Experiment Plan:

**Goal**: to determine whether we can correctly detect when the robot is ‘infinitely safe’, about to fall, and when it has already fallen. We define a fall as when the robot’s limbs other than the feet are in contact with the ground. We will initially study the robot’s behavior during standing under various forces applied at the torso. These external forces will vary in range from 0N up to forces that cause the robot to fall.

**Robot** - Digit

**Data to be collected**- (will most likely only use the italicized items below for the analysis)

* *Angular momentum about the CoM*
* *Angular momentum about the feet*
* *Torso angle*
* *Relative Height of the CoM w.r.t legs*
* *Virtual constraints (y and dy)*
* *Global position of the feet (should be constant if it’s not then the feet are slipping- a way to estimate friction indirectly)*
* *Feet rotation (I need to look more into this)*
  + *ZMP (captures the roll of the feet but since digit doesn’t have feet we can try to get estimates of the GRF and proceed to calculate ZMP via CoP or perhaps calculate the ZMP from the model itself)*
  + *Use ankle angles to estimate foot rotation*
* Motor torque and joint angle values (the torque and joint limitations will be implicitly embedded in the data but it’d be cool if we could explicitly include it)
* Global position of the CoM
* Global position of the torso
* Time (duration and initial time) external force is applied

**Experiment-**

* Where- In the lab with the robot attached to the gantry (although with digit being able to catch itself, it may not be necessary to run the experiment with the gantry but it’s certainly preferred.)
* Plan- Get data of the robot starting in a standing pose for about 30 seconds and then after 30 seconds or so, apply an external force from the list below and collect data for about a minute or two (I’m assuming that the robot will fall within a minute or two but the time duration can be adjusted during the experiment)
  + 0 external force so that we can capture the robot under normal operating conditions
  + Small external force that has no effect on the robot
  + Medium external force that cause the robot to stumble but recover
  + Large external force that causes the robot to fall

(Maybe there’s a way we can estimate the amount of force applied to the robot)

**Measure of success**:

* Successfully collecting the data which will later be analyzed