… in all you have : 1000\*3 time steps. (you can decide on a subset of this, one of the question of importance is how much can we reduce the training distribution using physics while not sacrificing the accuracy)

Any pair of time steps are the training and ground truth:

For example:

X\_TRAIN                                                                             Y\_TRAIN

State(x,y,vx,vy) @ time\_step =10                                 force @ time\_steo = 11

State(x,y,vx,vy) @ time\_step = 300                              force @ time\_step = 301

….                                                                                        ….

Target steps for the project:

1. Implement a baseline model that predicts the force at each step, invert and obtain the learned K and M matrices, does it learn physics?
2. Implement a PINN
   1. Decide on the physics constraints that can be implemented
   2. Invert and obtained the learned K and M matrices.
   3. Test on config with the spring constants and Mass matrices changed, does the model invert correctly after several training steps?

* Do we fix the number of masses? or vary them

**Types of model:**

1. Based on the equation of motion, predict the forces (accelerations) on each mass and then integrate
2. Include loss terms for e.g. energy, momentum conservation (but conservation will not be exact)
3. Model predicts a scalar like the Hamiltonian; then compute the force and speed of the masses by differentiating this predicted Hamiltonian with the holonomic coordinates