

Progress:

We have been struggling to derive equations of motion for our skateboarder, but we finally have a singularity-free set of equations of motion that we think are correct. We needed to add a mass at the knee and add masses jutting out posteriorly/anteriorly from the torso of the rider to remove singularities when all angles are equal to zero. We could have instead added masses that jut out laterally from the torso, or any other modification that would have given the torso some nonzero moment of inertia about its long axis. As well, instead of a mass at the knee, we could have defined inertias for the leg segments, or any other modification that would have removed the singularity when the knee is fully extended. Another key modification that we made to remove holes from the equations of motion was to define them in terms of the scalar velocity of the skateboard and the direction angle, instead of the x component and y component of the velocity as independent variables. This not only removed the holes we were seeing, but also reduced the size of the system of equations, making the derivation code much faster. The next step is to write our trajectory optimization routine. We will use multiple shooting.