```
cost =  2.9388540706327846
cost =  197.08978690470875
cost =  562.0881182712153
cost =  1802.7160616369808
cost =  4581.591252578519
cost =  inf
cost =  inf
cost =  inf
```

The cost is directly related to the initial state and perturbation of the cartpole. Starting from vertical position, because the cartpole is already at the optimal position, little control input is required to maintain the equilibrium. Therefore, the cost is minimal for the first situation. As the initial inclination angle increases, it requires an increasing control effort to keep the cartpole at the vertical position, the cost gets larger and larger. Eventually, when the perturbation reaches some threshold value, the linearization model falls apart and it simply becomes unrealistic to control the cartpole which explains why the cost is infinity.

For the DDP tests, if we start from vertical position, there is basically no vibration as the cartpole is kept vertical perfectly. If we start from either plus or minus 90 degrees from the vertical position i.e. horizontal position, it would take a while for the cartpole to swing back and forth to eventually achieve vertical position. Speaking of the comparison between LQR and DDP, we can clearly see that the DDP actually has a better performance, even though some initial conditions are at horizontal position, it still has the capability of making the cartpole upright regardless of the cost. This algorithm takes much longer time to train though. However, the LQR method, due to the limitation of linearization and approximation accuracy, only works well when the magnitude of the perturbation is small, it cannot handle situations with large initial error.