Table S2. Summary of available constraint terms for Tracking, Verification, and Design Optimization.

generalized coordinate deviation coordinate	Constraint Term	Component Type	Tracking Optimization	Verification Optimization	Design Optimization
generalized_coordinate periodicity coordinate initial generalized_coordinate deviation coordinate initial generalized_coordinate_deviation coordinate initial generalized_coordinate_deviation coordinate initial generalized_coordinate_deviation coordinate final_generalized_coordinate_deviation coordinate final_generalized_coordinate_value coordinate y generalized_speed_deviation coordinate generalized_speed_deviation generalized_speed_deviation generalized_speed_deviation coordinate y initial_generalized_speed_deviation coordinate y initial_generalized_speed_deviation coordinate y initial_generalized_speed_deviation coordinate y initial_generalized_speed_deviation coordinate y initial_generalized_speed_value generalized_speed_deviation coordinate y initial_generalized_speed_value generalized_acceleration_deviation generalized_acceleration_deviation generalized_acceleration_value marker_position_deviation marker marker_position_deviation marker marker_position_periodicity marker position_periodicity marker initial_marker_position_deviation marker initial_marker_position_deviation marker initial_marker_position_value marker marker initial_marker_position_value marker marker initial_marker_position_value marker marker initial_marker_position_value marker marker initial_marker_velocity_deviation body initial_body_orientation_deviation body initial_body_orientation_value body initial_bod	<pre>generalized_coordinate_deviation</pre>	coordinate	✓	✓	✓
initial generalized coordinate deviation coordinate final generalized coordinate generalized speed deviation generalized speed deviation generalized speed deviation generalized speed periodicity initial generalized speed deviation coordinate final generalized speed value coordinate final generalized speed value coordinate final generalized speed value coordinate final generalized acceleration deviation generalized acceleration deviation marker position deviation marker position deviation marker final marker position deviation marker final marker position deviation marker final marker position value marker final marker position value marker final marker position value marker final marker position value marker final marker velocity deviation marker final marker velocity deviation marker final marker velocity deviation marker	generalized_coordinate_value	coordinate	✓	✓	✓
initial generalized coordinate value coordinate coor	<pre>generalized_coordinate_periodicity</pre>	coordinate	✓	✓	✓
final generalized coordinate deviation coordinate	<pre>initial_generalized_coordinate_deviation</pre>	coordinate	✓	✓	✓
final_generalized_coordinate value coordinate	<pre>initial_generalized_coordinate_value</pre>	coordinate	✓	✓	✓
generalized speed deviation coordinate	final_generalized_coordinate_deviation	coordinate	✓	✓	✓
generalized speed value coordinate	final_generalized_coordinate_value	coordinate	✓	✓	✓
generalized_speed_periodicity	generalized_speed_deviation	coordinate	✓	✓	✓
initial generalized_speed_deviation	generalized_speed_value	coordinate	✓	✓	✓
initial generalized speed value coordinate	<pre>generalized_speed_periodicity</pre>	coordinate	✓	✓	✓
final generalized speed deviation coordinate	<pre>initial_generalized_speed_deviation</pre>	coordinate	✓	✓	✓
final generalized speed value coordinate	<pre>initial_generalized_speed_value</pre>	coordinate	✓	✓	✓
generalized_acceleration_deviation generalized_acceleration_value coordinate y y y marker_position_deviation marker marker_position_value marker_position_periodicity marker_position_deviation marker marker_velocity_deviation marker marker_velocity_value marker marker_velocity_value marker marker marker marker_velocity_value marker mark	final_generalized_speed_deviation	coordinate	✓	✓	✓
generalized_acceleration_value coordinate	final_generalized_speed_value	coordinate	✓	✓	✓
marker_position_deviation marker		coordinate	✓	✓	✓
marker_position_value		coordinate	✓	✓	✓
marker position_value marker	marker position deviation	marker	✓	✓	✓
marker_position_periodicity marker	marker position value	marker	✓	✓	✓
initial_marker_position_deviation marker		marker	✓	✓	✓
initial_marker_position_value marker		marker	✓	✓	✓
final_marker_position_deviation marker		marker	✓	✓	✓
final_marker_position_value marker		marker	✓	✓	✓
marker_velocity_deviation marker ✓ ✓ marker_velocity_value marker ✓ ✓ marker_velocity_periodicity marker ✓ ✓ initial_marker_velocity_deviation marker ✓ ✓ final_marker_velocity_value marker ✓ ✓ final_marker_velocity_value marker ✓ ✓ body_orientation_deviation body ✓ ✓ body_orientation_value body ✓ ✓ body_orientation_periodicity body ✓ ✓ initial_body_orientation_deviation body ✓ ✓ initial_body_orientation_deviation body ✓ ✓ final_body_orientation_value body ✓ ✓ final_body_orientation_value body ✓ ✓ kinetic_consistency load ✓ ✓ root_segment_residual_load load ✓ ✓ root_segment_residual_load_periodicity load ✓ ✓		marker	✓	✓	✓
marker_velocity_value marker / / marker_velocity_periodicity marker / / initial_marker_velocity_deviation marker / / final_marker_velocity_deviation marker / / final_marker_velocity_value marker / / body_orientation_deviation body / / body_orientation_value body / / body_orientation_periodicity body / / initial_body_orientation_deviation body / / initial_body_orientation_value body / / final_body_orientation_value body / / final_body_orientation_value body / / kinetic_consistency load / / / root_segment_residual_load_periodicity load / / /		marker	✓	✓	✓
marker_velocity_periodicity initial_marker_velocity_deviation marker initial_marker_velocity_value final_marker_velocity_deviation marker final_marker_velocity_value marker final_marker_velocity_value marker body_orientation_deviation body body_orientation_value body initial_body_orientation_deviation body final_body_orientation_value		marker	✓	✓	✓
initial_marker_velocity_deviation marker			✓	✓	✓
initial_marker_velocity_value final_marker_velocity_deviation marker final_marker_velocity_value body_orientation_deviation body body_orientation_value body initial_body_orientation_deviation body final_body_orientation_value body final_body_orientation_value body final_body_orientation_deviation body final_body_orientation_deviation body final_body_orientation_value f			✓	✓	✓
final_marker_velocity_deviation marker		marker	✓	✓	✓
final_marker_velocity_value marker			✓	✓	✓
body_orientation_deviation body ✓ ✓ body_orientation_value body ✓ ✓ body_orientation_periodicity body ✓ ✓ initial_body_orientation_deviation body ✓ ✓ initial_body_orientation_value body ✓ ✓ final_body_orientation_deviation body ✓ ✓ final_body_orientation_value body ✓ ✓ kinetic_consistency load ✓ ✓ root_segment_residual_load load ✓ ✓ root_segment_residual_load_periodicity load ✓ ✓			✓	✓	✓
<tbody orientation_value<="" th=""> body ✓ ✓ body_orientation_periodicity body ✓ ✓ ✓ initial_body_orientation_deviation body ✓ ✓ ✓ initial_body_orientation_value body ✓ ✓ ✓ final_body_orientation_deviation body ✓ ✓ ✓ final_body_orientation_value body ✓ ✓ ✓ kinetic_consistency load ✓ ✓ ✓ root_segment_residual_load load ✓ ✓ ✓ root_segment_residual_load_periodicity load ✓ ✓ ✓</tbody>			✓	✓	✓
body_orientation_periodicity body	-	,	✓	✓	✓
initial_body_orientation_deviation body		İ	✓	✓	✓
initial_body_orientation_value body			✓	✓	✓
final_body_orientation_deviation body			✓		✓
final_body_orientation_value body			✓	✓	✓
kinetic_consistency load ✓ ✓ ✓ ✓ ✓ ✓ root_segment_residual_load load ✓ ✓ ✓ ✓ ✓ ✓ ✓ root_segment_residual_load_periodicity load ✓ ✓ ✓ ✓		Ĭ	✓	✓	✓
root_segment_residual_load load \(\sqrt{ \sq}} \sqrt{ \q \sqrt{ \sqrt{ \sqrt{ \sqrt{ \sqrt{ \sqrt{ \sqrt{ \sqrt{ \sqrt{		İ	✓		
root_segment_residual_load_periodicity load ✓ ✓ ✓			✓	√	√
			✓	✓	✓
external torce deviation	external_force_deviation	force	✓	√	√

external_force_value	force	✓	✓	✓
external_force_periodicity	force	✓	✓	✓
<pre>initial_external_force_deviation</pre>	force	✓	✓	✓
initial_external_force_value	force	✓	✓	✓
final_external_force_deviation	force	✓	✓	✓
final_external_force_value	force	✓	✓	✓
external_moment_deviation	moment	✓	✓	✓
external_moment_value	moment	✓	✓	✓
external_moment_periodicity	moment	✓	✓	✓
<pre>initial_external_moment_deviation</pre>	moment	✓	✓	✓
<pre>initial_external_moment_value</pre>	moment	✓	✓	✓
final_external_moment_deviation	moment	✓	✓	✓
final_external_moment_value	moment	✓	✓	✓
center_of_pressure_deviation	hindfoot_body	✓		✓
center_of_pressure_value	hindfoot_body	✓		✓
synergy_vector_sum	synergy_group	✓		✓
synergy_vector_magnitude	synergy_group	✓		✓
limit_muscle_activation	muscle			✓
limit_normalized_fiber_length	muscle			✓
user_defined	any			✓