Analysis – Net Force and Moment Measures

Net shoulder force (Fnet) and moment (Mnet) were calculated from the individual intersegmental forces and joint moments. For every trial, values were first calculated for each propulsion cycle at 1% intervals using a vector sum, with net forces obtained using the equation:

$$F\_{net}=\sqrt[2]{F\_{ml}^{2}+F\_{ap}^{2}+F\_{si}^{2}}$$

and the moment magnitude determined from the equation:

$$M\_{net}=\sqrt[2]{M\_{ml}^{2}+M\_{ap}^{2}+M\_{si}^{2}}$$

In both equations, the subscripts ml, ap, and si represent the individual forces/moments directed in the medio-lateral, anterior-posterior, and superior-inferior directions, respectively. The orientation of the net force vector was also defined using two angles, representing the orientation of the Fnet vector in the sagittal and frontal planes relative to the inferior direction (supplemental Figure S2). Peak net forces and moments (i.e., largest magnitude) and their associated timing (percent of cycle) and orientation angles were obtained for each propulsion cycle then averaged across cycles to provide trial averages. Individual trail averages were then averaged across subjects to obtain representative peak net forces (Fnet,peak) and moments (Mnet,peak) – with their timing and angle values – for each study condition.