



# Impact of geometry on simulation output (hands-on)

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Musculoskeletal modelling to support clinical gait analysis:  
theoretical, practical, and hands-on considerations

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# Purpose

- Visually comparing models and simulation results
- Demonstrate how the subject-specific musculoskeletal geometry influences simulation results

# Models

- Gait2392 – generic scaled to the participant
- Same model but with modified femoral geometry – increased anteversion angle by 25 degrees at the right femur

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Torsion Tool: An automated tool for personalising femoral and tibial geometries in OpenSim musculoskeletal models



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### %% right femur

```
model = 'gait2392_genericssimpl0S4.osim';  
markerset = 'MarkerSet.xml';
```

```
deform_bone = 'F';
```

```
which_leg = 'R';
```

```
angle_AV_right = 42.6; % right anteversion angle (in degrees) %
```

```
angle_NS_right = 123.3; % right neck-shaft angle (in degrees) %
```

```
deformed_model = ['rightNSA' num2str(angle_NS_right) '_rightAVA' num2str(angle_AV_right) ];
```

```
make_PEmodel(model, deformed_model, markerset, deform_bone, which_leg, angle_AV_right, angle_NS_right);
```

### %% left femur

```
model = [deformed_model '.osim'];
```

```
markerset = [deformed_model '_' markerset];
```

```
deform_bone = 'F';
```

```
which_leg = 'L';
```

```
angle_AV_left = 17.6; % left anteversion angle (in degrees) %
```

```
angle_NS_left = 123.3; % left neck-shaft angle (in degrees) %
```

```
deformed_model = [ 'leftNSA' num2str(angle_NS_left) '_leftAVA' num2str(angle_AV_left)];
```

```
make_PEmodel(model, deformed_model, markerset, deform_bone, which_leg, angle_AV_left, angle_NS_left);
```

### %% right tibia

```
model = [deformed_model '.osim'];
```

```
markerset = [deformed_model '_' markerset];
```

```
deformed_model = 'TT15';
```

```
deform_bone = 'T';
```

```
which_leg = 'R';
```

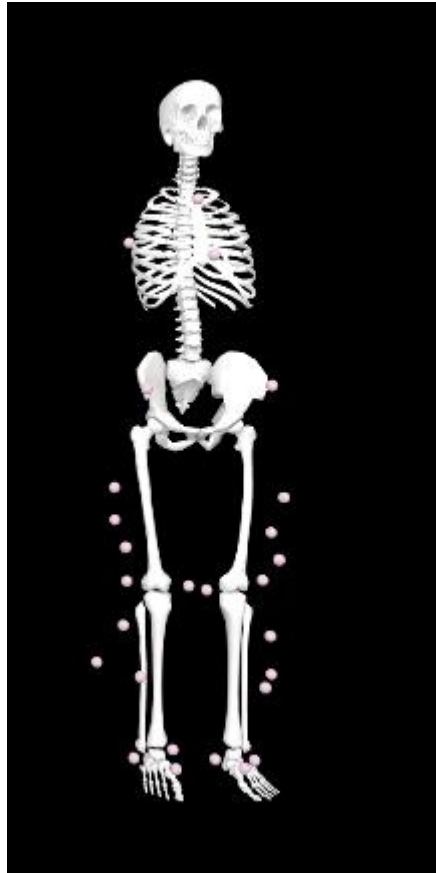
```
angle_TT_right = 0; % right tibial torsion angle (in degrees) %
```

```
deformed_model = [ 'rightTT' num2str(angle_TT_right) ];
```

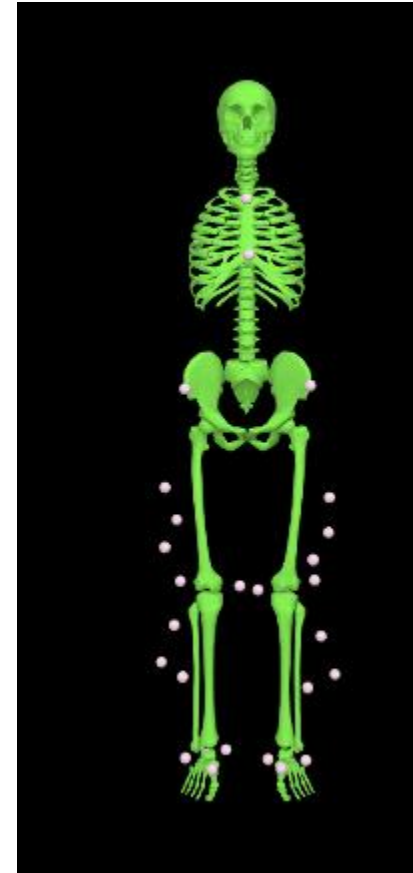
```
make_PEmodel(model, deformed_model, markerset, deform_bone, which_leg, angle_TT_right);
```

# Models

Scaled\_GenericBones.osim



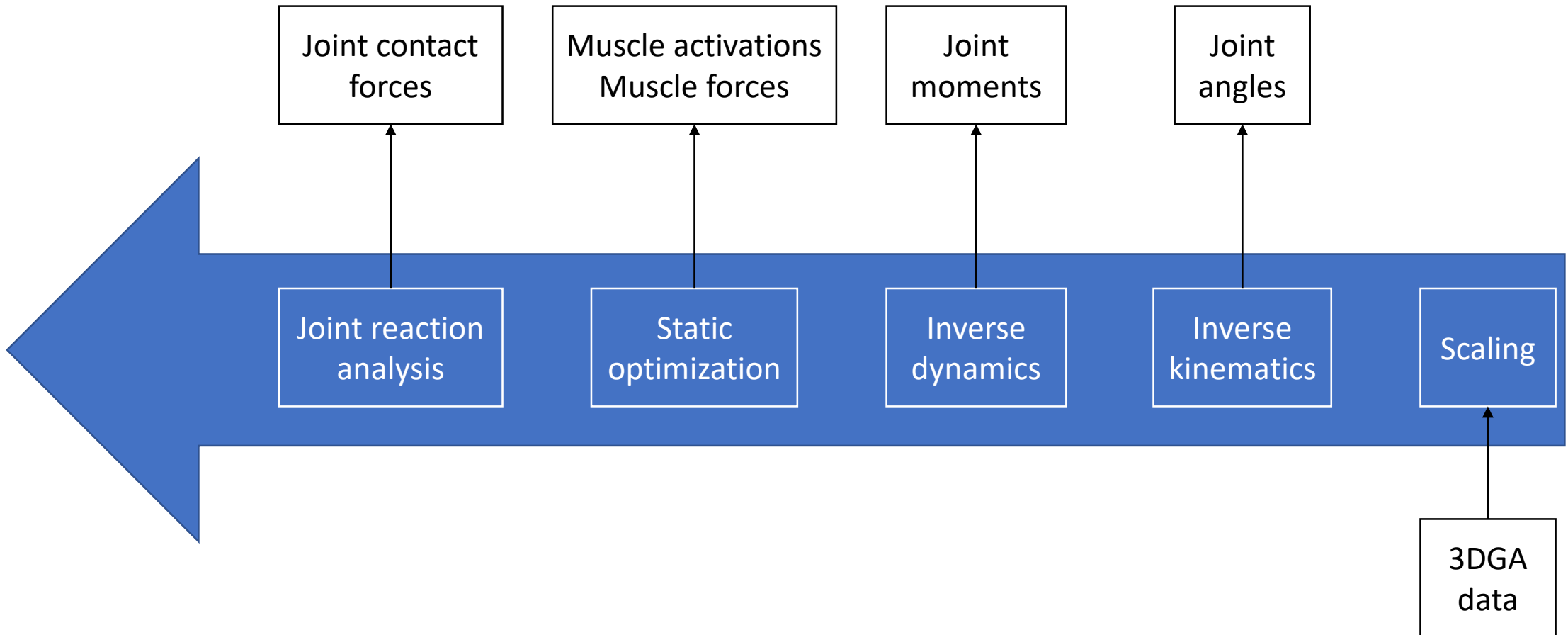
Scaled\_RFemur\_25degreesAnteversion.osim



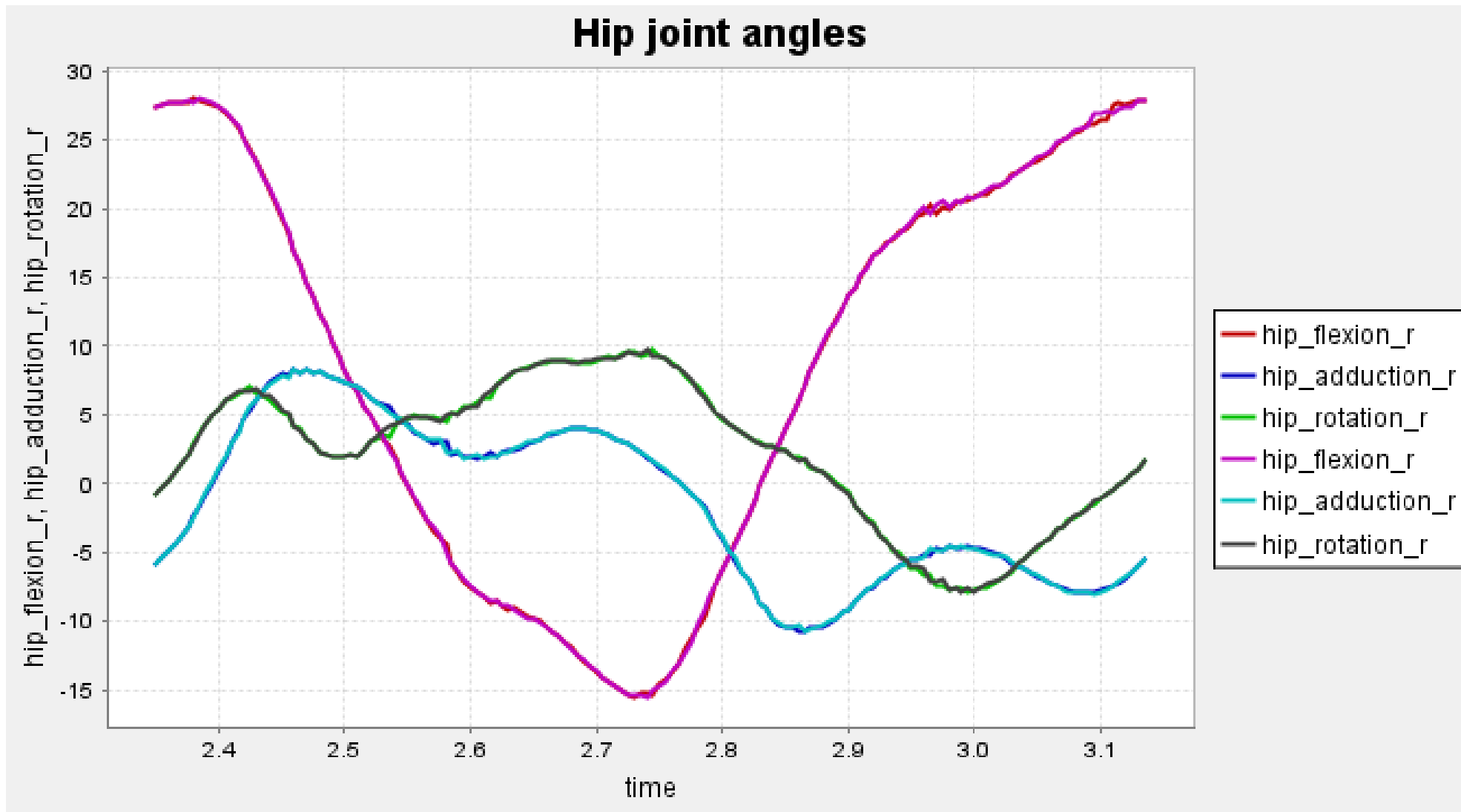
# Explore the two different models

- What is different between the models?
- Do the masses of bodies differ between models?
- Are the coordinates different?
- Are the markers different?
- Are joint coordinate systems different?
- Are muscle paths different?

# Which simulation results will be different between models?



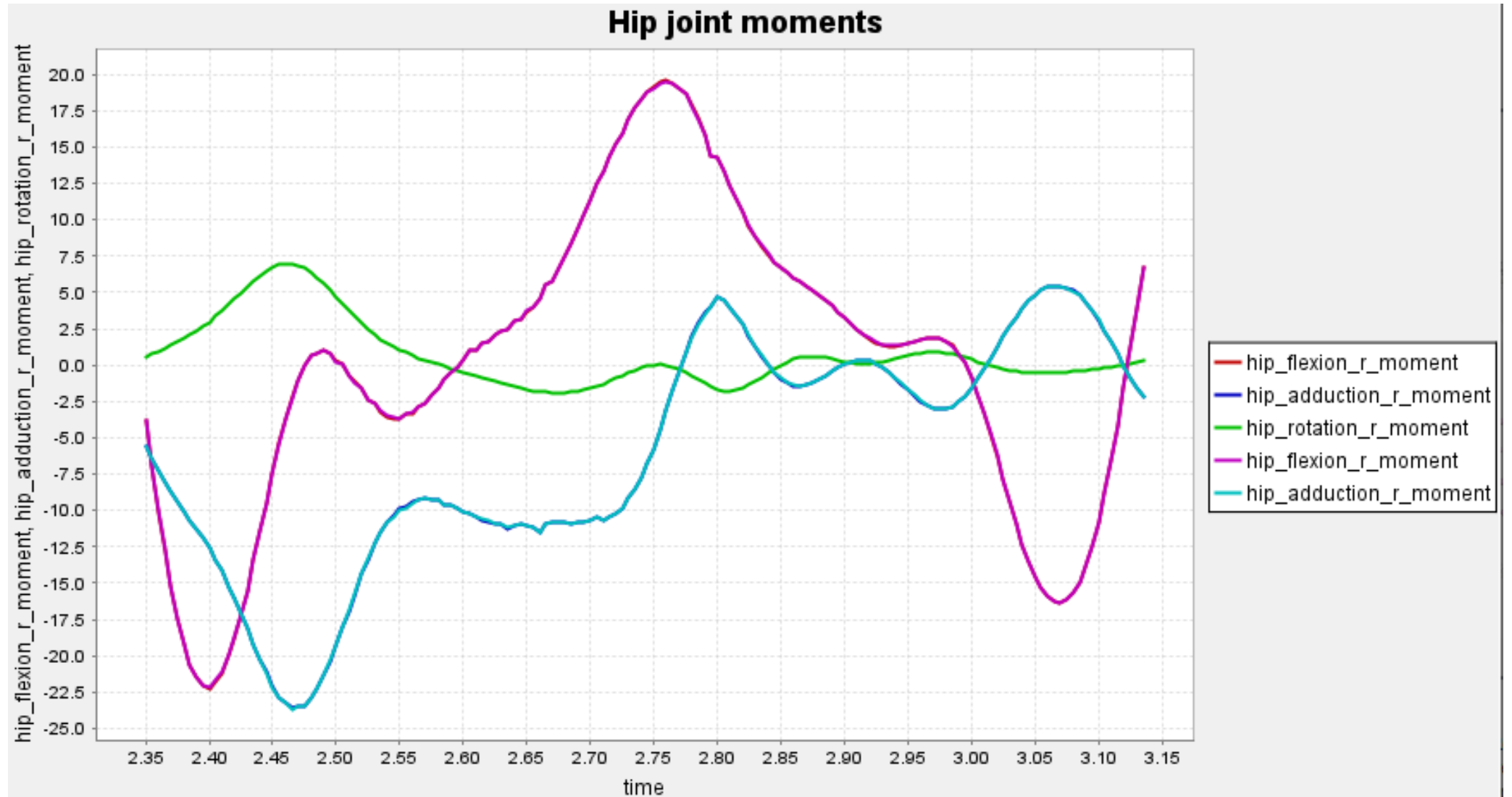
# Visualize IK results and plot hip kinematics





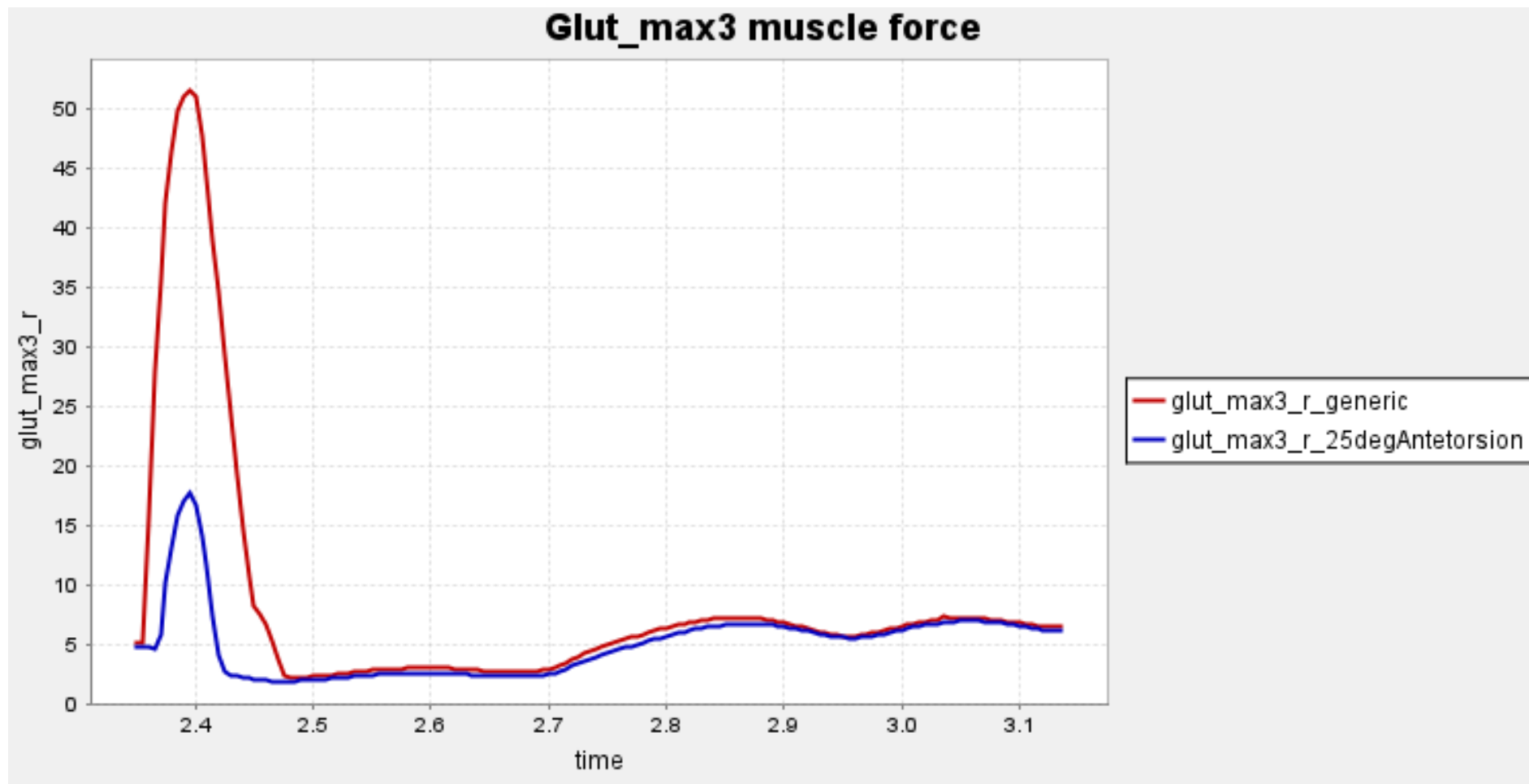
# Visualize ID results and plot hip joint moments

Do joint moments differ between models? Explain your observation.



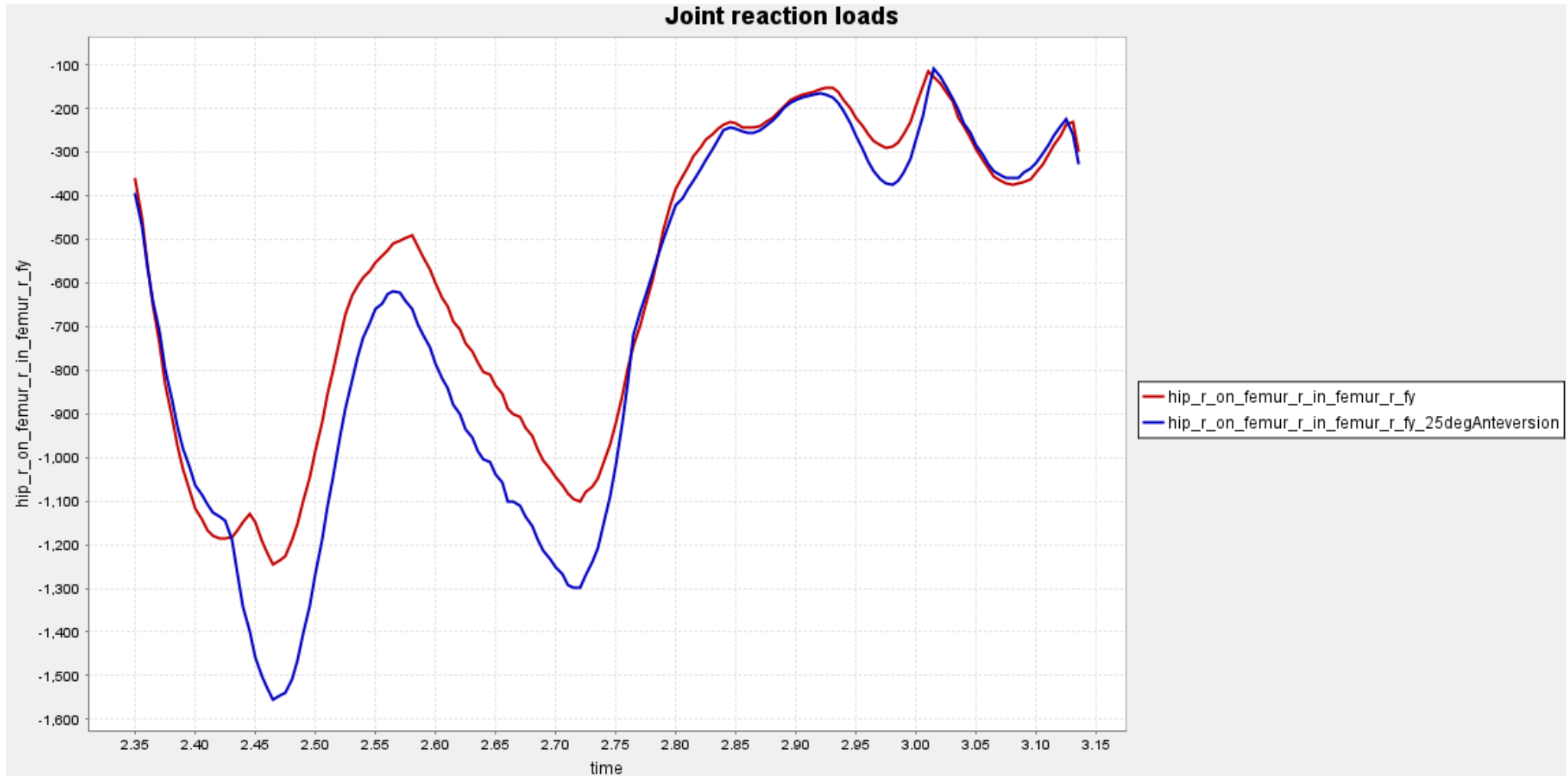
# Visualize SO forces and plot glut max 3 forces

Why are muscle forces different between models although hip kinematics and joint moments are the same between both models?



# Visualize JRL and plot vertical hip JRL

Are the hip joint loads different between models? Explain your observation.



# Take home message

- Subject-specific geometry affects muscle and joint reaction forces
- Joint moments do not tell us much about muscle forces and joint reaction forces