Validation of converted test model

The converted MJC model has been tested under the three categories below and with the accuracy of:

- Step 1: xml Conversion Validation

Check multi-body forward kinematics (using endpoints), approximation of custom/coupling joints & conditional/moving path points

Mean error:0.7925 cm; std: 0.9852 cm

- Step 2: Muscle Kinematics Validation

Check muscle moment arms as indication how muscle wrap over joints

Mean error:0.8055 cm; std: 0.0 cm

- Step 3: Muscle Kinetic Validation

Check muscle force-length relationship as indication of how similar of them in generating forces
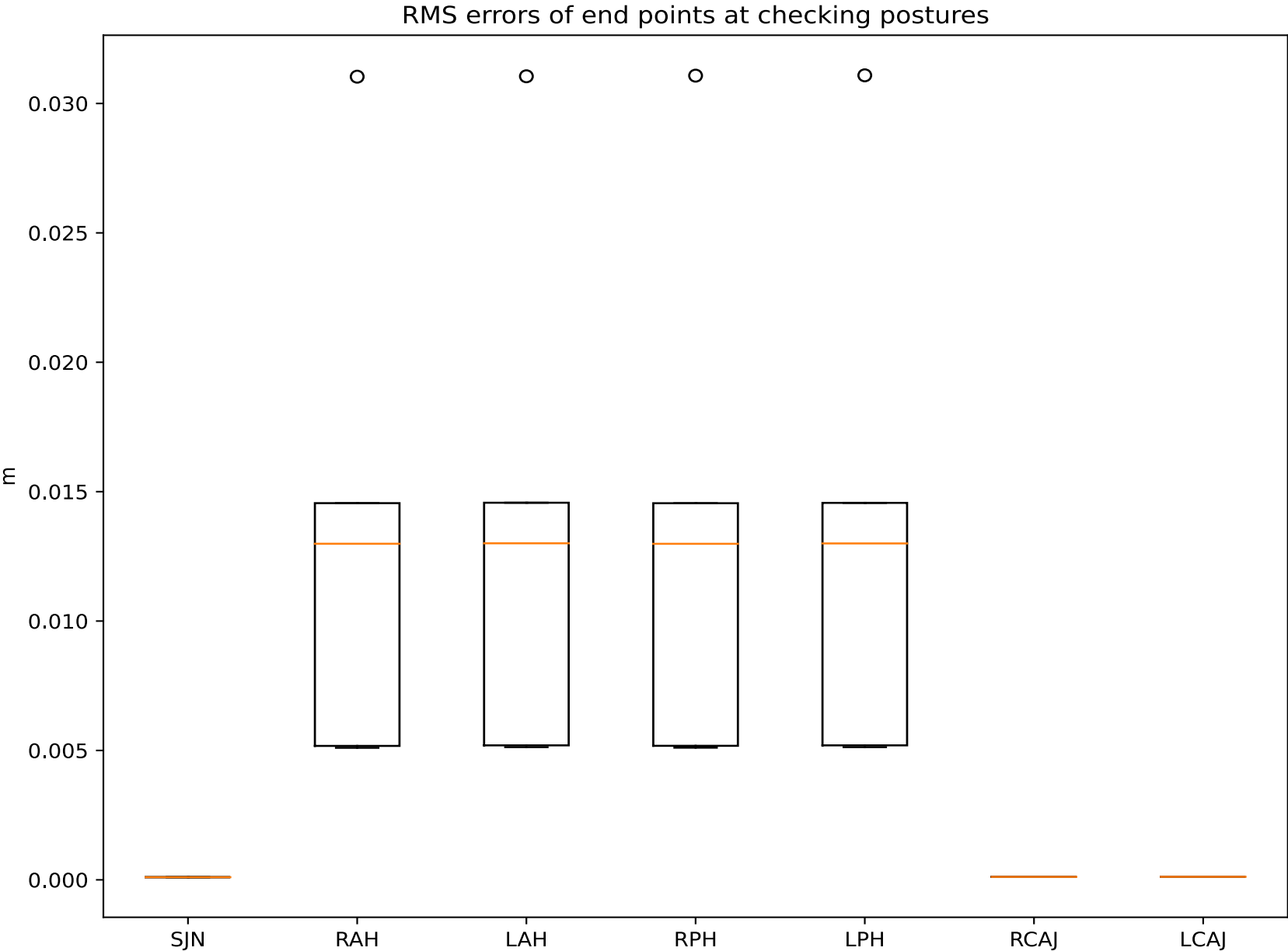
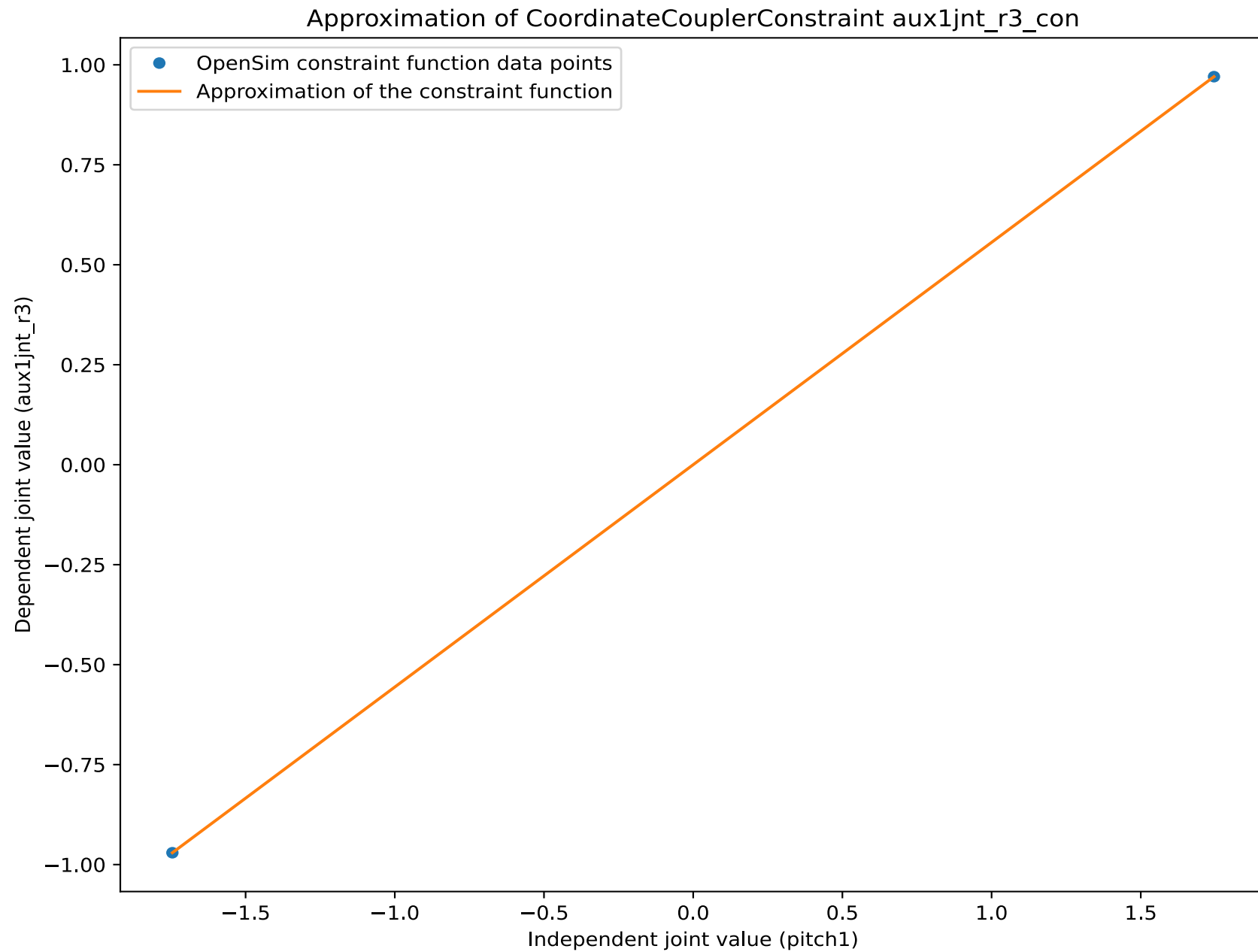*Mean error:0.038 Fmax; std: 0.0 Fmax*

Step 1: xml Conversion Validation

Randomly pose the model with 10 confgurations within the joint limits. In each posture, the endpoints(markers) global locations of Osim and Mjc models are extracted and compared. Box plot of their mean-std errros are plotted together. Individual endpoint differences of these 10 postures are also ploted in the VLT folder, but not included inside this report.

Besides the end point check, the approximation of customer joints, coupling joints, conditional/moving path points are plotted and attached. In these plots, blue dots/lines represent their setup in the OpenSim model. Yellow dots/lines represent the approximations in the MuJoCo model
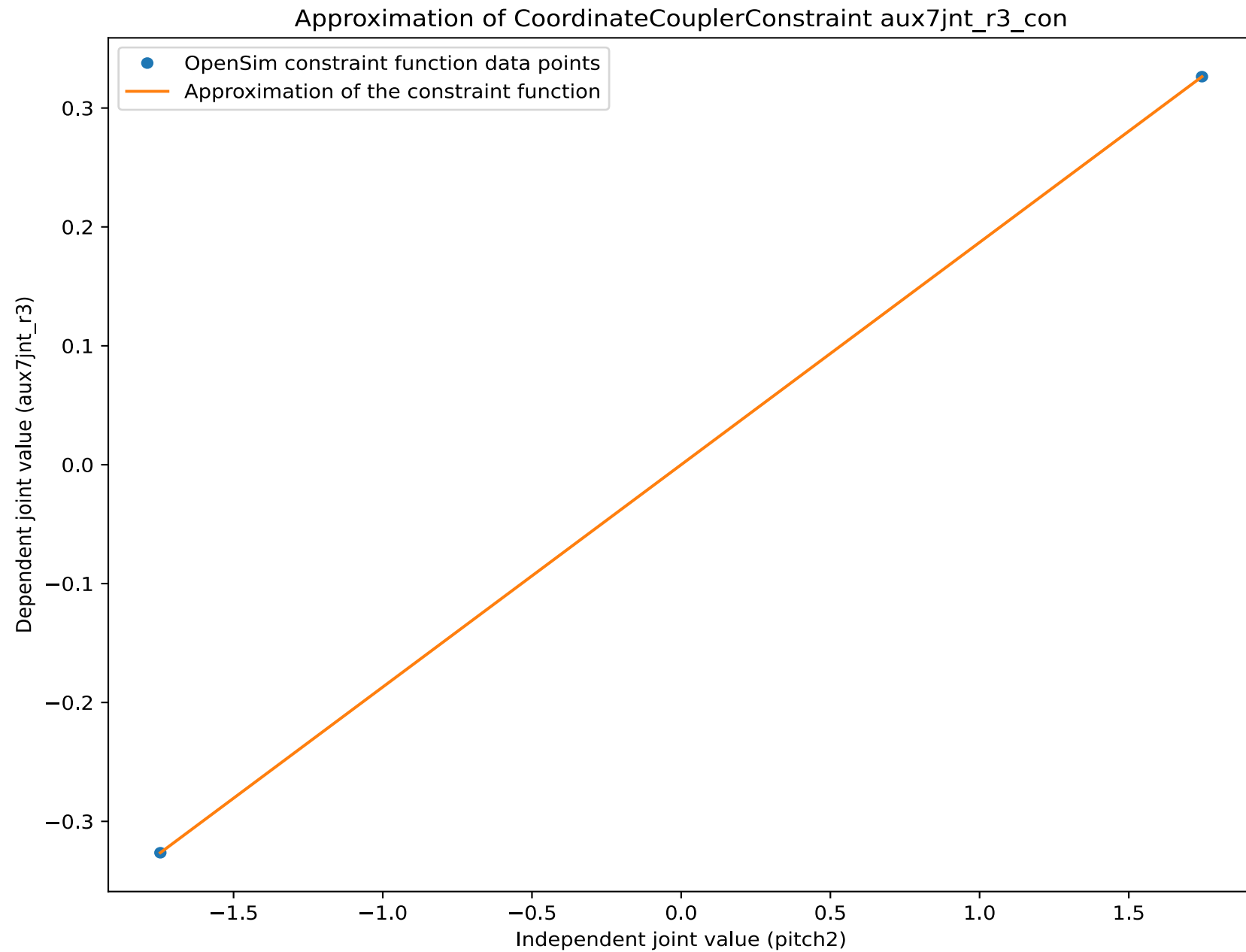
End points

RMS errors of end points at checking postures

Approximation of coupling joints

Approximation of CoordinateCouplerConstraint aux1jnt_r3_con

- OpenSim constraint function data points
- Approximation of the constraint function

Dependent joint value (aux1jnt_r3)

Independent joint value (pitch1)

Approximation of coupling joints

Approximation of CoordinateCouplerConstraint aux7jnt_r3_con

Step 2: Muscle Kinematics Validation

Moment arm of each muscle at each joint are compared between Osim and converted MJC model. A overall heatmap is included to indicate the overall moment arm errors before and after optimization. Then detail moment arm curves are plotted for comparison. For the muscles that wrap over muitiple joints, moment arms with respect to one joint maybe affected by several other joints. In this case, several mesh points were check of these affecting joints, when plotting moment arms at one joint. This is why there are multiple lines (with different grey levels) plotted for one muscle on one joint.

How to inteprate the plot:

Global title indicate the muscle and joints that affecting the moment arms in the plots. X axis indicate the joint that moment arms were extracted. Grey level of the lines indicate the mesh postures of other relvant joints (in the global tile, but not the x axis)
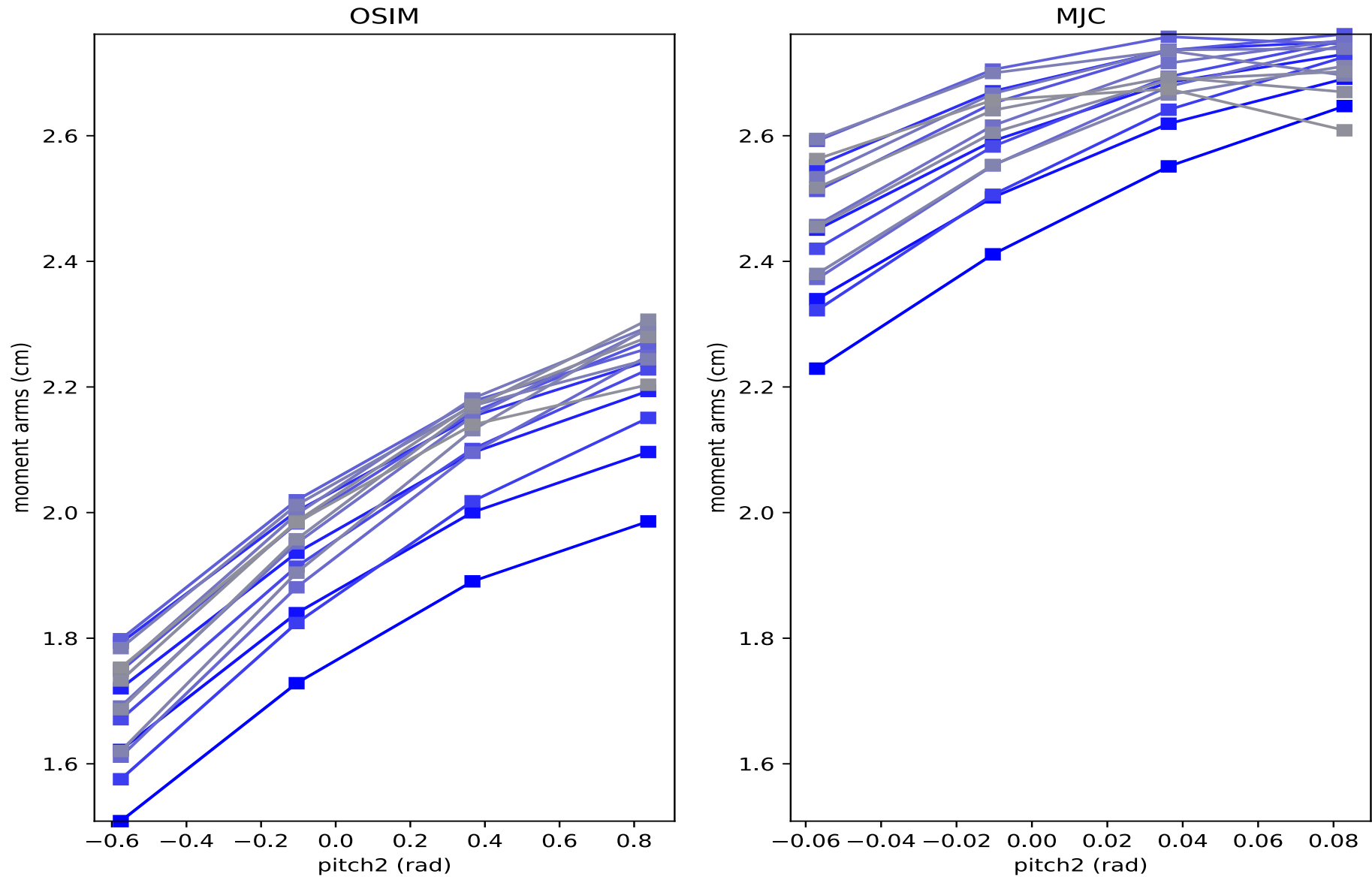
Overall comparison of muscle moment arms before/after optimization

Moment arm comparison of all muscles (cm)
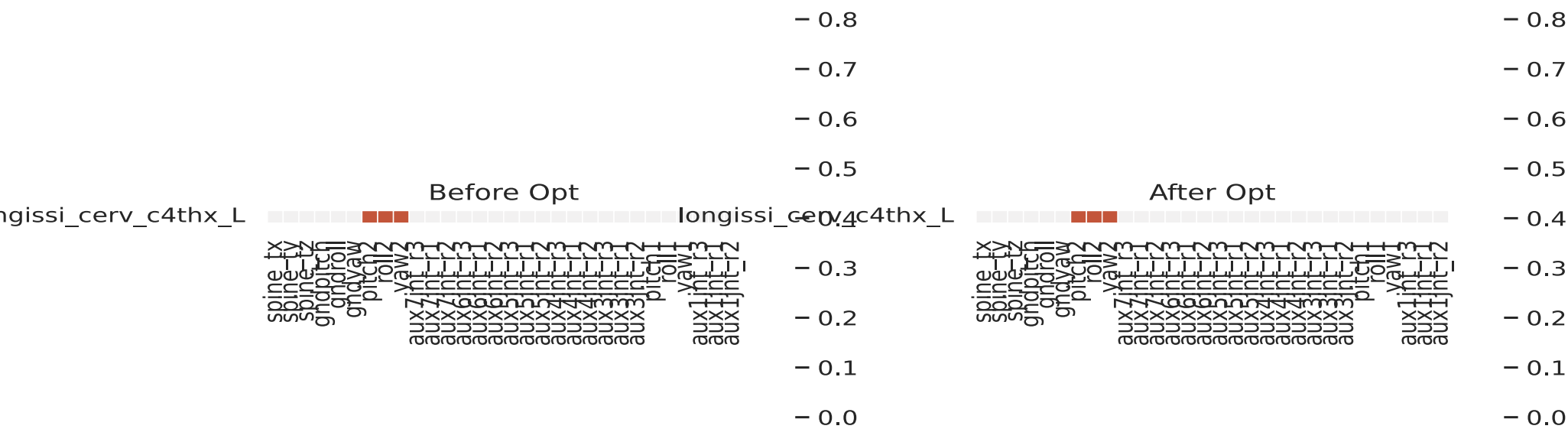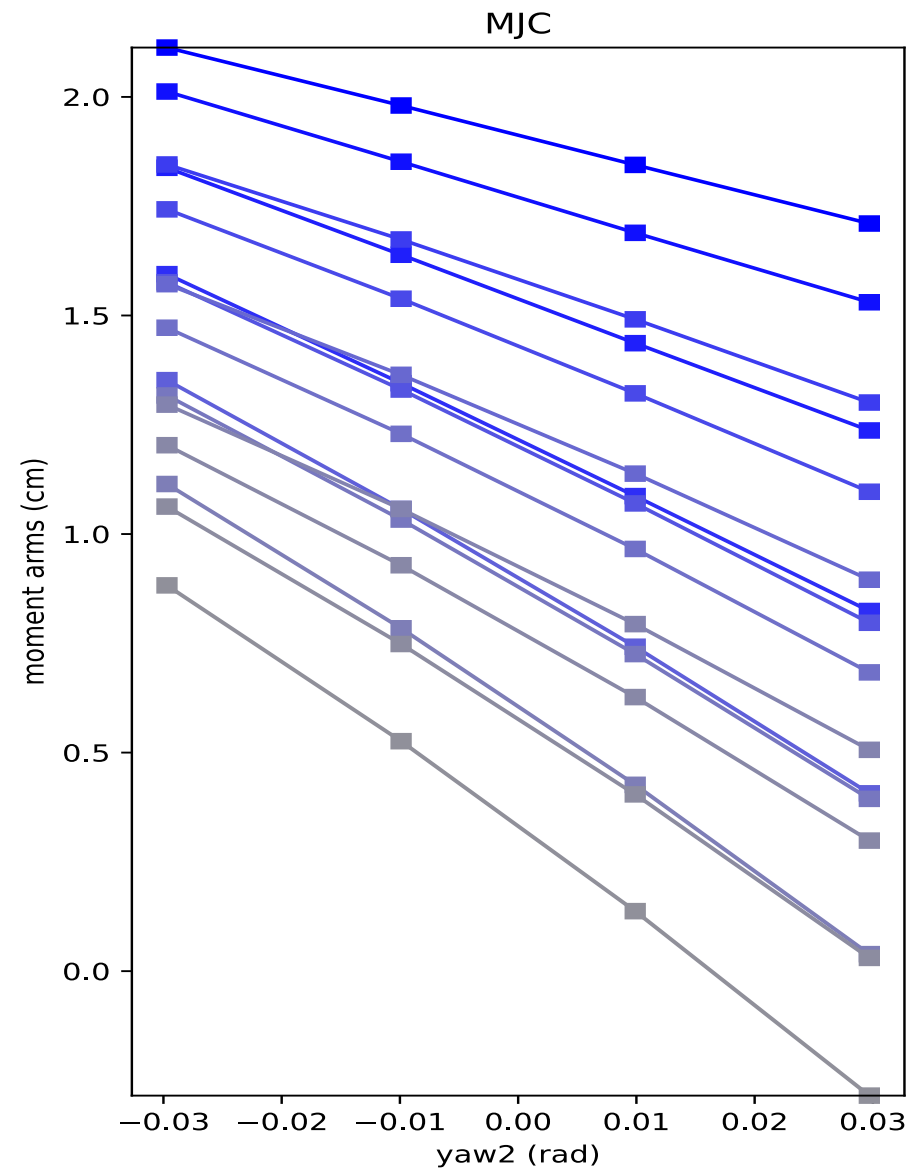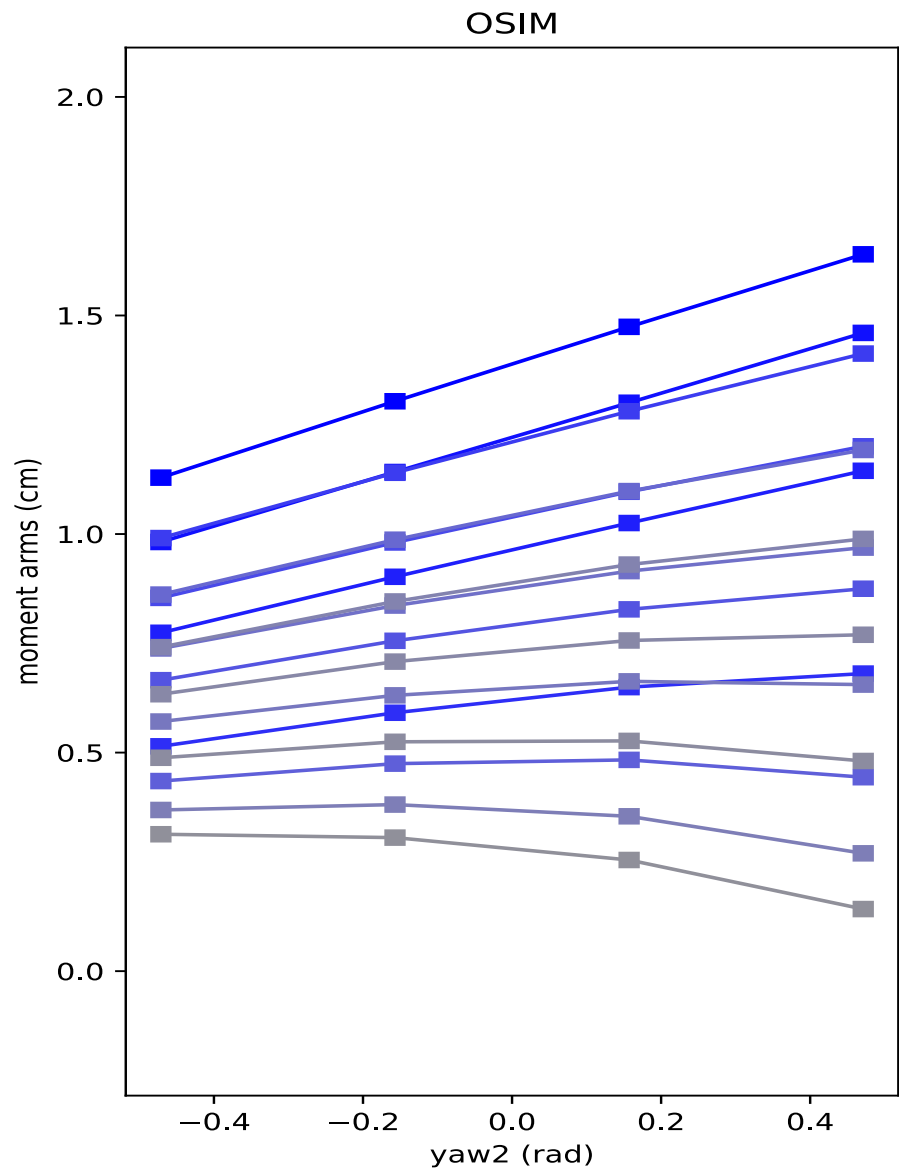

Before Opt

After Opt

Muscle specific moment arm comparison before/after optimization

longissi_cerv_c4thx_L - pitch2 - roll2 - yaw2

Muscle specific moment arm comparison before/after optimization

longissi_cerv_c4thx_L - pitch2 - roll2 - yaw2

Step 3: Muscle Kinetic Validation

Muscle force-length property are validated between Osim and Mjc models. This force-length property only depends on muscle-fiber-tendon unit lengths. We made it isolated with the moment arm, so that the change in moment arms will not affect the muscle force properties. The muscle-fiber-tendon unit lengths were roughly even extracted (from shorest to longest) with all possible body postures. A bar plot of the froce errors of all muscle before and after optimization is included. Then the detail force-length curve comparsion plot of each muscle is included.

How to inteprate the plot:

Global title indicate the muscle name. X axis indicate the muscle-fiber-tendon unit length. Y axis is the muscle force (unnormalized)

Overall comparison of muscle force-length relationship before/after optimization
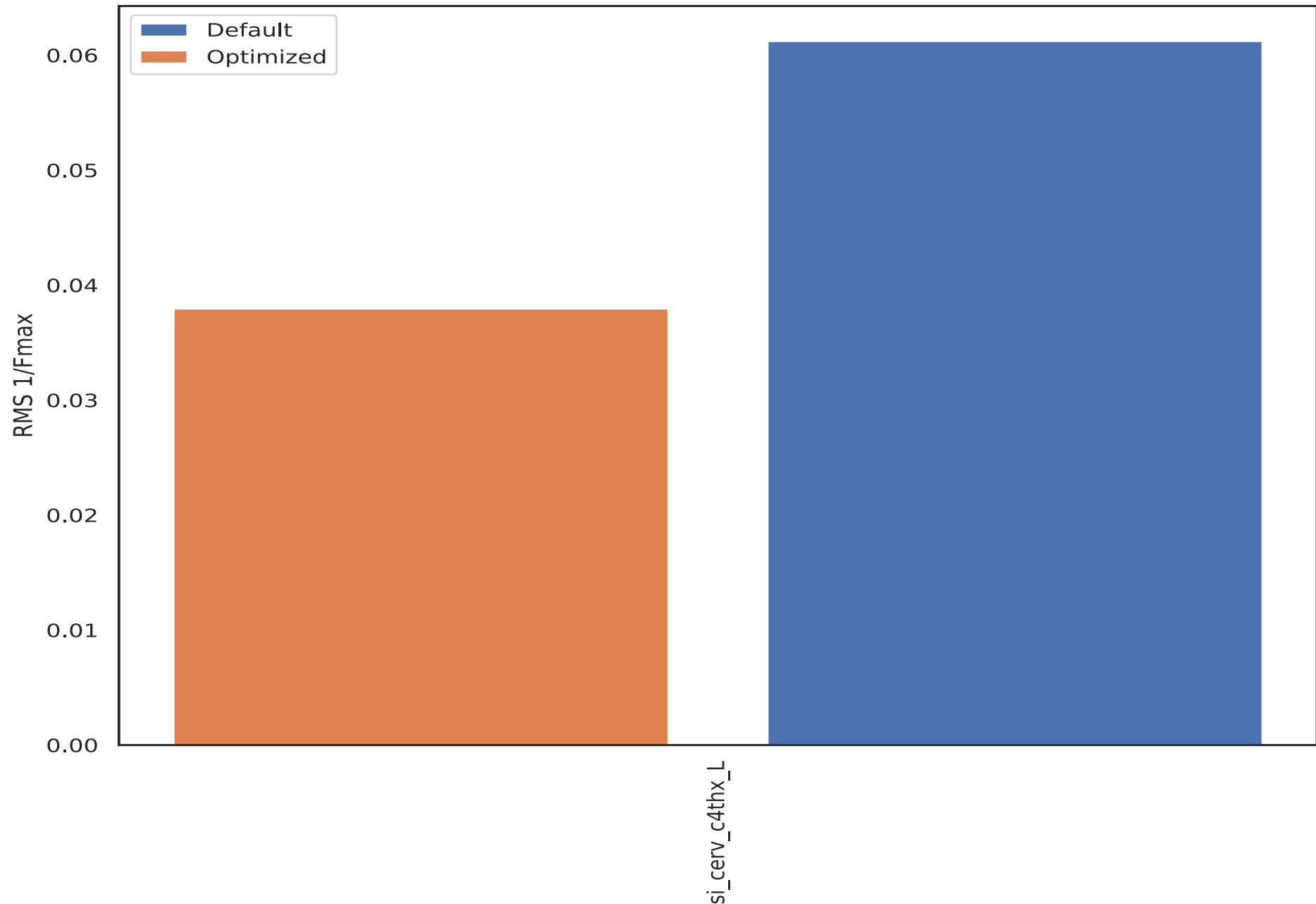
Muscle specific force comparison before/after optimization

longissi_cerv_c4thx_L