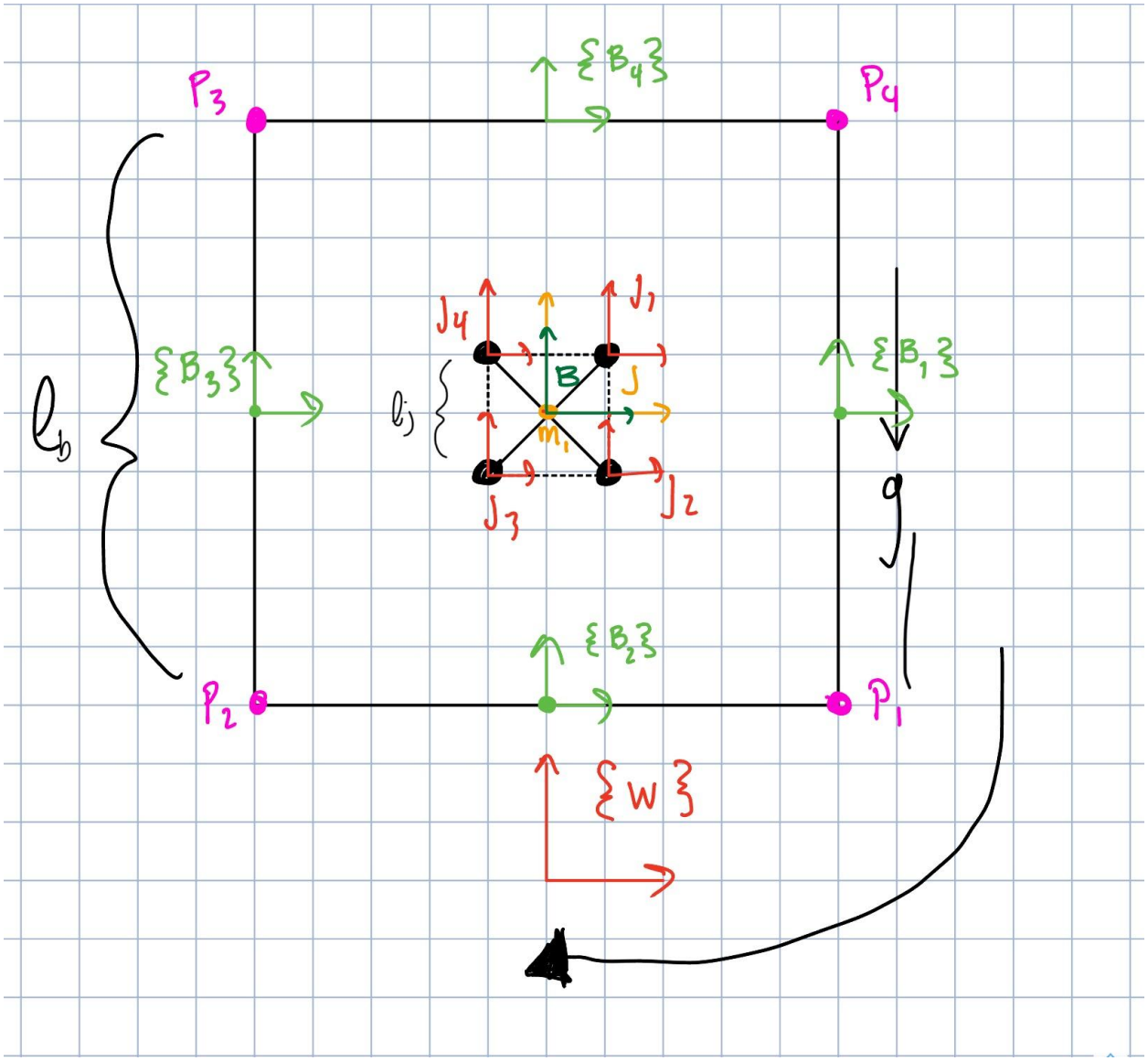
Dice in a Cup

I. I chose to do the default project, which is the simulation of a dice in a cup

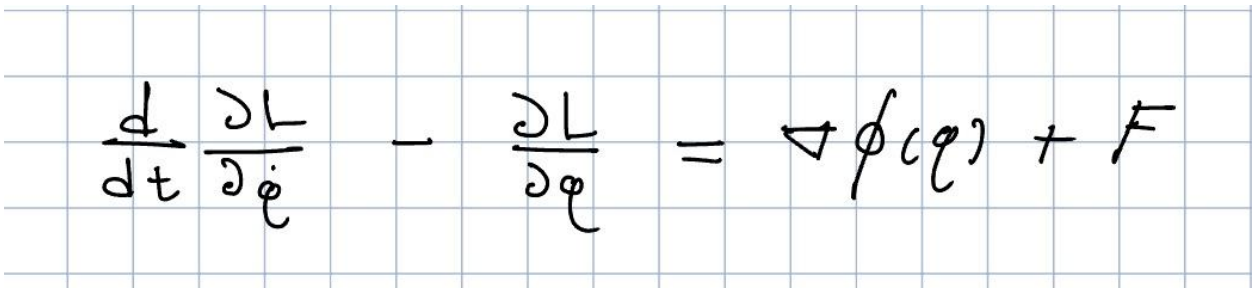
II. System Diagram



III. Description of Calculations

Using the above defined system, I started by getting the transformations from the world frame to the rest of the frames. From here I calculated the Kinetic and Potential energies in order to define the Lagrangian. This involved using the Twists V_wb and V_wj. After this, I calculated the Potential energies using the masses of the box and dice and their y components. From here we

calculated the Euler Lagrange with the normal procedure. Since we are doing a constrained problem, this is what the left and right hand sides look like.



Our constraints were constructed by first constructing the Transformation frames from the Box walls to the dice vertices. After construction these transformations, we used them to construct our constraints, ϕ. These involved checking if the x or y of the wall is in contact with a vertex of the die.

The external forces consisted of a y and theta component. The y component negated gravity while the theta component spun the box. With these all assembled we move onto the impact update laws.

Essentially the code tests if there is an impact between the collision of a dice vertex and a side of the wall. If a collision occurs, we update our state variables accordingly.

IV. Description of Simulation

My simulation works as expected, simulating several impacts between an incredibly heavy spinning box and a very light die. Because of the differences in mass, the die looks exactly like what you would imagine if you were to roll a dice in a cup. The dice itself spins in reaction to the collisions, and bounces from wall to wall.