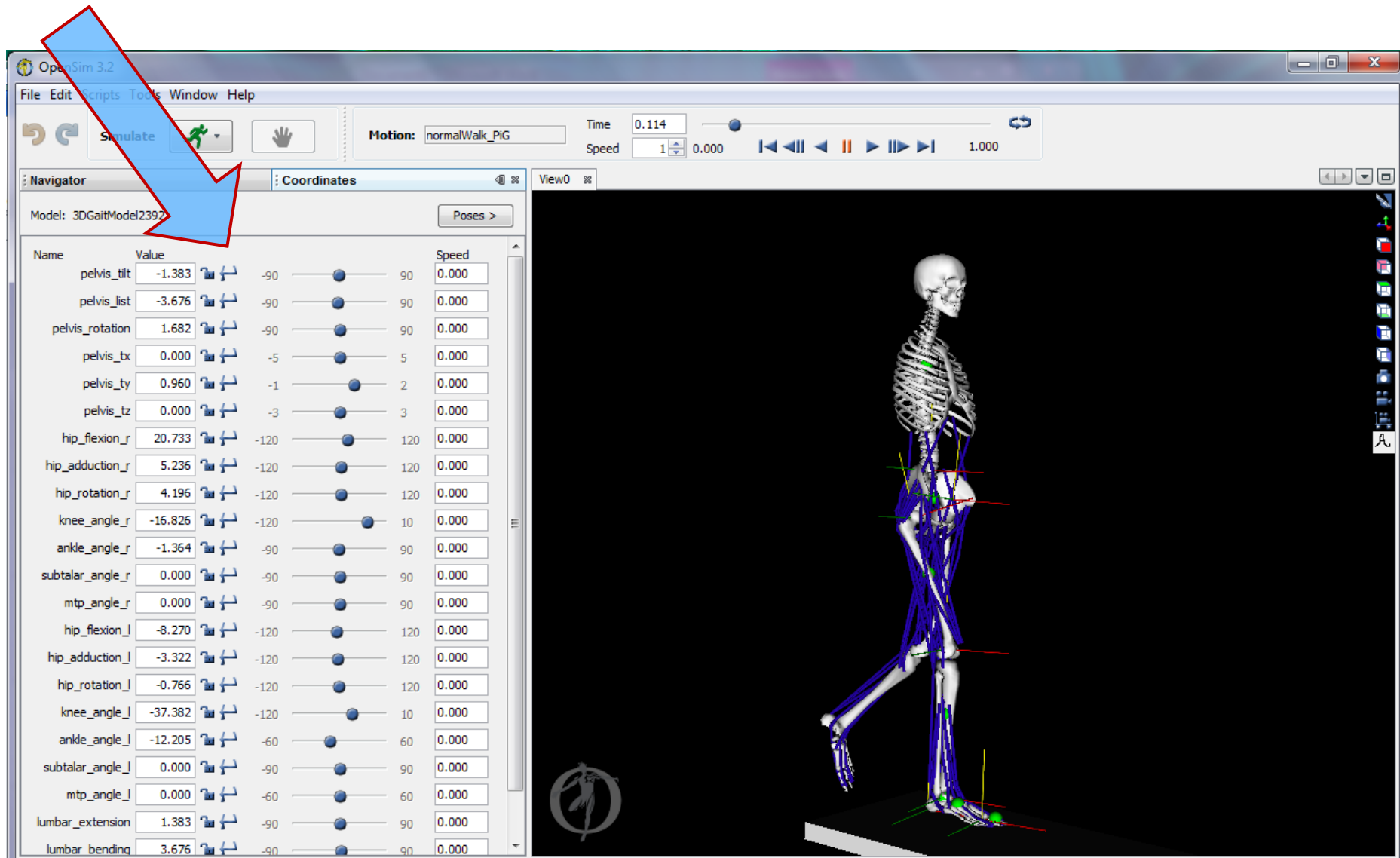
A few more details ...

JOINTS:

- connect **adjacent** BODIES
- **constrain movements** within physiological bounds
- translations, rotations are *coordinates*



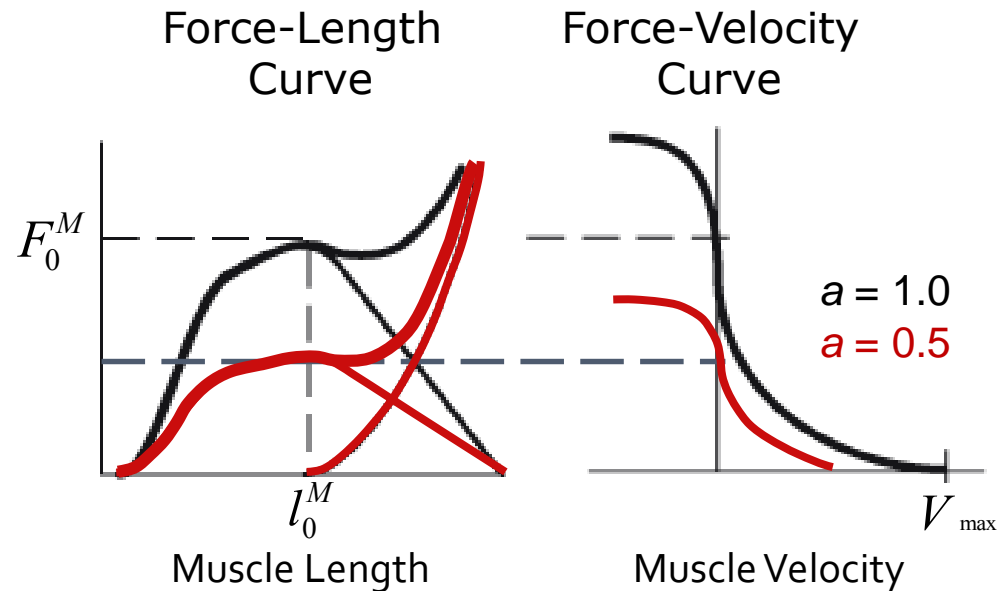
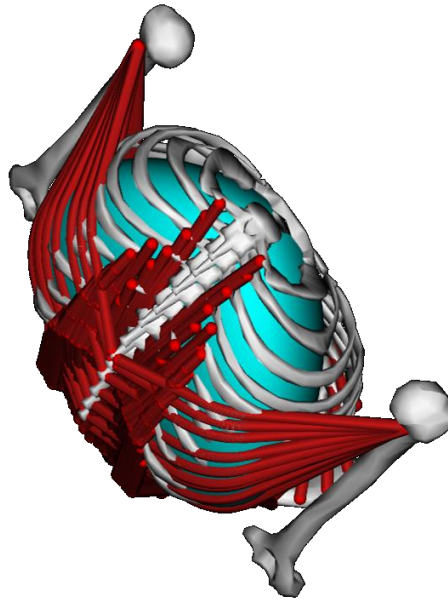
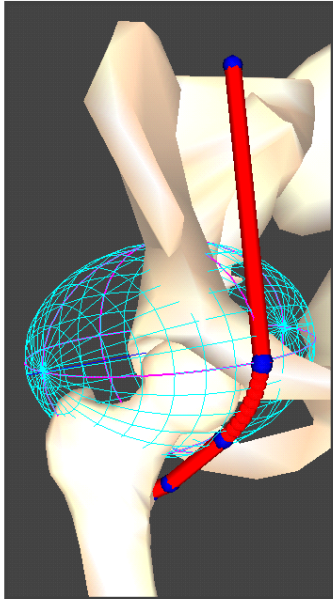
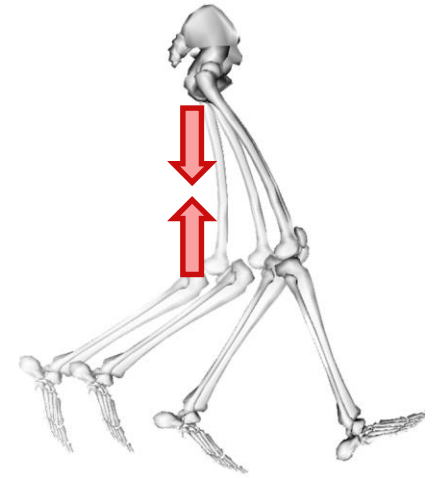
Coordinates window shows model coordinates



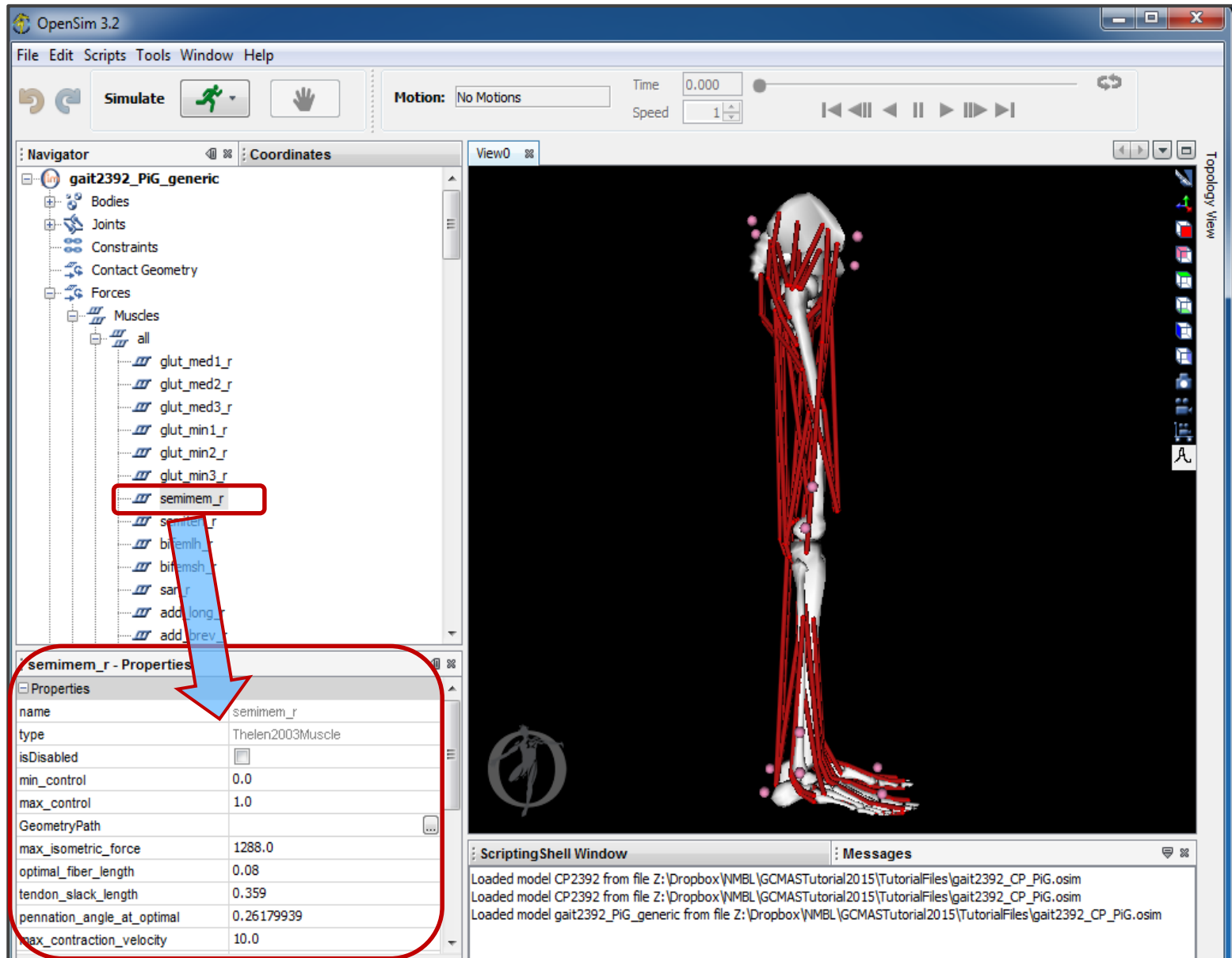
More details ...

MUSCLES:



- transmit **force** at attachment sites on bodies
- may “wrap” over underlying surfaces
- forces depend on **activation**, **length** and **velocity**



Properties window for muscles



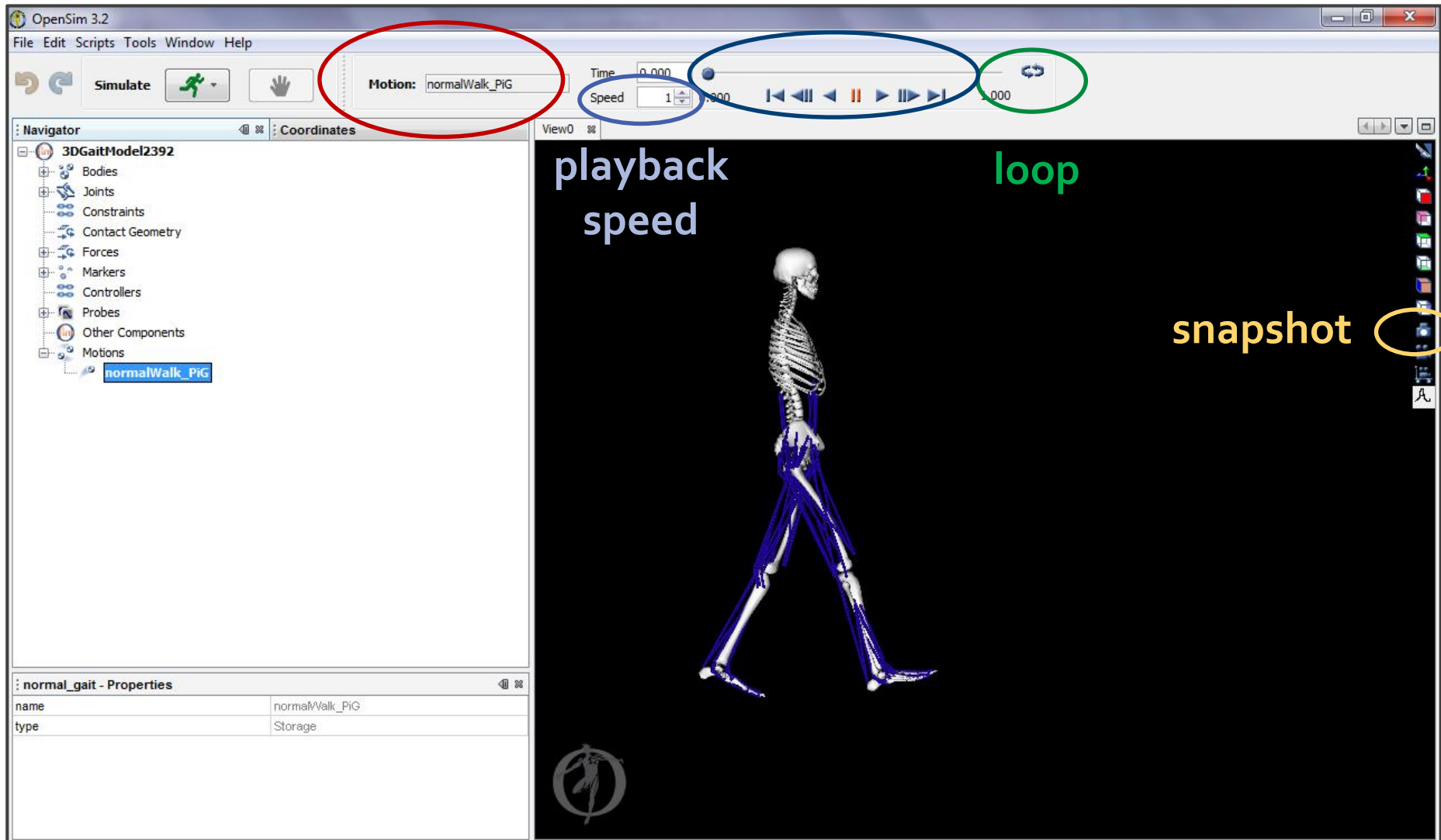
Loading a motion

- From **File** menu, select **Close Model** to close any existing models
 - From **File** menu, select **Open Model**
 - Navigate to folder **HandsOnMaterial\Introduction\example_synchronization**
 - select **subject01.osim**
- 
- OpenSim Model File*
-
- From **File** menu, select **Load Motion**
 - Navigate to folder **HandsOnMaterial\Introduction\example_synchronization**
 - Open **subject01_walk1_ik.mot**
- 
- OpenSim Motion File*

Animating a model

name of active motion

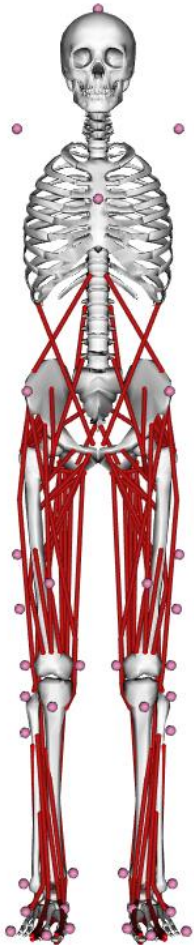
motion slider &
playback buttons



On your own: Exploring the GUI

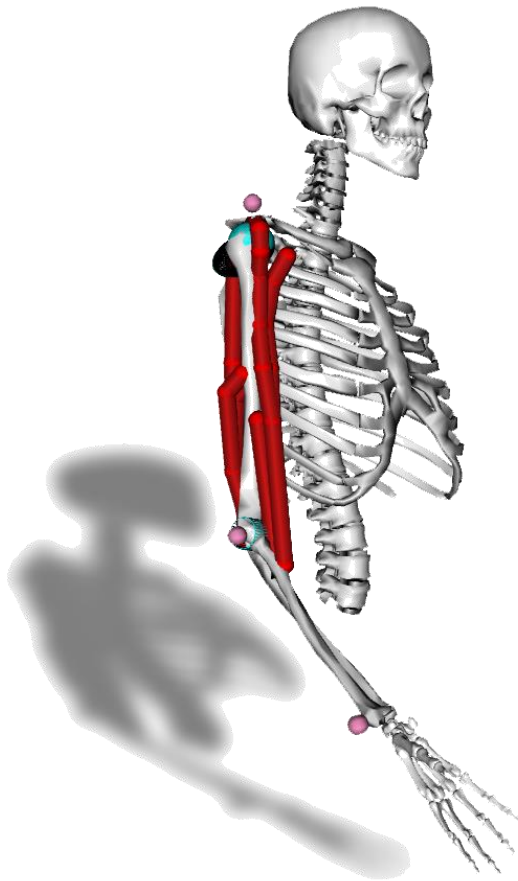
- Save a few **snapshots** at key events in the gait cycle.
- Use the View, Navigator, and Coordinates Windows to answer the following questions:
 1. How many **bodies** (segments) does this model have?
 2. How many **coordinates** does this model have?
 3. What is the **maximum isometric force** that the model's semimembranosus can produce?
 4. How many **muscle-tendon compartments** are used to represent the geometry of gluteus maximus and gluteus medius?
Why do you think these muscles are modeled this way?

Demo of Model editing



```
1 <?xml version="1.0" encoding="UTF-8" ?>
2 <OpenSimDocument Version="20303">
3   <Model name="3DGaitModel2392">
4     <!--See the credits section below for info-->
7     <credits> Delp S.L., Loan J.P., Hoy M.G.,
21     <publications>
27     <length_units>meters</length_units>
28     <force_units>N</force_units>
29     <!--Acceleration due to gravity.-->
30     <gravity> 0 -9.80665 0</gravity>
31     <!--Bodies in the model.-->
32     <BodySet>
2249     <!--Constraints in the model.-->
2250     <ConstraintSet>
2254     <!--Forces in the model.-->
2255     <ForceSet>
9655     <!--Markers in the model.-->
9656     <MarkerSet>
9660     <!--ContactGeometries in the model.-->
9661     <ContactGeometrySet>
9665     <!--Controllers in the model.-->
9666     <ControllerSet name="Controllers">
9670     <!--Probes in the model.-->
9671     <ProbeSet>
9675     <!--Additional components in the model-->
9676     <ComponentSet name="MiscComponents">
9680     </Model>
9681 </OpenSimDocument>
```

Under the hood: OpenSim models



modelName.osim

```
<Model name="Arm26">
  <!--Default values for properties that are not specified.-->
  <defaults> ...
  <credits> Model authors names..
  <publications> ...
  <length_units> m </length_units>
  <force_units> N </force_units>
  <!--Acceleration due to gravity.-->
  <gravity> 0.00000000 -9.80650000 0.00000000 </gravity>
  <!--Bodies in the model.-->
  <BodySet name=""> ...
  <!--Constraints in the model.-->
  <ConstraintSet name=""> ...
  <!--All the force elements in the model.-->
  <ForceSet name=""> ...
  <!--Kinematic markers on the model.-->
  <MarkerSet name=""> ...
  <!--Surface meshes used by contact force elements in the model.-->
  <ContactGeometrySet name=""> ...
</Model>
```

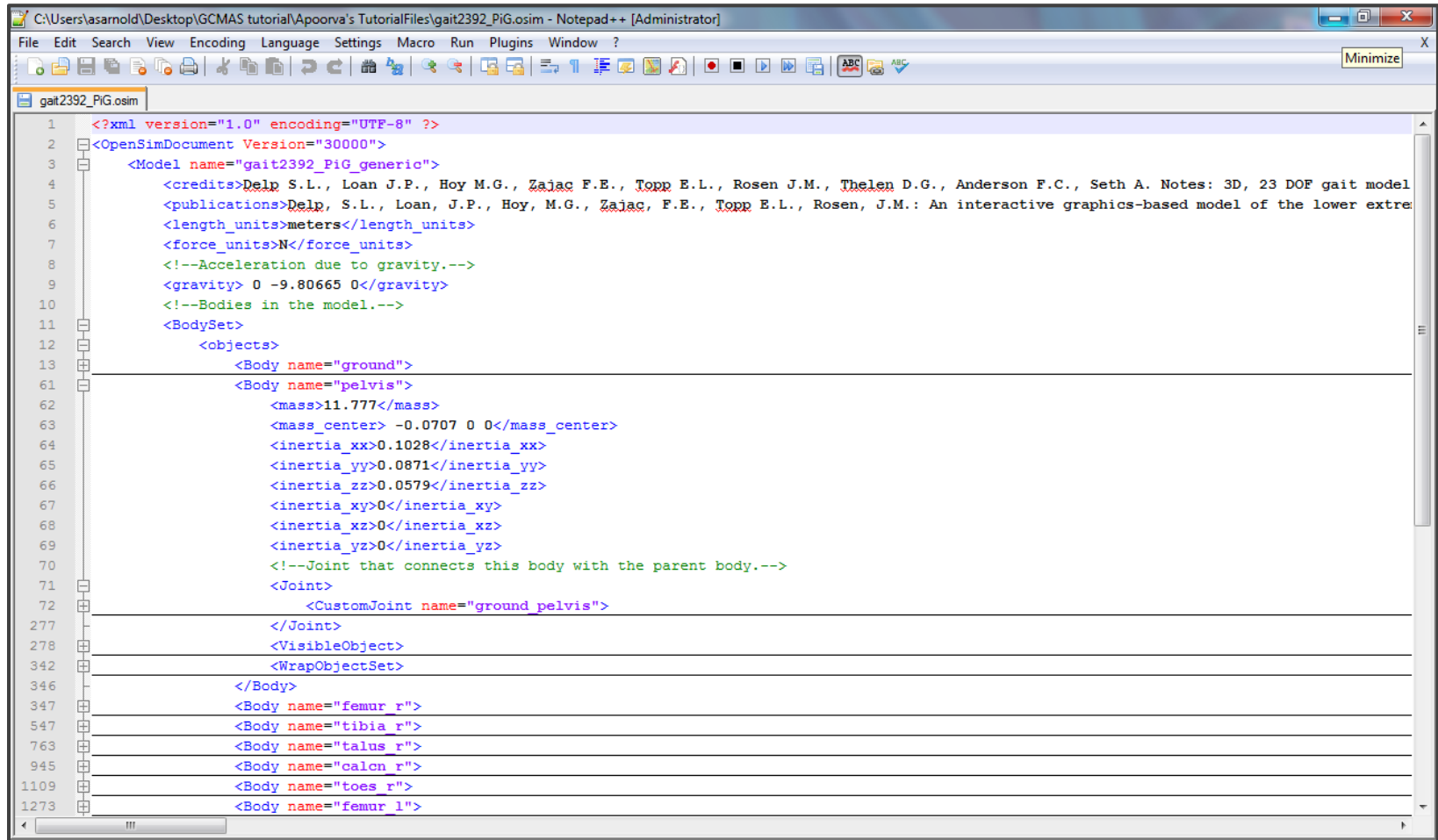

Viewing model files in Notepad++

- Minimize **OpenSim** (*click minimize button, upper right corner*)
- Launch **Notepad++**
- From **File** menu, select **Open ...**
- Navigate to folder **HandsOnMaterial>Introduction**
- Open **gait2392.osim**

Tip #1

If NOT color-coded:

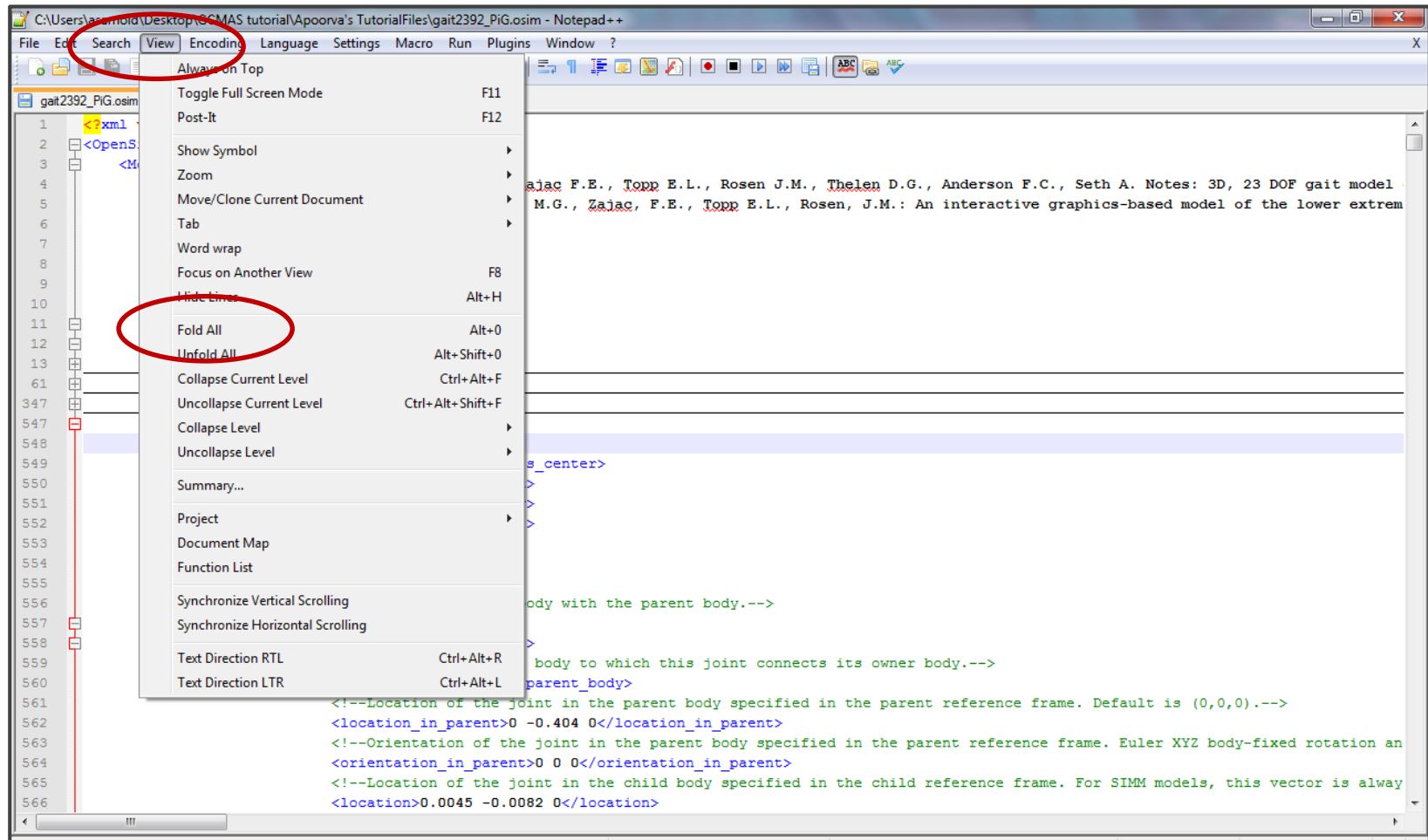
from **Language** menu, select **XML**



```
<?xml version="1.0" encoding="UTF-8" ?>
<OpenSimDocument Version="30000">
  <Model name="gait2392_PiG_generic">
    <credits>Delp S.L., Loan J.P., Hoy M.G., Zajac F.E., Topp E.L., Rosen J.M., Thelen D.G., Anderson F.C., Seth A. Notes: 3D, 23 DOF gait model
    <publications>Delp, S.L., Loan, J.P., Hoy, M.G., Zajac, F.E., Topp E.L., Rosen, J.M.: An interactive graphics-based model of the lower extre
    <length_units>meters</length_units>
    <force_units>N</force_units>
    <!--Acceleration due to gravity.-->
    <gravity> 0 -9.80665 0</gravity>
    <!--Bodies in the model.-->
    <BodySet>
      <objects>
        <Body name="ground">
        <Body name="pelvis">
          <mass>11.777</mass>
          <mass_center> -0.0707 0 0</mass_center>
          <inertia_xx>0.1028</inertia_xx>
          <inertia_yy>0.0871</inertia_yy>
          <inertia_zz>0.0579</inertia_zz>
          <inertia_xy>0</inertia_xy>
          <inertia_xz>0</inertia_xz>
          <inertia_yz>0</inertia_yz>
          <!--Joint that connects this body with the parent body.-->
          <Joint>
            <CustomJoint name="ground pelvis">
          </Joint>
          <VisibleObject>
          <WrapObjectSet>
        </Body>
        <Body name="femur r">
        <Body name="tibia r">
        <Body name="talus r">
        <Body name="calcn r">
        <Body name="toes r">
        <Body name="femur l">
```

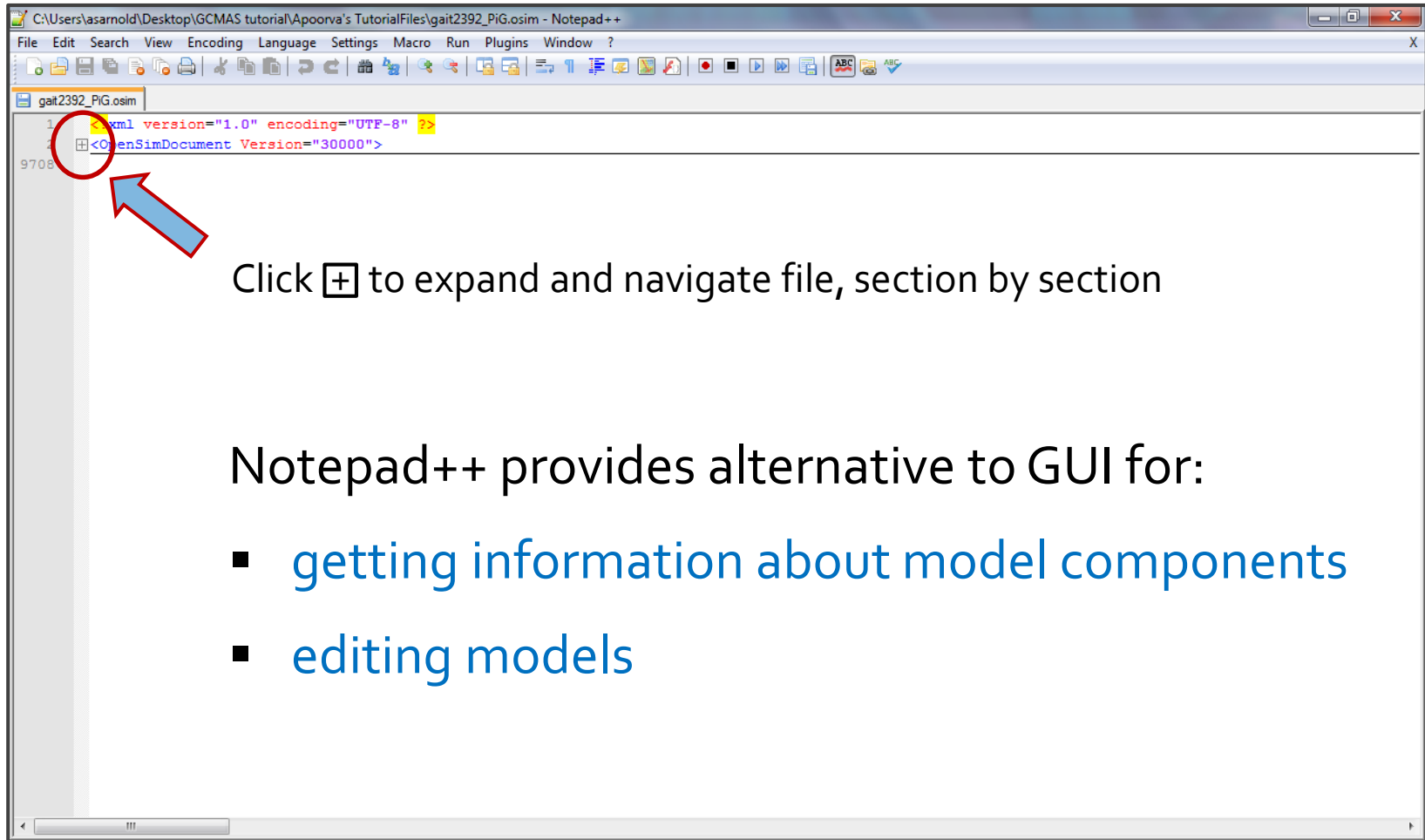
Tip #2

From **View** menu, select **Fold All**



Tip #2

From **View** menu, select **Fold All**



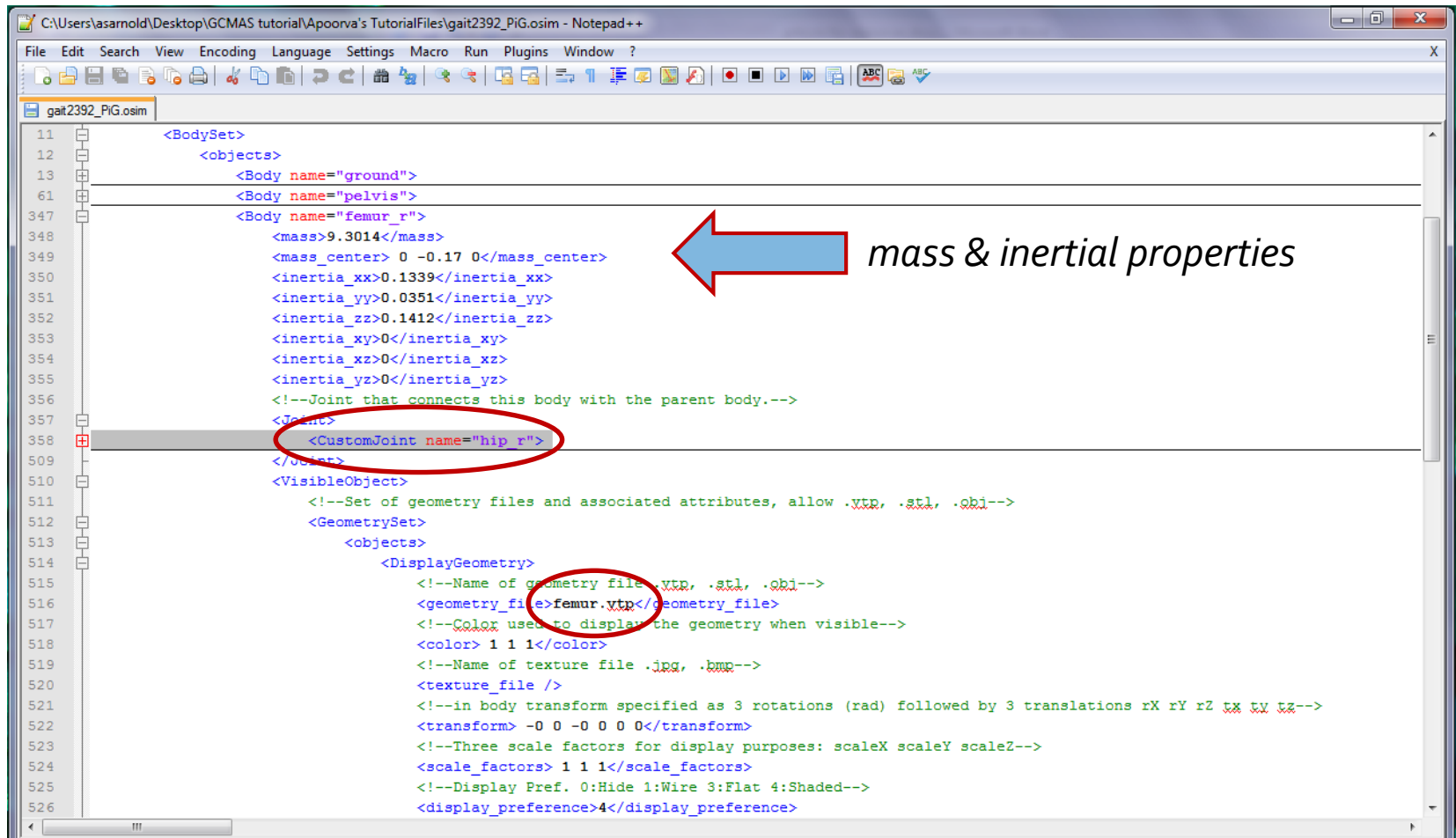
Click  to expand and navigate file, section by section

Notepad++ provides alternative to GUI for:

- getting information about model components
- editing models

Viewing model files in Notepad++

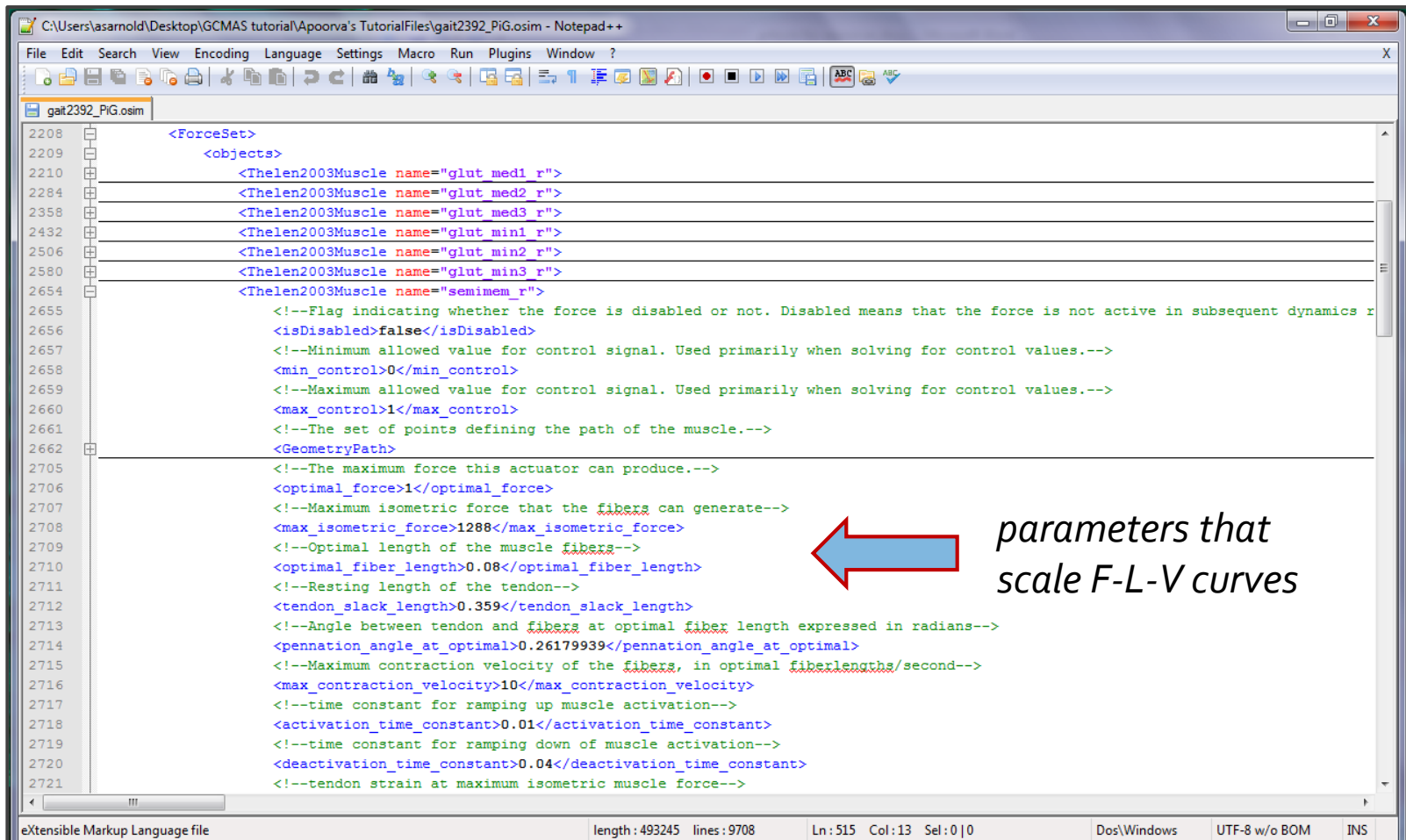
- For example, expand:
<Model, then **<BodySet**, then **<objects**, then **<Body name="femur_r"**



```
11 <BodySet>
12   <objects>
13     <Body name="ground">
61     <Body name="pelvis">
347     <Body name="femur_r">
348       <mass>9.3014</mass>
349       <mass_center> 0 -0.17 0</mass_center>
350       <inertia_xx>0.1339</inertia_xx>
351       <inertia_yy>0.0351</inertia_yy>
352       <inertia_zz>0.1412</inertia_zz>
353       <inertia_xy>0</inertia_xy>
354       <inertia_xz>0</inertia_xz>
355       <inertia_yz>0</inertia_yz>
356       <!--Joint that connects this body with the parent body.-->
357       <Joint>
358         <CustomJoint name="hip_r">
509       </Joint>
510     </Body>
511   </objects>
512   <VisibleObject>
513     <!--Set of geometry files and associated attributes, allow .vtp, .stl, .obj-->
514     <GeometrySet>
515       <objects>
516         <DisplayGeometry>
517           <!--Name of geometry file .vtp, .stl, .obj-->
518           <geometry_file>femur.vtp</geometry_file>
519           <!--Color used to display the geometry when visible-->
520           <color> 1 1 1</color>
521           <!--Name of texture file .jpg, .bmp-->
522           <texture_file />
523           <!--in body transform specified as 3 rotations (rad) followed by 3 translations rX rY rZ tX tY tZ-->
524           <transform> -0 0 -0 0 0 0</transform>
525           <!--Three scale factors for display purposes: scaleX scaleY scaleZ-->
526           <scale_factors> 1 1 1</scale_factors>
527           <!--Display Pref. 0:Hide 1:Wire 3:Flat 4:Shaded-->
528           <display_preference>4</display_preference>
```

Viewing model files in Notepad++

- **<ForceSet** provides information about muscle properties



```
2208 <ForceSet>
2209   <objects>
2210     <Thelen2003Muscle name="glut_med1_r">
2284     <Thelen2003Muscle name="glut_med2_r">
2358     <Thelen2003Muscle name="glut_med3_r">
2432     <Thelen2003Muscle name="glut_mini_r">
2506     <Thelen2003Muscle name="glut_min2_r">
2580     <Thelen2003Muscle name="glut_min3_r">
2654     <Thelen2003Muscle name="semimem_r">
2655       <!--Flag indicating whether the force is disabled or not. Disabled means that the force is not active in subsequent dynamics r
2656       <isDisabled>false</isDisabled>
2657       <!--Minimum allowed value for control signal. Used primarily when solving for control values.-->
2658       <min_control>0</min_control>
2659       <!--Maximum allowed value for control signal. Used primarily when solving for control values.-->
2660       <max_control>1</max_control>
2661       <!--The set of points defining the path of the muscle.-->
2662       <GeometryPath>
2705       <!--The maximum force this actuator can produce.-->
2706       <optimal_force>1</optimal_force>
2707       <!--Maximum isometric force that the fibers can generate-->
2708       <max_isometric_force>1288</max_isometric_force>
2709       <!--Optimal length of the muscle fibers-->
2710       <optimal_fiber_length>0.08</optimal_fiber_length>
2711       <!--Resting length of the tendon-->
2712       <tendon_slack_length>0.359</tendon_slack_length>
2713       <!--Angle between tendon and fibers at optimal fiber length expressed in radians-->
2714       <pennation_angle_at_optimal>0.26179939</pennation_angle_at_optimal>
2715       <!--Maximum contraction velocity of the fibers, in optimal fiberlengths/second-->
2716       <max_contraction_velocity>10</max_contraction_velocity>
2717       <!--time constant for ramping up muscle activation-->
2718       <activation_time_constant>0.01</activation_time_constant>
2719       <!--time constant for ramping down of muscle activation-->
2720       <deactivation_time_constant>0.04</deactivation_time_constant>
2721       <!--tendon strain at maximum isometric muscle force-->
```

parameters that scale F-L-V curves