ddpg_model_analysis

February 27, 2019

```
In [2]: from drift.robots import ETHModel
        from drift.commons import Sequence, Animation
        from collections import deque
        %matplotlib inline
```

1 Deep Deterministic Policy Gradient (DDPG) Model Analysis

The DDPG algorithm will be analysed in two ways:

```
- the effect of changes in vehicle dynamics on the performance of the model and
- the effect of changes in hyper-parameters on the performance of the model on a vehicle.
```

1.1 Vehicle Dynamic Changes

The best DDPG control model 1 trained so far will be tested for robustness and performance by running it on vehicles with different dynamics. The control model was trained on a vehicle with dynamics that made it suitable to drift easily.

There are 9 main variables that determine the dynamics of the vehicle as discussed in the Methodology report. The table below describes the effect of each variables observed during experiments:

Variables	Description
B	It affects how quickly the vehicle makes a turn (i.e. it affects the angular velocity)
C	It affects the driftness of the vehicle (i.e. controls the friction of the wheels)

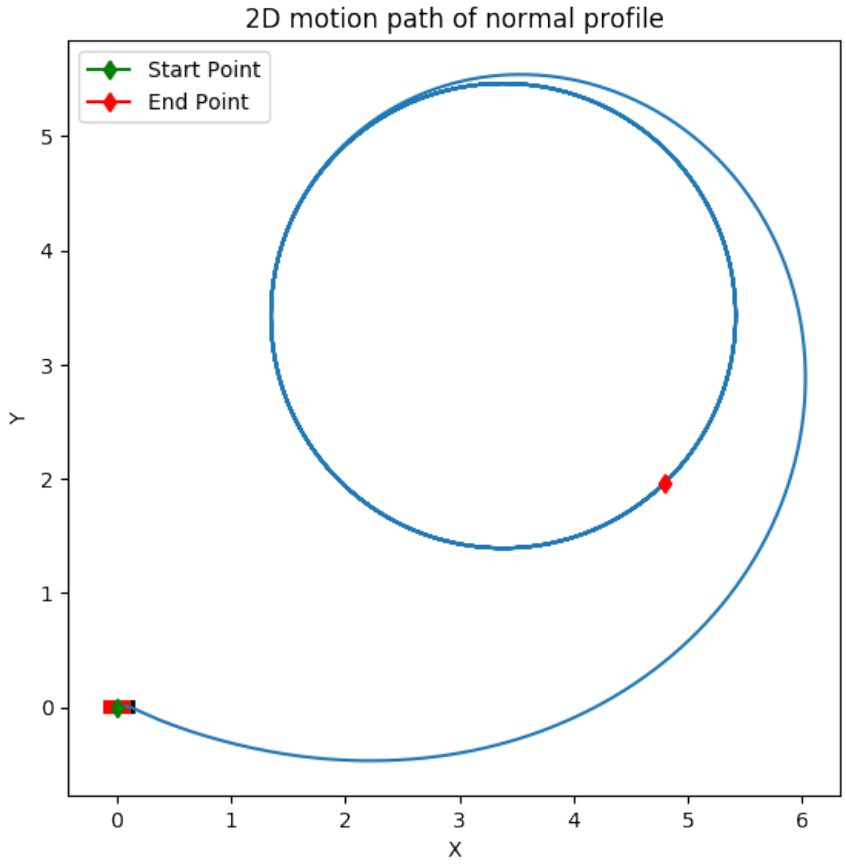
Variables	Description
D	It scales the lateral forces applied to the wheels
C_{m1}	It scales the longitudinal velocity of the vehicle
C_{m2}	same as C_{m1}
C_r	...
C_d	...
I_z	Moment of Inertia
m	Mass

The effect of each variables are however not independent. The `moment of inertia` and `mass` of the vehicle are kept constant during this analysis while the remaining parameters are changed.

1.1.1 Inference Runs Parameters

Inference (#)	B	C	D	C_{m1}	C_{m2}	C_r	C_d	Total Reward	Max dt Reward	Mean Reward
1	8	9.5	2500	1250	3	100	45	-222.506	-0.057	-0.111
2	7	"	"	"	"	"	"	-614.90	-0.206	-0.307
3	9	"	"	"	"	"	"	-1999.998	-0.999	-0.999
4	9	"	"	"	"	"	"	"	"	"

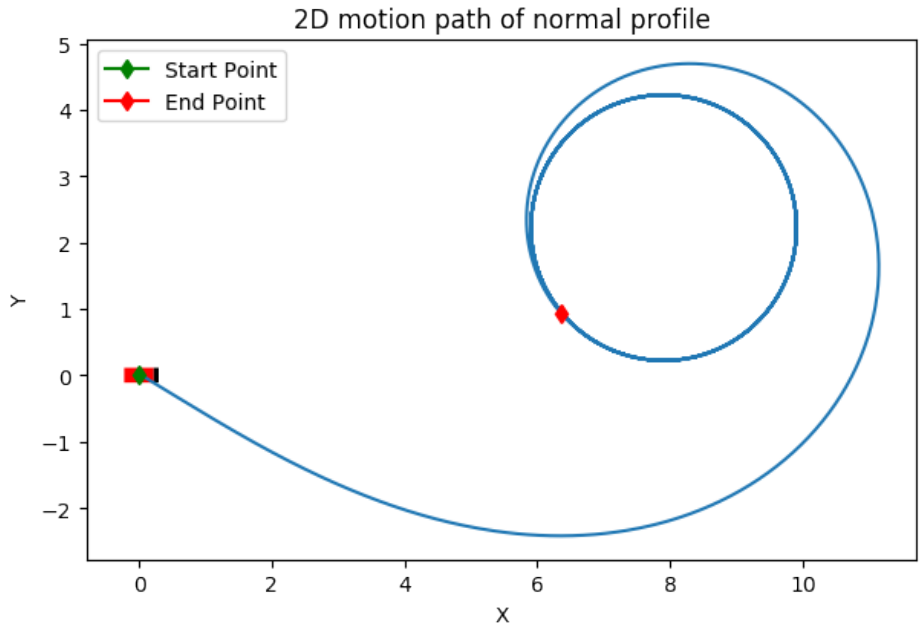
1.1.2 Inference 1 | Section 1.1.1



- The default model used for training

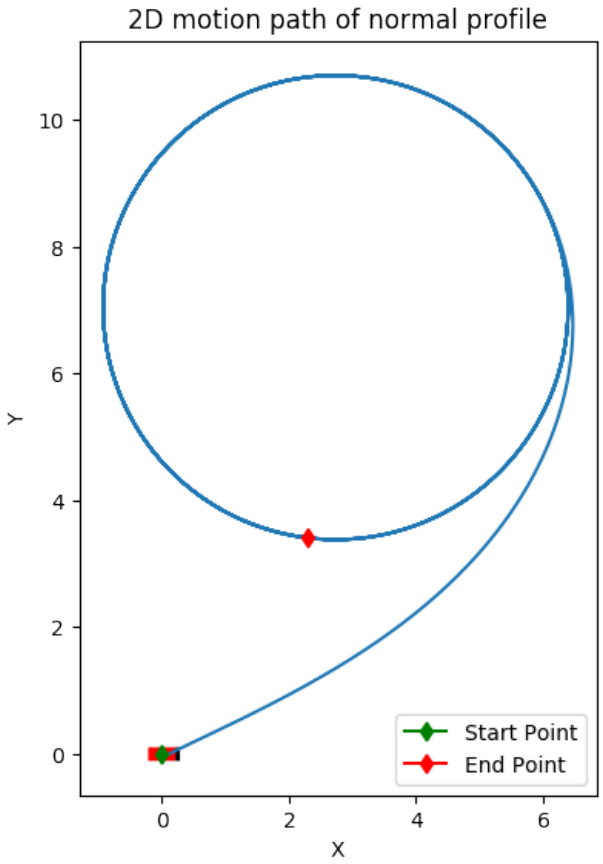
1.1.3 Inference 2 | Section 1.1.1

- Lower Total Reward
- Higher Max and Mean Reward compared to #1
- Takes longer to reach steady state.
- Decreasing increases the drifting property of the vehicle



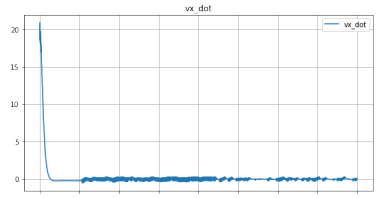
1.1.4 Inference 3 | Section 1.1.1

- While the Reward values signifies that the vehicle did not achieve drifting, the vehicle does. It however drifts with the vehicle facing the wrong direction. The steady state value been set so that the vehicle faces the center of the drift radius when drifting, however in this run the model is facing outward the radius. (i.e. is positive instead of been negative)



1.1.5 Inference 4 | Section 1.1.1

```
In [16]: path = "/home/zadiq/dev/@p/drift_project/data/26-02-2019/ddpg_run_3/eps-93--234.sequer
         sequence = Sequence.load(path)
         sequence.plot()
```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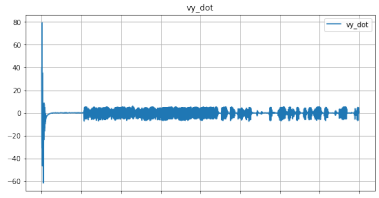
vx_dot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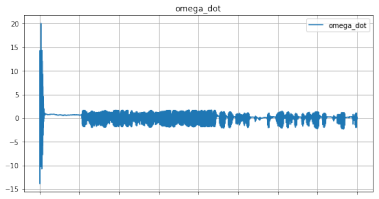
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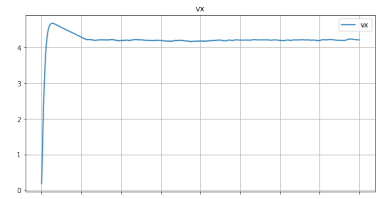
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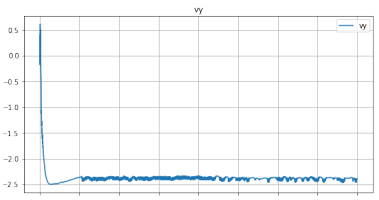
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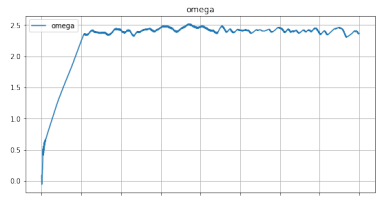
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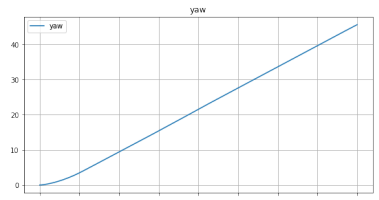
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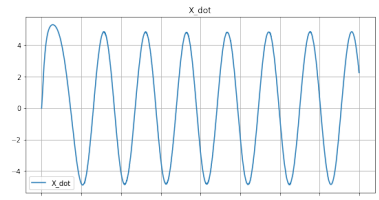
yaw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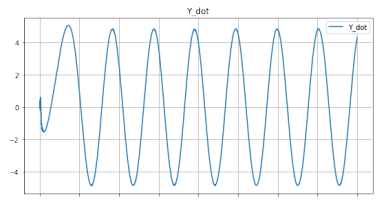
X_dot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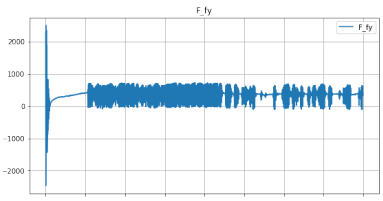
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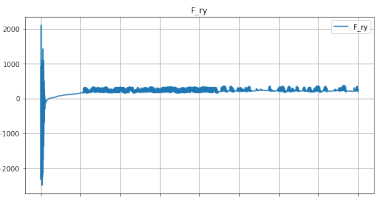
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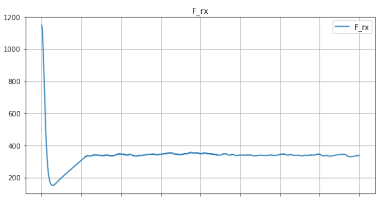
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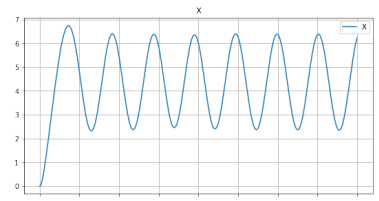
X
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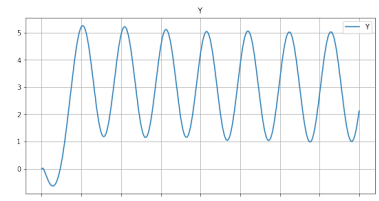
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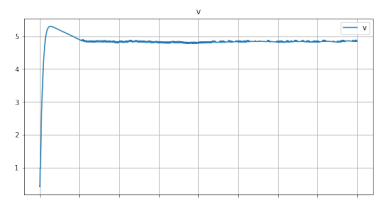
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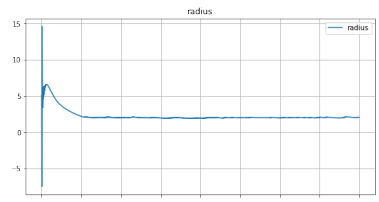
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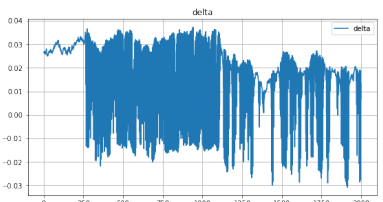
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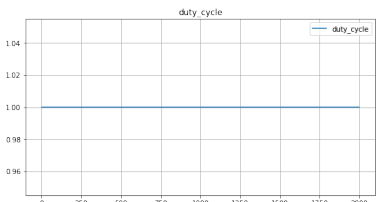
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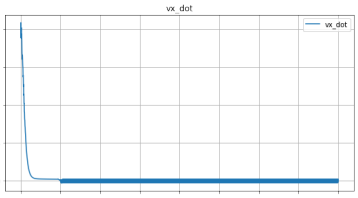
duty_cycle

```
In [32]: path = "/home/zadiq/dev/@p/drift_project/data/inference/26-02-2019-3-eps-38--171-infe
         sequence = Sequence.load(path)
         sequence.plot()
```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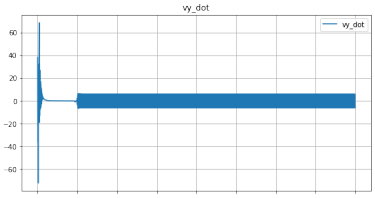
vx_dot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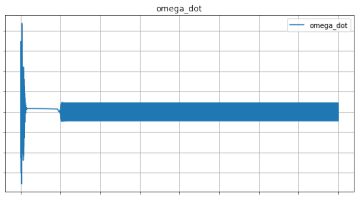
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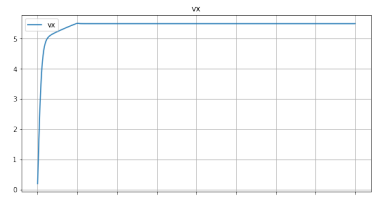
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vy
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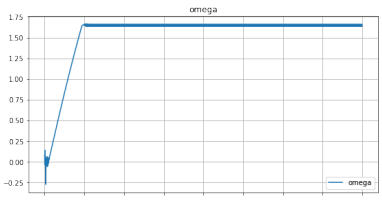
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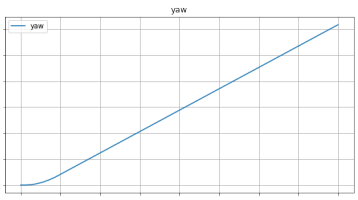
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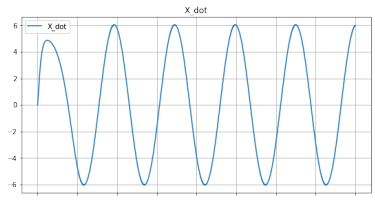
yaw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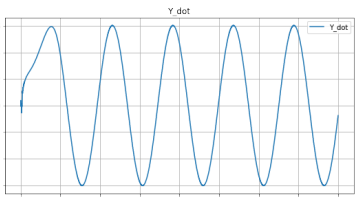
X_dot


Y_dot
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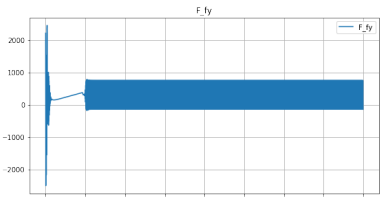
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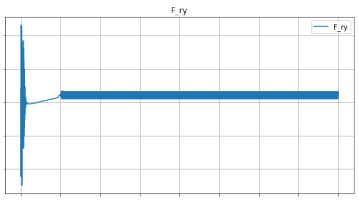
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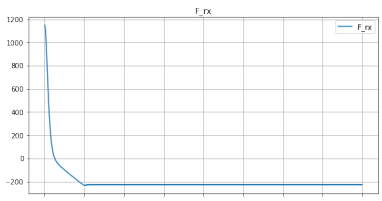
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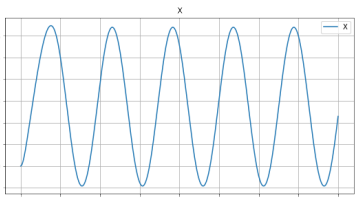
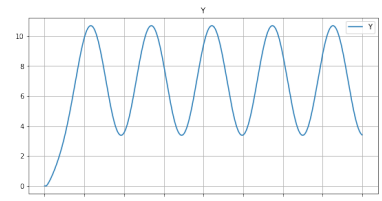

X
X


Y
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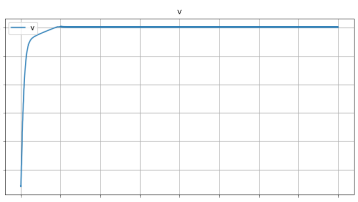
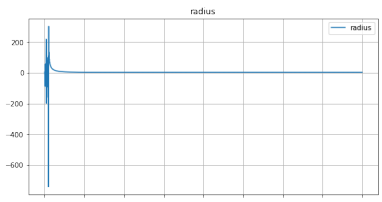

v
v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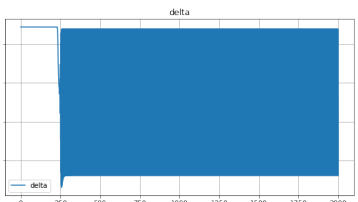
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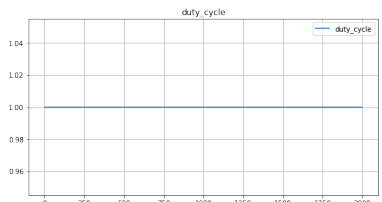
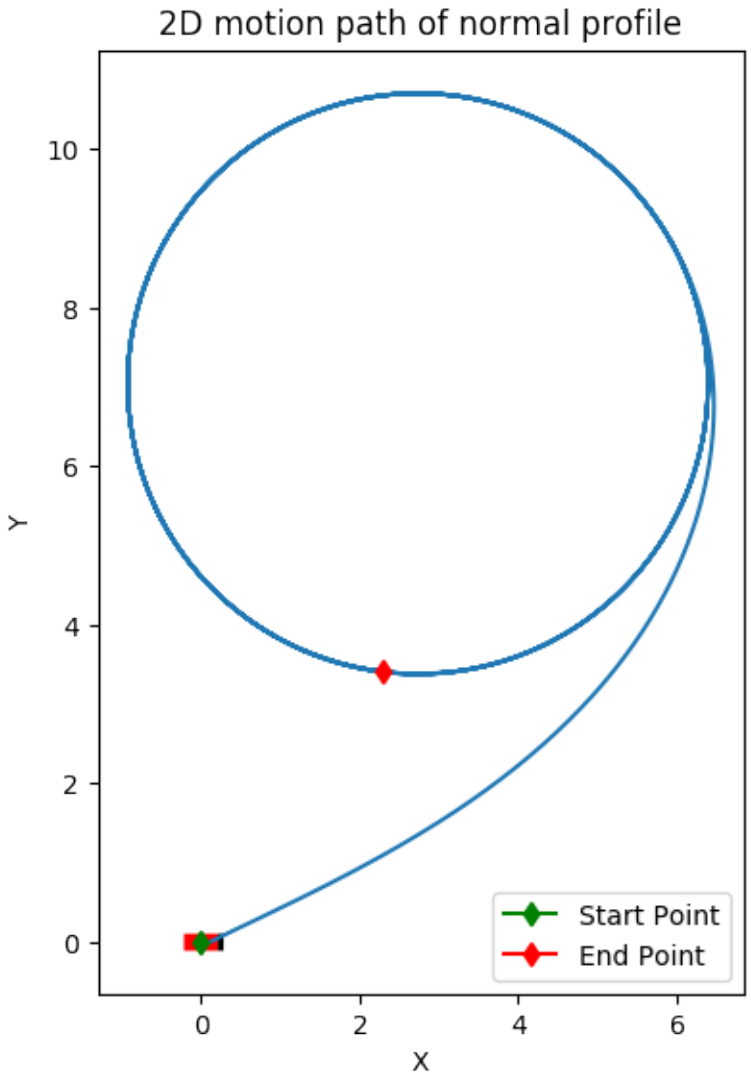

duty_cycle
duty_cycle

In [33]:
```
ani = Animation(sequence)
ani.show()
```



Out[33]: <matplotlib.animation.FuncAnimation at 0x7f54a96ed0b8>

In [ ]: