

Rllib 활용 신호 최적화 실험 결과 분석 (v.0818)

- 목적 : State-Reward-Action 의 영향 분석
- 실험일 : 2021.08.18.~24.

교통 환경 : Doan지역 데이터 활용 SALT 시뮬레이션

Train

```
{
  "scenario": {
    "id": "doan4Train",
    "time": {
      "begin": 0,
      "end": 86400
    },
  },
  "input": {
    "fileType": "SALT",
    "node": "doan_20210401.nod.xml",
    "link": "doan_20210401.edg.xml",
    "connection": "doan_20210421.con.xml",
    "trafficLightSystem": "doan_20210421.tss.xml",
    "route": "dj_doan_mon_20210709_12th.rou.xml"
  },
  "parameter": {
    "minCellLength": 30,
    "vehLength": 5
  },
  "output": {
    "fileDir": "outputs.salt/doan4Train/",
    "period": 600,
    "level": "link",
    "save": 1
  }
}
```

24시간 수요

통계정보 수집 주기

Test

```
{
  "scenario": {
    "id": "doan",
    "time": {
      "begin": 0,
      "end": 7200
    },
  },
  "input": {
    "fileType": "SALT",
    "node": "doan_20210401.nod.xml",
    "link": "doan_20210401.edg.xml",
    "connection": "doan_20210421.con.xml",
    "trafficLightSystem": "doan_20210421.tss.xml",
    "route": "dj_doan_kaist_2h.rou.xml"
  },
  "parameter": {
    "minCellLength": 30,
    "vehLength": 5
  },
  "output": {
    "fileDir": "outputs.salt/doan/",
    "period": 600,
    "level": "link",
    "save": 1
  }
}
```

2시간 수요

State

- 차선별 세세한 정보
- 아래의 조합
 - [DPL] Density_per_lane
 - [NDPL] Neighbor_density_per_lane
 - [HDPL] halting_density_per_lane
 - [HRPL] halting_rate_per_lane

State #	Fields
0	DPL
1	DPL, NDPL
2	DPL, NDPL, HDPL
3	DPL, NDPL, HDPL, HRPL

Reward

- 해당 교차로에서의 Pressure, 대기시간, 평균속도 활용
 - 합, 평균,...
- 항목
 - Pressure : 현재 해당 교차로의 Pressure (* -1)
 - 대기시간(waiting time, WT) : 대기시간이 줄어든 경우 (+)
 - 링크별 WT의 합 `wt = libsalt.link.getAverageVehicleWaitingTime(linkID=linkid, cu`
 - (현재 WT) .vs. (이전 Cycle의 WT – 현재 Cycle의 WT)
 - 평균 속도(mean speed, MS)
 - 차선별 MS의 평균 `return libsalt.lane.getAverageVehicleSpeed(lane_id)`
 - (현재 MS) .vs. (현재 MS – 이전 MS)
- Todo
 - 이웃 교차로 고려
 - 전체 동일 비율: avg(자신, 이웃1, 이웃2,...)
 - 자신 50% + 이웃 50% : 실험 중

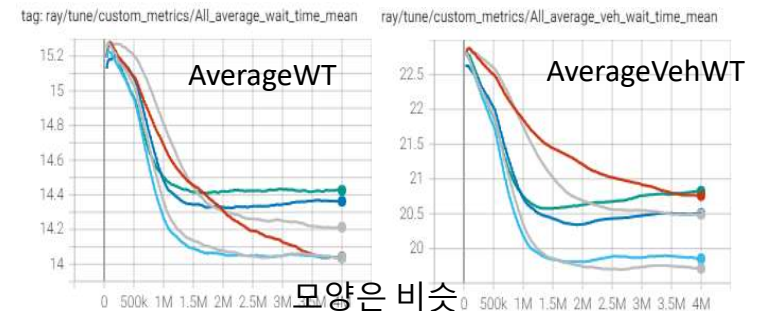
```
def getWaitingTimePerLink(self):  
    wt_list = []  
    last_cycle_start_time = self.next_action_time - self.cycle_length  
    for link_id in self.link_id_list:  
        wt = self.env.te_connector.getLinkAverageVehicleWaitingTime(link_id, self.env.currentSimulationStep, last_cycle_start_time)  
        wt_list.append(wt)  
    def getLinkAverageVehicleWaitingTime(self, linkid, current_step, from_time):  
        wt = libsalt.link.getAverageVehicleWaitingTime(linkID=linkid, currentStep=current_step, lastSwitchingTime=from_time)  
    return wt_list
```

Statistics Info

- 일정 주기로 수집하여 Episode 종료시 평균
 - stat_info_gathering_frequency : 100 step

- 필드

- Reward, average_wait_time, average_veh_wait_time, average_speed
- average_waiting_time
 - 링크별 평균 WT의 평균
 - libsalt.link.getAverageWaitingTime(linkid)
- average_veh_waiting_time
 - 링크별 차량 평균 WT의 평균
 - libsalt.link.getAverageVehicleWaitingTime(linkid, current_step, last_cycle_start_time)
- average_speed
 - 링크별 평균 속도의 평균
 - libsalt.link.getAverageSpeed(linkid)
- [ToDo] average_veh_speed
 - 링크별 차량 평균 속도의 평균
 - libsalt.link.getAverageVehicleSpeed(linkid)

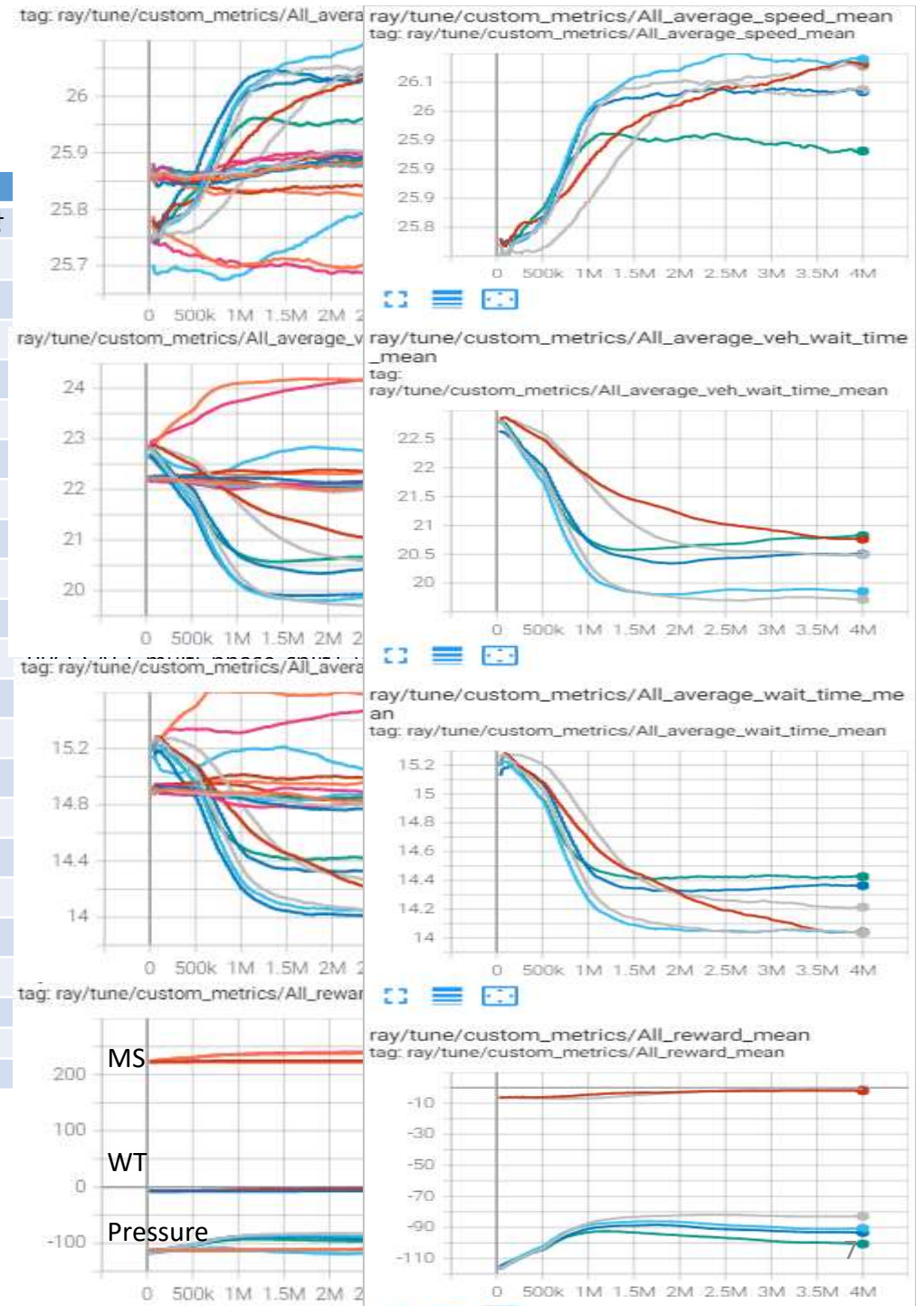


Action

- Phase Split
- [0] 현시별 일부 지속시간 교환(+,-)
 - 사이클 길이 보존
 - 현시별 지속시간 (-3, 0, 3) 조정
 - ToDo
 - 시간 교환 크기 조정하여 실험
 - (-5, 0, 5)
 - (-6, -3, 0, 3, 6)
 - (-10, -5, 0, 5, 10): 실험 진행
- [1] 각 신호 페이즈 비율에 따라 신호 분할
 - 사이클 길이 보존
 - 최소 녹색시간 만족하나 최대 녹색시간 초과 가능성 존재
 - 여분 시간을 비율에 따라 할당
- ...

실험

Exp#	split_mode	attention	reward	state	기타	그래프 모양	
						WT,MS	보상
0.0	0	FALSE	pressure	0	$\pm 3,0$	조금	
0.1	0			1	$\pm 3,0$	X	
0.2	1			0		좋은	수렴
0.3	1			1		좋은	수렴
1.0	0	FALSE	WT	0		조금	?
1.1	0			1		X	?
1.2	1			0		좋은	수렴
1.3	1			1		좋은	수렴
2.0	0	FALSE	MS	0		나쁨	
2.1	0			1		나쁨	
2.2	1			0		나쁨	
2.3	1			1		나쁨	
3.0	0	FALSE	pressure	2		X	
3.1	1			2		좋은	수렴
4.0	0	TRUE	pressure	1		X	
4.1	1			1		나쁨	
5.0	0	FALSE	pressure	0	차원 증가	조금	
5.1	0			1		조금	
5.2	1			0		좋은	수렴?
5.3	1			1		좋은	수렴?
6.0	0	FALSE	pressure	0	$\pm 10, \pm 5, 0$	좋은	수렴
6.1	0			1	$\pm 10, \pm 5, 0$	좋은	수렴



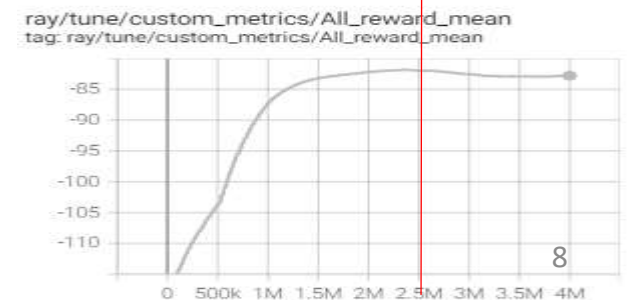
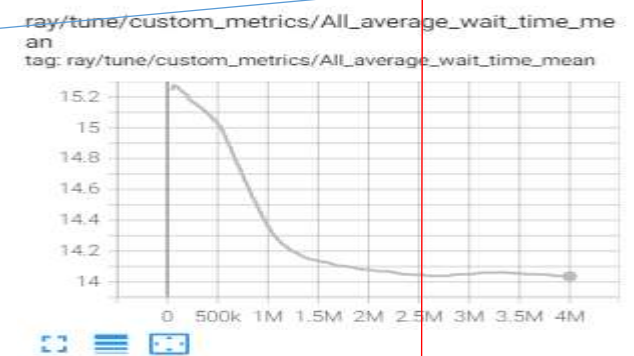
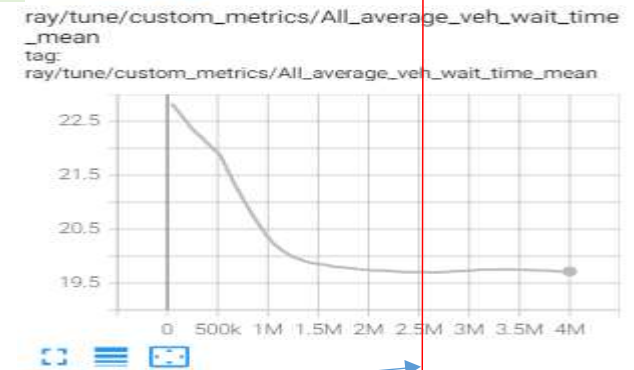
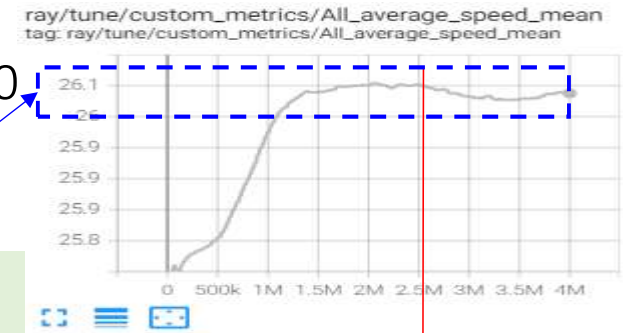
Exp-0.2 : split_mode 1, w/o attention, pressure, state 0

		static	Exp.0.2	대비 비율
Speed	Average	23.73	23.73	99.982%
평균	Doan_4	23.67	25.90	109.44%
속도	Doan12	26.68	26.57	99.58%
	Doan1Danji_4	25.35	24.38	96.21%
	Doan28_4	30.38	30.63	100.83%
	Doan5Danji_4	17.77	17.69	99.55%
	Doan9Danji_4	26.55	25.49	96.00%
	DoanSub_4	20.50	20.47	99.89%
	Insamol_4	21.20	21.32	100.57%
	Jinter_4	25.24	24.66	97.68%
	MokwonUniv_4	26.28	26.73	101.72%
	Sangda_4	24.24	24.43	100.79%
	Wongol_4	26.06	25.93	99.53%
	YusungMid_3	14.57	14.28	97.97%
		static	Exp.0.2	Exp.0.2
VWT	Average	25.82	24.91	94.42%
차량	Doan_4	29.32	19.93	67.97%
평균	Doan12	28.63	27.81	97.13%
대기	Doan1Danji_4	17.34	17.50	100.97%
시간	Doan28_4	22.22	20.17	90.77%
	Doan5Danji_4	47.91	49.84	104.03%
	Doan9Danji_4	12.99	12.73	97.97%
	DoanSub_4	35.50	34.51	97.21%
	Insamol_4	33.22	32.74	98.58%
	Jinter_4	28.53	33.31	116.77%
	MokwonUniv_4	17.59	19.38	110.19%
	Sangda_4	18.66	15.66	83.93%
	Wongol_4	38.55	36.76	95.35%
	YusungMid_3	5.22	3.48	66.61%
		static	Exp.0.2	Exp.0.2
WT	Average	14.84	15.25	106.11%
평균	Doan_4	21.55	17.55	81.45%
대기	Doan12	16.34	16.52	101.09%
시간	Doan1Danji_4	9.25	10.43	112.72%
	Doan28_4	15.01	14.10	93.92%
	Doan5Danji_4	27.46	28.52	103.88%
	Doan9Danji_4	6.05	9.16	151.59%
	DoanSub_4	18.24	20.16	110.48%
	Insamol_4	15.91	15.70	98.67%
	Jinter_4	16.24	17.79	109.56%
	MokwonUniv_4	8.94	10.10	112.94%
	Sangda_4	11.42	11.58	101.44%
	Wongol_4	20.13	20.08	99.73%
	YusungMid_3	6.41	6.53	101.96%

23.x .vs. 26.x

train과 test의 통계정보 차이는
수요가 다르기 때문이다.

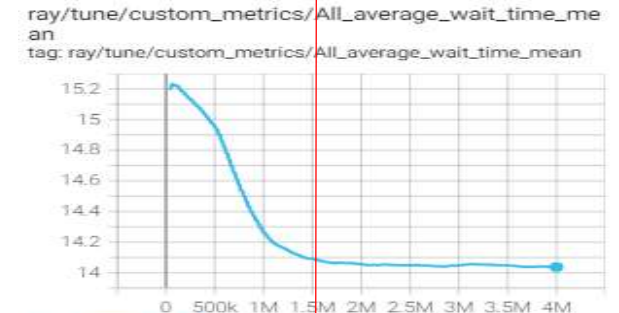
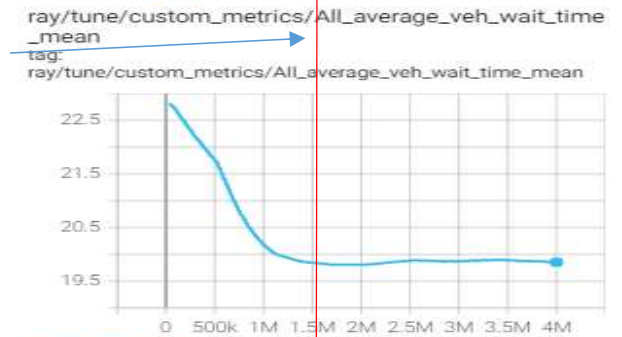
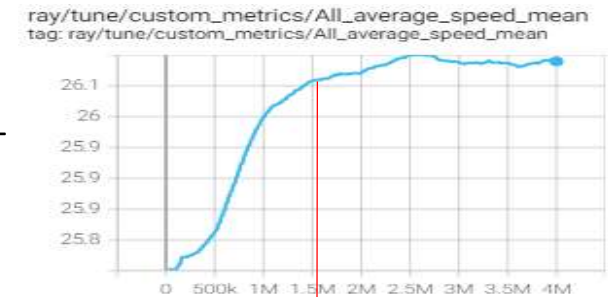
저장된 모델
CKPT 631



Exp-0.3 : split_mode 1, w/o attention, pressure, state 1

		static	Exp.0.3	대비비율
Speed	Average	23.73	23.82	100.544%
평균	Doan_4	23.67	26.13	110.42%
속도	Doan12	26.68	26.30	98.57%
	Doan1Danji_4	25.35	24.15	95.30%
	Doan28_4	30.38	30.79	101.35%
	Doan5Danji_4	17.77	17.84	100.42%
	Doan9Danji_4	26.55	25.41	95.70%
	DoanSub_4	20.50	20.81	101.55%
	Insamol_4	21.20	21.31	100.51%
	Jinter_4	25.24	25.01	99.06%
	MokwonUniv_4	26.28	26.83	102.11%
	Sangda_4	24.24	24.23	99.98%
	Wongol_4	26.06	26.02	99.85%
	YusungMid_3	14.57	14.90	102.24%
		static	Exp.0.3	Exp.0.3
VWT	Average	25.82	24.30	91.70%
차량	Doan_4	29.32	19.73	67.28%
평균	Doan12	28.63	29.67	103.65%
대기	Doan1Danji_4	17.34	18.64	107.52%
시간	Doan28_4	22.22	18.87	84.93%
	Doan5Danji_4	47.91	47.77	99.71%
	Doan9Danji_4	12.99	9.03	69.53%
	DoanSub_4	35.50	34.62	97.54%
	Insamol_4	33.22	31.57	95.06%
	Jinter_4	28.53	31.96	112.01%
	MokwonUniv_4	17.59	19.58	111.33%
	Sangda_4	18.66	14.23	76.26%
	Wongol_4	38.55	36.40	94.43%
	YusungMid_3	5.22	3.81	72.92%
		static	Exp.0.3	Exp.0.3
WT	Average	14.84	14.94	100.70%
평균	Doan_4	21.55	17.70	82.12%
대기	Doan12	16.34	17.69	108.24%
시간	Doan1Danji_4	9.25	10.37	112.09%
	Doan28_4	15.01	13.92	92.70%
	Doan5Danji_4	27.46	28.31	103.12%
	Doan9Danji_4	6.05	5.39	89.12%
	DoanSub_4	18.24	19.33	105.98%
	Insamol_4	15.91	15.78	99.21%
	Jinter_4	16.24	17.96	110.59%
	MokwonUniv_4	8.94	9.46	105.86%
	Sangda_4	11.42	11.28	98.79%
	Wongol_4	20.13	20.68	102.74%
	YusungMid_3	6.41	6.32	98.57%

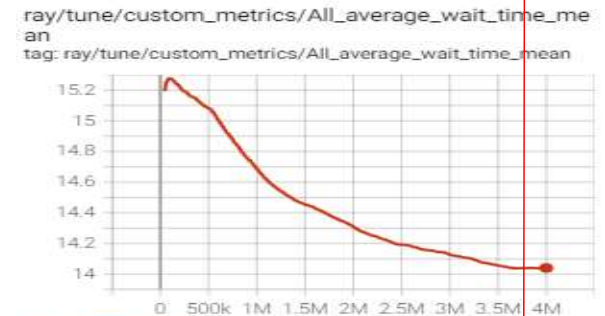
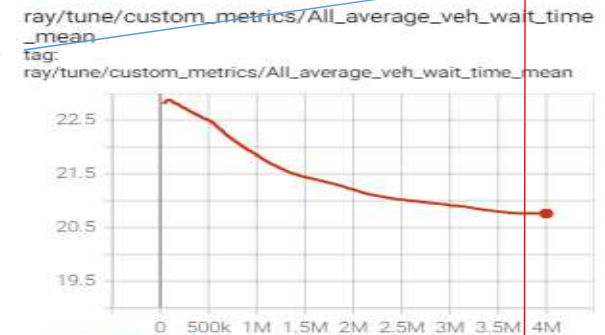
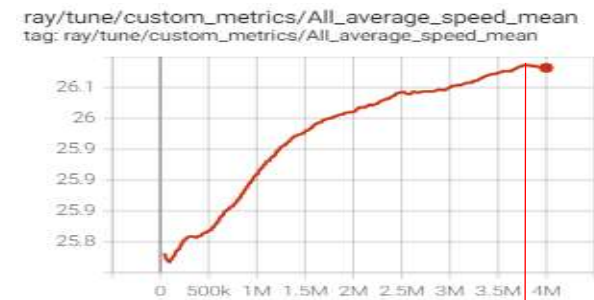
CKPT 627



Exp-1.2 : split_mode 1, w/o attention, WT, state 0

		static	Exp.1.2	대비비율
Speed	Average	23.73	23.79	100.211%
평균	Doan_4	23.67	24.23	102.38%
속도	Doan12	26.68	26.61	99.74%
	Doan1Danji_4	25.35	24.90	98.26%
	Doan28_4	30.38	30.88	101.66%
	Doan5Danji_4	17.77	17.64	99.28%
	Doan9Danji_4	26.55	26.76	100.79%
	DoanSub_4	20.50	20.35	99.26%
	Insamol_4	21.20	21.43	101.09%
	Jinter_4	25.24	25.08	99.37%
	MokwonUniv_4	26.28	26.45	100.67%
	Sangda_4	24.24	24.45	100.88%
	Wongol_4	26.06	25.86	99.24%
	YusungMid_3	14.57	14.59	100.12%
		static	Exp.1.2	Exp.1.2
VWT	Average	25.82	24.88	94.56%
차량	Doan_4	29.32	22.14	75.51%
평균	Doan12	28.63	27.93	97.55%
대기	Doan1Danji_4	17.34	18.46	106.47%
시간	Doan28_4	22.22	19.36	87.10%
	Doan5Danji_4	47.91	48.04	100.27%
	Doan9Danji_4	12.99	12.07	92.91%
	DoanSub_4	35.50	36.93	104.03%
	Insamol_4	33.22	32.23	97.04%
	Jinter_4	28.53	29.23	102.44%
	MokwonUniv_4	17.59	20.23	115.03%
	Sangda_4	18.66	16.11	86.31%
	Wongol_4	38.55	37.13	96.32%
	YusungMid_3	5.22	3.57	68.35%
		static	Exp.1.2	Exp.1.2
WT	Average	14.84	14.62	99.01%
평균	Doan_4	21.55	19.55	90.74%
대기	Doan12	16.34	15.91	97.34%
시간	Doan1Danji_4	9.25	10.44	112.77%
	Doan28_4	15.01	14.03	93.49%
	Doan5Danji_4	27.46	28.50	103.80%
	Doan9Danji_4	6.05	6.05	100.06%
	DoanSub_4	18.24	18.31	100.37%
	Insamol_4	15.91	15.51	97.48%
	Jinter_4	16.24	14.85	91.49%
	MokwonUniv_4	8.94	10.04	112.77%
	Sangda_4	11.42	11.33	99.22%
	Wongol_4	20.13	19.74	98.07%
	YusungMid_3	6.41	5.77	90.08%

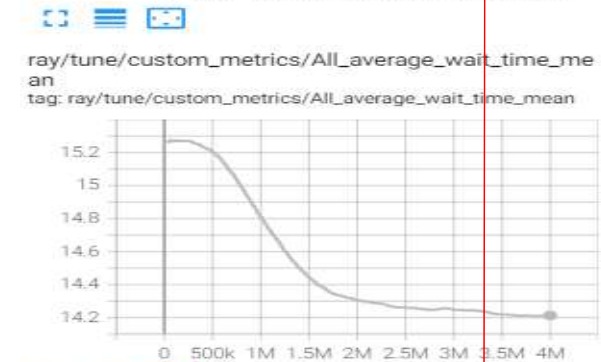
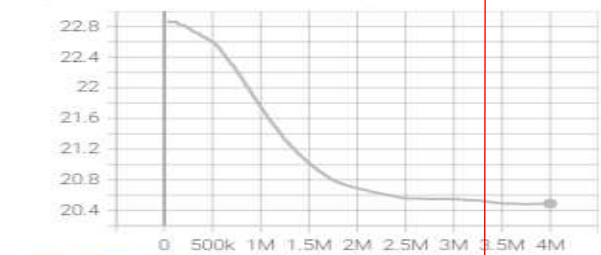
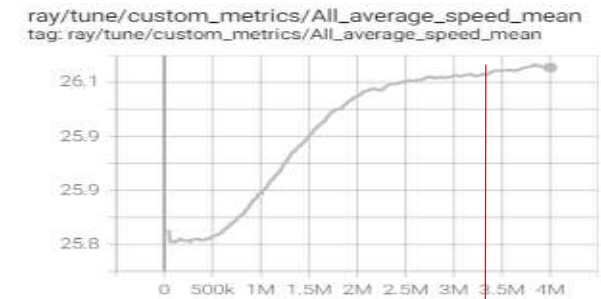
CKPT 945



Exp-1.3 : split_mode 1, w/o attention, WT, state 1

		static	Exp.1.3	대비비율
Speed	Average	23.73	23.83	100.456%
평균	<u>Doan_4</u>	23.67	24.95	105.42%
속도	Doan12	26.68	26.66	99.92%
	Doan1Danji.4	25.35	24.97	98.53%
	Doan28.4	30.38	30.72	101.12%
	Doan5Danji.4	17.77	17.73	99.77%
	Doan9Danji.4	26.55	26.32	99.16%
	<u>DoanSub_4</u>	20.50	21.09	102.88%
	<u>Insamol_4</u>	21.20	21.05	99.31%
	<u>Jinter_4</u>	25.24	25.34	100.39%
	<u>MokwonUniv_4</u>	26.28	26.03	99.05%
	<u>Sangda_4</u>	24.24	24.41	100.71%
	<u>Wongol_4</u>	26.06	26.09	100.13%
	<u>YusungMid_3</u>	14.57	14.51	99.55%
		static	Exp.1.3	Exp.1.3
VWT	Average	25.82	24.83	95.29%
차량	<u>Doan_4</u>	29.32	19.54	66.65%
평균	Doan12	28.63	30.01	104.83%
대기	Doan1Danji.4	17.34	20.35	117.40%
시간	Doan28.4	22.22	19.84	89.25%
	Doan5Danji.4	47.91	47.89	99.96%
	Doan9Danji.4	12.99	11.27	86.69%
	<u>DoanSub_4</u>	35.50	33.47	94.29%
	<u>Insamol_4</u>	33.22	31.29	94.20%
	<u>Jinter_4</u>	28.53	31.70	111.10%
	<u>MokwonUniv_4</u>	17.59	18.42	104.70%
	<u>Sangda_4</u>	18.66	16.74	89.70%
	<u>Wongol_4</u>	38.55	38.00	98.56%
	<u>YusungMid_3</u>	5.22	4.25	81.46%
		static	Exp.1.3	Exp.1.3
WT	Average	14.84	14.63	99.30%
평균	<u>Doan_4</u>	21.55	17.54	81.41%
대기	Doan12	16.34	16.74	102.41%
시간	Doan1Danji.4	9.25	10.40	112.38%
	Doan28.4	15.01	14.36	95.64%
	Doan5Danji.4	27.46	28.54	103.96%
	Doan9Danji.4	6.05	6.12	101.17%
	<u>DoanSub_4</u>	18.24	17.64	96.69%
	<u>Insamol_4</u>	15.91	14.94	93.88%
	<u>Jinter_4</u>	16.24	16.62	102.36%
	<u>MokwonUniv_4</u>	8.94	9.38	104.97%
	<u>Sangda_4</u>	11.42	10.57	92.58%
	<u>Wongol_4</u>	20.13	21.06	104.65%
	<u>YusungMid_3</u>	6.41	6.33	98.76%

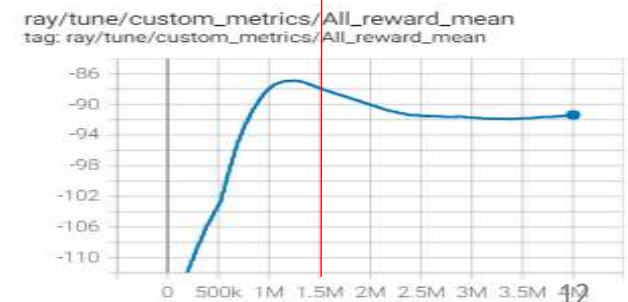
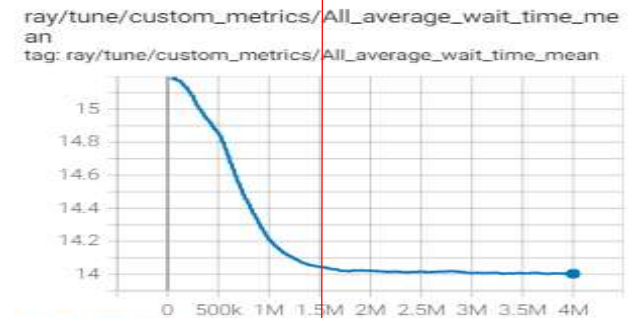
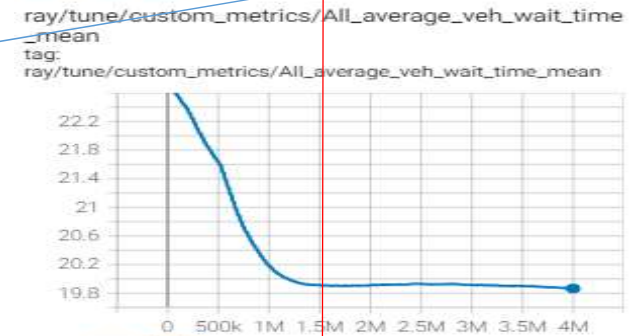
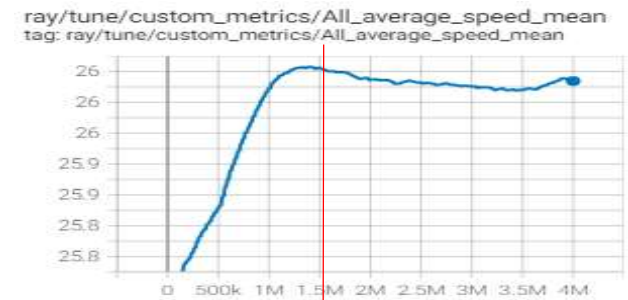
CKPT 838



Exp-3.1 : split_mode 1, w/o attention, pressure, state 2

		static	Exp.3.1	대비비율
Speed	Average	23.73	23.83	100.211%
평균	Doan_4	23.67	26.65	112.62%
속도	Doan12	26.68	26.41	98.99%
	Doan1Danji_4	25.35	24.57	96.92%
	Doan28_4	30.38	30.96	101.94%
	Doan5Danji_4	17.77	17.84	100.42%
	Doan9Danji_4	26.55	25.70	96.82%
	DoanSub_4	20.50	20.25	98.79%
	Insamol_4	21.20	21.21	100.06%
	Jinter_4	25.24	25.04	99.18%
	MokwonUniv_4	26.28	27.00	102.75%
	Sangda_4	24.24	24.72	101.99%
	Wongol_4	26.06	26.07	100.06%
	YusungMid_3	14.57	13.43	92.19%
VWT	Average	25.82	24.17	90.79%
차량	Doan_4	29.32	18.96	64.67%
평균	Doan12	28.63	27.40	95.72%
대기	Doan1Danji_4	17.34	17.33	99.96%
시간	Doan28_4	22.22	19.15	86.17%
	Doan5Danji_4	47.91	49.42	103.16%
	Doan9Danji_4	12.99	11.55	88.89%
	DoanSub_4	35.50	33.86	95.38%
	Insamol_4	33.22	33.23	100.05%
	Jinter_4	28.53	33.14	116.15%
	MokwonUniv_4	17.59	14.44	82.10%
	Sangda_4	18.66	15.22	81.57%
	Wongol_4	38.55	36.75	95.31%
	YusungMid_3	5.22	3.72	71.18%
WT	Average	14.84	14.76	99.86%
평균	Doan_4	21.55	17.07	79.24%
대기	Doan12	16.34	16.58	101.44%
시간	Doan1Danji_4	9.25	10.05	108.59%
	Doan28_4	15.01	14.05	93.57%
	Doan5Danji_4	27.46	28.93	105.37%
	Doan9Danji_4	6.05	6.54	108.11%
	DoanSub_4	18.24	19.43	106.51%
	Insamol_4	15.91	15.97	100.39%
	Jinter_4	16.24	17.75	109.33%
	MokwonUniv_4	8.94	7.76	86.83%
	Sangda_4	11.42	11.01	96.45%
	Wongol_4	20.13	20.11	99.88%
	YusungMid_3	6.41	6.56	102.43%

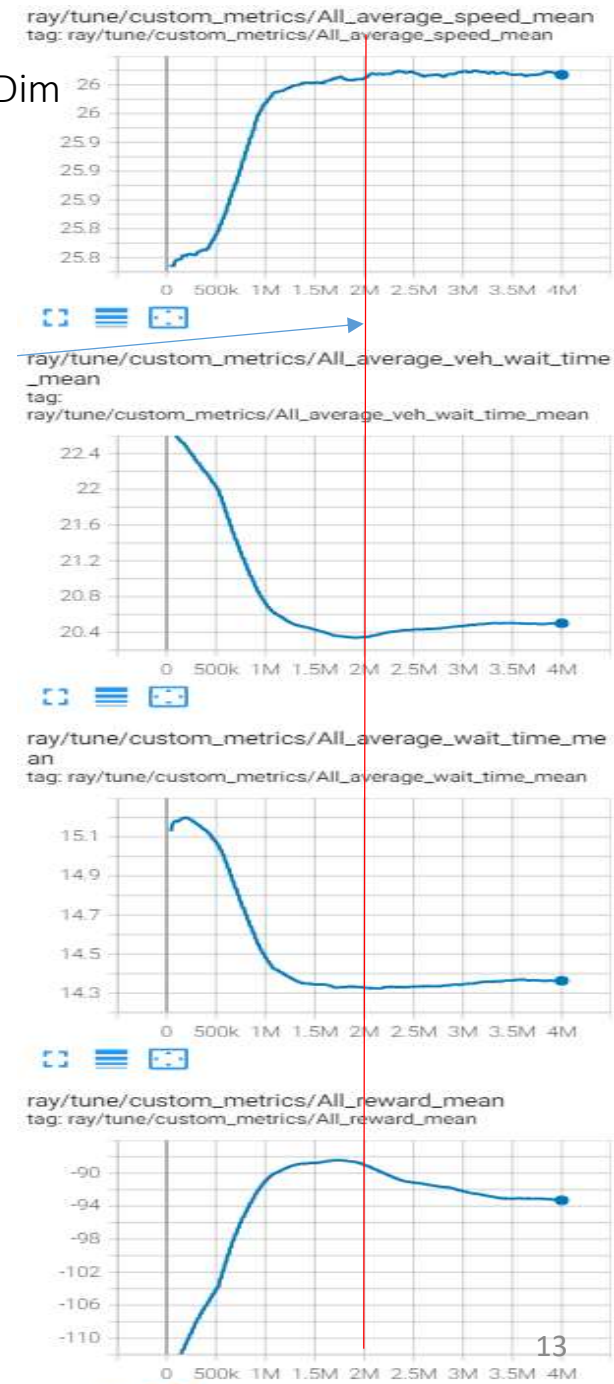
CKPT 375



Exp-5.2 : split_mode 1, w/o attention, pressure, state 0, increaseDim

		static	Exp.5.2	대비비율
Speed	Average	23.73	23.76	99.980%
평균	<u>Doan_4</u>	23.67	26.47	111.83%
속도	Doan12	26.68	26.48	99.25%
	Doan1Danji_4	25.35	24.67	97.32%
	Doan28_4	30.38	30.78	101.34%
	Doan5Danji_4	17.77	17.77	100.03%
	Doan9Danji_4	26.55	25.76	97.05%
	<u>DoanSub_4</u>	20.50	20.89	101.91%
	<u>Insamol_4</u>	21.20	20.75	97.90%
	<u>Jinter_4</u>	25.24	24.24	96.03%
	<u>MokwonUniv_4</u>	26.28	26.90	102.37%
	<u>Sangda_4</u>	24.24	24.50	101.11%
	<u>Wongol_4</u>	26.06	25.96	99.65%
	<u>YusungMid_3</u>	14.57	13.69	93.96%
		static	Exp.5.2	Exp.5.2
VWT	Average	25.82	24.49	92.52%
차량	<u>Doan_4</u>	29.32	19.07	65.03%
평균	Doan12	28.63	28.14	98.29%
대기	Doan1Danji_4	17.34	18.21	105.03%
시간	Doan28_4	22.22	18.44	82.97%
	Doan5Danji_4	47.91	48.81	101.89%
	Doan9Danji_4	12.99	10.89	83.83%
	<u>DoanSub_4</u>	35.50	32.03	90.22%
	<u>Insamol_4</u>	33.22	30.78	92.67%
	<u>Jinter_4</u>	28.53	34.05	119.34%
	<u>MokwonUniv_4</u>	17.59	21.27	120.93%
	<u>Sangda_4</u>	18.66	15.54	83.25%
	<u>Wongol_4</u>	38.55	37.92	98.37%
	<u>YusungMid_3</u>	5.22	3.18	60.93%
		static	Exp.5.2	Exp.5.2
WT	Average	14.84	14.75	99.66%
평균	<u>Doan_4</u>	21.55	17.39	80.72%
대기	Doan12	16.34	17.46	106.80%
시간	Doan1Danji_4	9.25	10.18	110.04%
	Doan28_4	15.01	13.37	89.08%
	Doan5Danji_4	27.46	27.87	101.49%
	Doan9Danji_4	6.05	6.10	100.93%
	<u>DoanSub_4</u>	18.24	18.35	100.60%
	<u>Insamol_4</u>	15.91	15.58	97.94%
	<u>Jinter_4</u>	16.24	18.29	112.63%
	<u>MokwonUniv_4</u>	8.94	10.40	116.34%
	<u>Sangda_4</u>	11.42	10.74	94.03%
	<u>Wongol_4</u>	20.13	20.81	103.41%
	<u>YusungMid_3</u>	6.41	5.22	81.52%

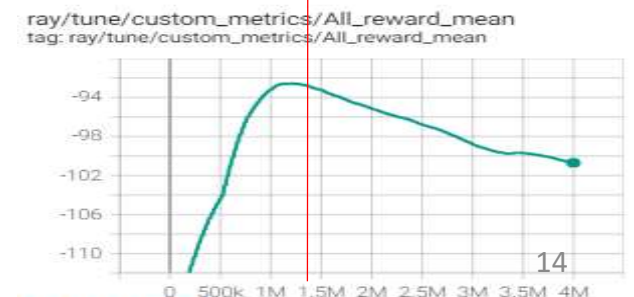
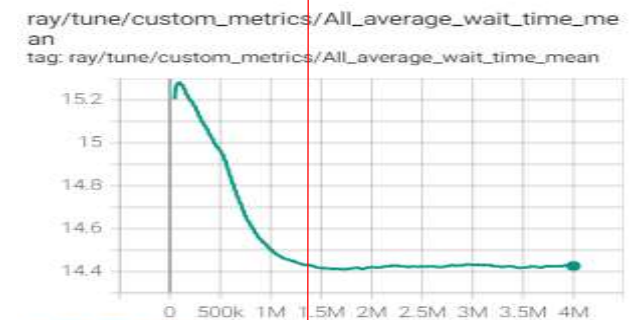
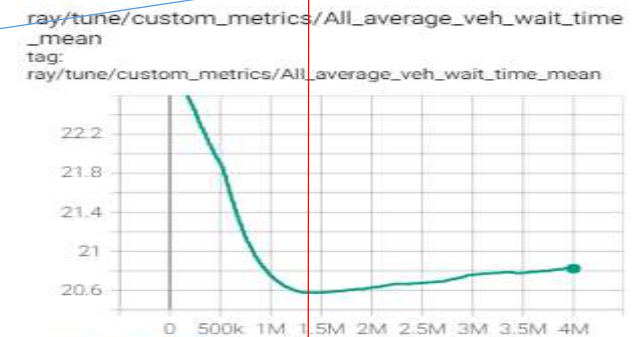
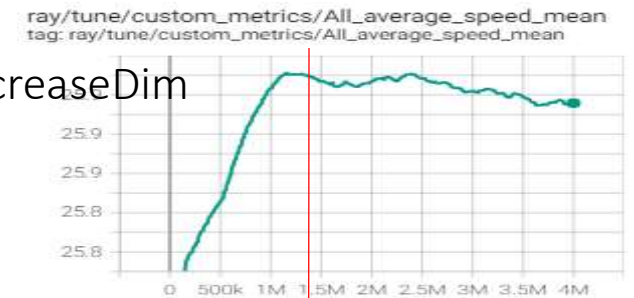
CKPT 500



Exp-5.3 : split_mode 1, w/o attention, pressure, state 1, increasedDim

		static	Exp.5.3	대비비율
Speed	Average	23.73	23.81	100.157%
평균	<u>Doan_4</u>	23.67	25.85	109.21%
속도	<u>Doan12</u>	26.68	26.47	99.24%
	<u>Doan1Danji_4</u>	25.35	24.95	98.46%
	<u>Doan28_4</u>	30.38	30.64	100.88%
	<u>Doan5Danji_4</u>	17.77	17.72	99.73%
	<u>Doan9Danji_4</u>	26.55	26.70	100.56%
	<u>DoanSub_4</u>	20.50	20.27	98.92%
	<u>Insamol_4</u>	21.20	20.91	98.63%
	<u>Jinter_4</u>	25.24	25.29	100.18%
	<u>MokwonUniv_4</u>	26.28	26.34	100.26%
	<u>Sangda_4</u>	24.24	24.49	101.03%
	<u>Wongol_4</u>	26.06	26.10	100.18%
	<u>YusungMid_3</u>	14.57	13.81	94.76%
		static	Exp.5.3	Exp.5.3
VWT	Average	25.82	24.60	94.56%
차량	<u>Doan_4</u>	29.32	19.09	65.10%
평균	<u>Doan12</u>	28.63	25.47	88.96%
대기	<u>Doan1Danji_4</u>	17.34	20.10	115.97%
시간	<u>Doan28_4</u>	22.22	19.34	87.01%
	<u>Doan5Danji_4</u>	47.91	49.49	103.30%
	<u>Doan9Danji_4</u>	12.99	11.35	87.34%
	<u>DoanSub_4</u>	35.50	33.57	94.57%
	<u>Insamol_4</u>	33.22	31.36	94.40%
	<u>Jinter_4</u>	28.53	31.04	108.79%
	<u>MokwonUniv_4</u>	17.59	19.72	112.12%
	<u>Sangda_4</u>	18.66	16.59	88.90%
	<u>Wongol_4</u>	38.55	38.34	99.45%
	<u>YusungMid_3</u>	5.22	4.36	83.41%
		static	Exp.5.3	Exp.5.3
WT	Average	14.84	14.90	101.69%
평균	<u>Doan_4</u>	21.55	17.23	79.95%
대기	<u>Doan12</u>	16.34	16.27	99.52%
시간	<u>Doan1Danji_4</u>	9.25	10.26	110.91%
	<u>Doan28_4</u>	15.01	14.31	95.35%
	<u>Doan5Danji_4</u>	27.46	28.12	102.43%
	<u>Doan9Danji_4</u>	6.05	5.61	92.76%
	<u>DoanSub_4</u>	18.24	19.43	106.50%
	<u>Insamol_4</u>	15.91	16.07	100.98%
	<u>Jinter_4</u>	16.24	16.99	104.63%
	<u>MokwonUniv_4</u>	8.94	10.04	112.30%
	<u>Sangda_4</u>	11.42	12.39	108.48%
	<u>Wongol_4</u>	20.13	20.04	99.57%
	<u>YusungMid_3</u>	6.41	6.96	108.55%

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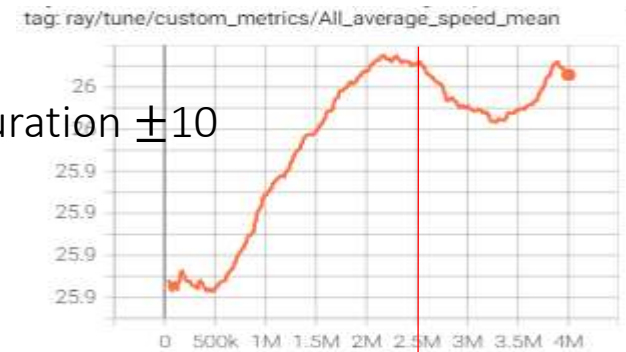


Exp-6.0 : split_mode 0, w/o attention, pressure, state 0, duration ± 10

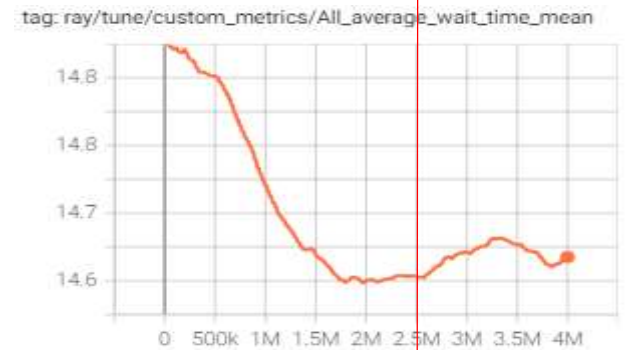
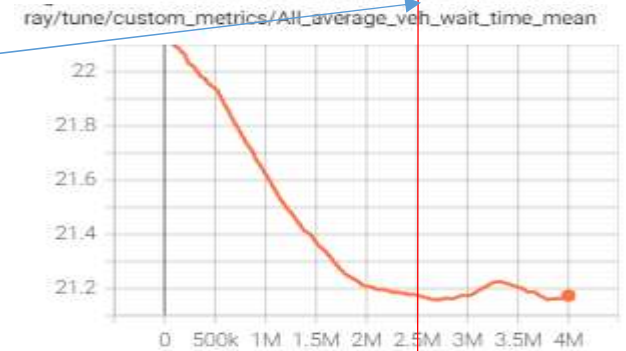
static			Exp 6.0	대비비율
Speed	Average	23.73	23.78	100.140%
평균	Doan.4	23.67	24.58	103.86%
속도	Doan12	26.68	26.82	100.55%
	Doan1Danji.4	25.35	25.61	101.03%
	Doan28.4	30.38	30.35	99.92%
	Doan5Danji.4	17.77	17.73	99.78%
	Doan9Danji.4	26.55	26.46	99.68%
	DoanSub.4	20.50	20.55	100.25%
	Insamol.4	21.20	20.97	98.93%
	Jinter.4	25.24	24.96	98.87%
	MokwonUniv.4	26.28	26.64	101.39%
	Sangda.4	24.24	24.35	100.47%
	Wongol.4	26.06	26.00	99.79%
	YusungMid.3	14.57	14.18	97.30%

static			Exp 6.0	Exp 6.0
VWT	Average	25.82	25.09	96.20%
차량	Doan.4	29.32	24.81	84.60%
평균	Doan12	28.63	27.87	97.34%
대기	Doan1Danji.4	17.34	17.34	100.00%
시간	Doan28.4	22.22	20.71	93.20%
	Doan5Danji.4	47.91	48.86	102.00%
	Doan9Danji.4	12.99	12.44	95.73%
	DoanSub.4	35.50	36.04	101.52%
	Insamol.4	33.22	32.67	98.36%
	Jinter.4	28.53	29.58	103.69%
	MokwonUniv.4	17.59	15.76	89.59%
	Sangda.4	18.66	16.12	86.35%
	Wongol.4	38.55	38.91	100.93%
	YusungMid.3	5.22	5.08	97.33%

static			Exp 6.0	Exp 6.0
WT	Average	14.84	14.92	100.29%
평균	Doan.4	21.55	18.92	87.78%
대기	Doan12	16.34	16.76	102.52%
시간	Doan1Danji.4	9.25	9.51	102.81%
	Doan28.4	15.01	14.76	98.29%
	Doan5Danji.4	27.46	28.38	103.37%
	Doan9Danji.4	6.05	6.38	105.54%
	DoanSub.4	18.24	20.38	111.73%
	Insamol.4	15.91	16.03	100.77%
	Jinter.4	16.24	17.82	109.75%
	MokwonUniv.4	8.94	7.54	84.38%
	Sangda.4	11.42	10.47	91.65%
	Wongol.4	20.13	20.36	101.13%
	YusungMid.3	6.41	6.67	104.05%

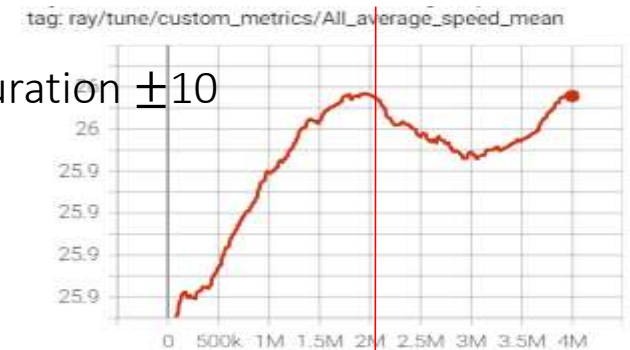


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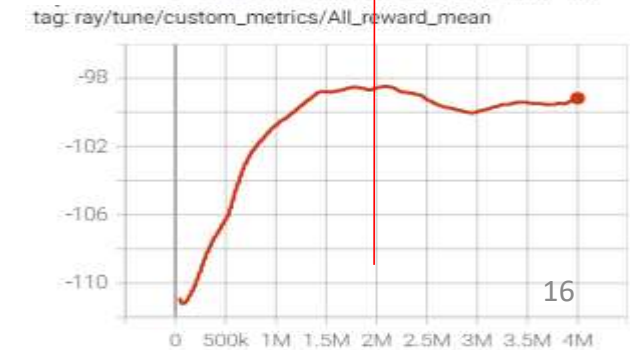
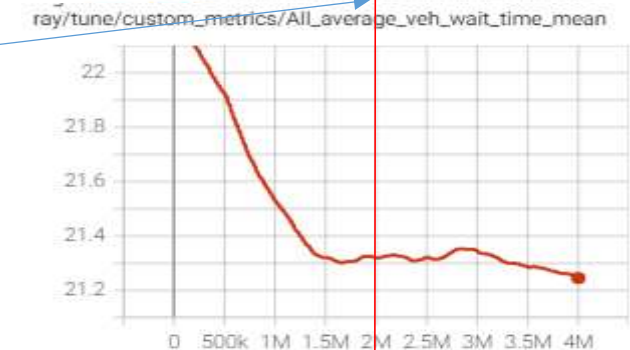


Exp-6.1 : split_mode 0, w/o attention, pressure, state 1, duration ± 10

		static	Exp.6.1	대비비율
Speed	Average	23.73	23.67	99.689%
평균	Doan.4	23.67	24.27	102.55%
속도	Doan12	26.68	26.40	98.95%
	Doan1Danji.4	25.35	25.21	99.47%
	Doan28.4	30.38	30.53	100.50%
	Doan5Danji.4	17.77	17.74	99.87%
	Doan9Danji.4	26.55	25.47	95.94%
	DoanSub.4	20.50	20.68	100.91%
	Insamol.4	21.20	21.27	100.33%
	Jinter.4	25.24	25.52	101.09%
	MokwonUniv.4	26.28	26.28	99.99%
	Sangda.4	24.24	24.32	100.36%
	Wongol.4	26.06	25.90	99.39%
	YusungMid.3	14.57	14.08	96.61%
		static	Exp.6.1	Exp.6.1
VWT	Average	25.82	25.20	96.20%
차량	Doan.4	29.32	26.54	90.51%
평균	Doan12	28.63	28.02	97.88%
대기	Doan1Danji.4	17.34	18.61	107.34%
시간	Doan28.4	22.22	20.06	90.29%
	Doan5Danji.4	47.91	49.03	102.35%
	Doan9Danji.4	12.99	11.92	91.71%
	DoanSub.4	35.50	35.77	100.75%
	Insamol.4	33.22	30.51	91.86%
	Jinter.4	28.53	28.85	101.14%
	MokwonUniv.4	17.59	17.62	100.20%
	Sangda.4	18.66	17.30	92.68%
	Wongol.4	38.55	39.08	101.37%
	YusungMid.3	5.22	4.31	82.58%
		static	Exp.6.1	Exp.6.1
WT	Average	14.84	14.75	99.26%
평균	Doan.4	21.55	20.29	94.14%
대기	Doan12	16.34	16.77	102.58%
시간	Doan1Danji.4	9.25	10.16	109.77%
	Doan28.4	15.01	13.68	91.12%
	Doan5Danji.4	27.46	27.97	101.88%
	Doan9Danji.4	6.05	6.37	105.39%
	DoanSub.4	18.24	18.84	103.27%
	Insamol.4	15.91	15.05	94.61%
	Jinter.4	16.24	16.17	99.59%
	MokwonUniv.4	8.94	8.44	94.37%
	Sangda.4	11.42	11.77	103.10%
	Wongol.4	20.13	20.52	101.92%
	YusungMid.3	6.41	5.68	88.65%



CKPT 500



최근 600초 동안의 대기시간을 100초 주기로 수집

평균속도 : libsalt.link.getAverageSpeed(linkid)

		static	Exp.0.2	Exp.0.3	Exp.1.2	Exp.1.3	Exp.3.1	Exp.5.2	Exp.5.3	Exp.6.0	Exp.6.1
Speed	Average	23.73	23.73	23.82	23.79	23.83	23.83	23.76	23.81	23.78	23.67
평균	Doan.4	23.67	25.90	26.13	24.23	24.95	26.65	26.47	25.85	24.58	24.27
속도	Doan12	26.68	26.57	26.30	26.61	26.66	26.41	26.48	26.47	26.82	26.40
	Doan1Danji.4	25.35	24.38	24.15	24.90	24.97	24.57	24.67	24.95	25.61	25.21
	Doan28.4	30.38	30.63	30.79	30.88	30.72	30.96	30.78	30.64	30.35	30.53
	Doan5Danji.4	17.77	17.69	17.84	17.64	17.73	17.84	17.77	17.72	17.73	17.74
	Doan9Danji.4	26.55	25.49	25.41	26.76	26.32	25.70	25.76	26.70	26.46	25.47
	DoanSub.4	20.50	20.47	20.81	20.35	21.09	20.25	20.89	20.27	20.55	20.68
	Insamol.4	21.20	21.32	21.31	21.43	21.05	21.21	20.75	20.91	20.97	21.27
	Jinter.4	25.24	24.66	25.01	25.08	25.34	25.04	24.24	25.29	24.96	25.52
	MokwonUniv.4	26.28	26.73	26.83	26.45	26.03	27.00	26.90	26.34	26.64	26.28
	Sangda.4	24.24	24.43	24.23	24.45	24.41	24.72	24.50	24.49	24.35	24.32
	Wongol.4	26.06	25.93	26.02	25.86	26.09	26.07	25.96	26.10	26.00	25.90
	YusungMid.3	14.57	14.28	14.90	14.59	14.51	13.43	13.69	13.81	14.18	14.08

Static 대비 비율		Exp.0.2	Exp.0.3	Exp.1.2	Exp.1.3	Exp.3.1	Exp.5.2	Exp.5.3	Exp.6.0	Exp.6.1
Speed	Average	99.982%	100.544%	100.211%	100.456%	100.211%	99.980%	100.157%	100.140%	99.689%
평균	Doan.4	109.44%	110.42%	102.38%	105.42%	112.62%	111.83%	109.21%	103.86%	102.55%
속도	Doan12	99.58%	98.57%	99.74%	99.92%	98.99%	99.25%	99.24%	100.55%	98.95%
	Doan1Danji.4	96.21%	95.30%	98.26%	98.53%	96.92%	97.32%	98.46%	101.03%	99.47%
	Doan28.4	100.83%	101.35%	101.66%	101.12%	101.94%	101.34%	100.88%	99.92%	100.50%
	Doan5Danji.4	99.55%	100.42%	99.28%	99.77%	100.42%	100.03%	99.73%	99.78%	99.87%
	Doan9Danji.4	96.00%	95.70%	100.79%	99.16%	96.82%	97.05%	100.56%	99.68%	95.94%
	DoanSub.4	99.89%	101.55%	99.26%	102.88%	98.79%	101.91%	98.92%	100.25%	100.91%
	Insamol.4	100.57%	100.51%	101.09%	99.31%	100.06%	97.90%	98.63%	98.93%	100.33%
	Jinter.4	97.68%	99.06%	99.37%	100.39%	99.18%	96.03%	100.18%	98.87%	101.09%
	MokwonUniv.4	101.72%	102.11%	100.67%	99.05%	102.75%	102.37%	100.26%	101.39%	99.99%
	Sangda.4	100.79%	99.98%	100.88%	100.71%	101.99%	101.11%	101.03%	100.47%	100.36%
	Wongol.4	99.53%	99.85%	99.24%	100.13%	100.06%	99.65%	100.18%	99.79%	99.39%
	YusungMid.3	97.97%	102.24%	100.12%	99.55%	92.19%	93.96%	94.76%	97.30%	96.61%

거의 유사

사이클 시작 이후 대기시간

대기시간 : libsalt.link.getAverageVehicleWaitingTime(linkid, current_step, last_cycle_start_time)

		static	Exp.0.2	Exp.0.3	Exp.1.2	Exp.1.3	Exp.3.1	Exp.5.2	Exp.5.3	Exp.6.0	Exp.6.1
VWT	Average	25.82	24.91	24.30	24.88	24.83	24.17	24.49	24.60	25.09	25.20
차량	Doan.4	29.32	19.93	19.73	22.14	19.54	18.96	19.07	19.09	24.81	26.54
평균	Doan12	28.63	27.81	29.67	27.93	30.01	27.40	28.14	25.47	27.87	28.02
대기	Doan1Danji.4	17.34	17.50	18.64	18.46	20.35	17.33	18.21	20.10	17.34	18.61
시간	Doan28.4	22.22	20.17	18.87	19.36	19.84	19.15	18.44	19.34	20.71	20.06
	Doan5Danji.4	47.91	49.84	47.77	48.04	47.89	49.42	48.81	49.49	48.86	49.03
	Doan9Danji.4	12.99	12.73	9.03	12.07	11.27	11.55	10.89	11.35	12.44	11.92
	DoanSub.4	35.50	34.51	34.62	36.93	33.47	33.86	32.03	33.57	36.04	35.77
	Insamol.4	33.22	32.74	31.57	32.23	31.29	33.23	30.78	31.36	32.67	30.51
	Jinter.4	28.53	33.31	31.96	29.23	31.70	33.14	34.05	31.04	29.58	28.85
	MokwonUniv.4	17.59	19.38	19.58	20.23	18.42	14.44	21.27	19.72	15.76	17.62
	Sangda.4	18.66	15.66	14.23	16.11	16.74	15.22	15.54	16.59	16.12	17.30
	Wongol.4	38.55	36.76	36.40	37.13	38.00	36.75	37.92	38.34	38.91	39.08
	YusungMid.3	5.22	3.48	3.81	3.57	4.25	3.72	3.18	4.36	5.08	4.31

Static 대비 비율		Exp.0.2	Exp.0.3	Exp.1.2	Exp.1.3	Exp.3.1	Exp.5.2	Exp.5.3	Exp.6.0	Exp.6.1
VWT	Average	94.42%	91.70%	94.56%	95.29%	90.79%	92.52%	94.56%	96.20%	96.20%
차량	Doan.4	67.97%	67.28%	75.51%	66.65%	64.67%	65.03%	65.10%	84.60%	90.51%
평균	Doan12	97.13%	103.65%	97.55%	104.83%	95.72%	98.29%	88.96%	97.34%	97.88%
대기	Doan1Danji.4	100.97%	107.52%	106.47%	117.40%	99.96%	105.03%	115.97%	100.00%	107.34%
시간	Doan28.4	90.77%	84.93%	87.10%	89.25%	86.17%	82.97%	87.01%	93.20%	90.29%
	Doan5Danji.4	104.03%	99.71%	100.27%	99.96%	103.16%	101.89%	103.30%	102.00%	102.35%
	Doan9Danji.4	97.97%	69.53%	92.91%	86.69%	88.89%	83.83%	87.34%	95.73%	91.71%
	DoanSub.4	97.21%	97.54%	104.03%	94.29%	95.38%	90.22%	94.57%	101.52%	100.75%
	Insamol.4	98.58%	95.06%	97.04%	94.20%	100.05%	92.67%	94.40%	98.36%	91.86%
	Jinter.4	116.77%	112.01%	102.44%	111.10%	116.15%	119.34%	108.79%	103.69%	101.14%
	MokwonUniv.4	110.19%	111.33%	115.03%	104.70%	82.10%	120.93%	112.12%	89.59%	100.20%
	Sangda.4	83.93%	76.26%	86.31%	89.70%	81.57%	83.25%	88.90%	86.35%	92.68%
	Wongol.4	95.35%	94.43%	96.32%	98.56%	95.31%	98.37%	99.45%	100.93%	101.37%
	YusungMid.3	66.61%	72.92%	68.35%	81.46%	71.18%	60.93%	83.41%	97.33%	82.58%

4~5% 이상 향상

최근 600초 동안의 대기시간

대기시간 : libsalt.link.getAverageWaitingTime(linkid)

단위가 초?

		static	Exp.0.2	Exp.0.3	Exp.1.2	Exp.1.3	Exp.3.1	Exp.5.2	Exp.5.3	Exp.6.0	Exp.6.1
WT	Average	14.84	15.25	14.94	14.62	14.63	14.76	14.75	14.90	14.92	14.75
평균	Doan.4	21.55	17.55	17.70	19.55	17.54	17.07	17.39	17.23	18.92	20.29
대기	Doan12	16.34	16.52	17.69	15.91	16.74	16.58	17.46	16.27	16.76	16.77
시간	Doan1Danji.4	9.25	10.43	10.37	10.44	10.40	10.05	10.18	10.26	9.51	10.16
	Doan28.4	15.01	14.10	13.92	14.03	14.36	14.05	13.37	14.31	14.76	13.68
	Doan5Danji.4	27.46	28.52	28.31	28.50	28.54	28.93	27.87	28.12	28.38	27.97
	Doan9Danji.4	6.05	9.16	5.39	6.05	6.12	6.54	6.10	5.61	6.38	6.37
	DoanSub.4	18.24	20.16	19.33	18.31	17.64	19.43	18.35	19.43	20.38	18.84
	Insamol.4	15.91	15.70	15.78	15.51	14.94	15.97	15.58	16.07	16.03	15.05
	Jinter.4	16.24	17.79	17.96	14.85	16.62	17.75	18.29	16.99	17.82	16.17
	MokwonUniv.4	8.94	10.10	9.46	10.04	9.38	7.76	10.40	10.04	7.54	8.44
	Sangda.4	11.42	11.58	11.28	11.33	10.57	11.01	10.74	12.39	10.47	11.77
	Wongol.4	20.13	20.08	20.68	19.74	21.06	20.11	20.81	20.04	20.36	20.52
	YusungMid.3	6.41	6.53	6.32	5.77	6.33	6.56	5.22	6.96	6.67	5.68

Static 대비 비율		Exp.0.2	Exp.0.3	Exp.1.2	Exp.1.3	Exp.3.1	Exp.5.2	Exp.5.3	Exp.6.0	Exp.6.1
WT	Average	106.11%	100.70%	99.01%	99.30%	99.86%	99.66%	101.69%	100.29%	99.26%
평균	Doan.4	81.45%	82.12%	90.74%	81.41%	79.24%	80.72%	79.95%	87.78%	94.14%
대기	Doan12	101.09%	108.24%	97.34%	102.41%	101.44%	106.80%	99.52%	102.52%	102.58%
시간	Doan1Danji.4	112.72%	112.09%	112.77%	112.38%	108.59%	110.04%	110.91%	102.81%	109.77%
	Doan28.4	93.92%	92.70%	93.49%	95.64%	93.57%	89.08%	95.35%	98.29%	91.12%
	Doan5Danji.4	103.88%	103.12%	103.80%	103.96%	105.37%	101.49%	102.43%	103.37%	101.88%
	Doan9Danji.4	151.59%	89.12%	100.06%	101.17%	108.11%	100.93%	92.76%	105.54%	105.39%
	DoanSub.4	110.48%	105.98%	100.37%	96.69%	106.51%	100.60%	106.50%	111.73%	103.27%
	Insamol.4	98.67%	99.21%	97.48%	93.88%	100.39%	97.94%	100.98%	100.77%	94.61%
	Jinter.4	109.56%	110.59%	91.49%	102.36%	109.33%	112.63%	104.63%	109.75%	99.59%
	MokwonUniv.4	112.94%	105.86%	112.27%	104.97%	86.83%	116.34%	112.30%	84.38%	94.37%
	Sangda.4	101.44%	98.79%	99.22%	92.58%	96.45%	94.03%	108.48%	91.65%	103.10%
	Wongol.4	99.73%	102.74%	98.07%	104.65%	99.88%	103.41%	99.57%	101.13%	101.92%
	YusungMid.3	101.96%	98.57%	90.08%	98.76%	102.43%	81.52%	108.55%	104.05%	88.65%

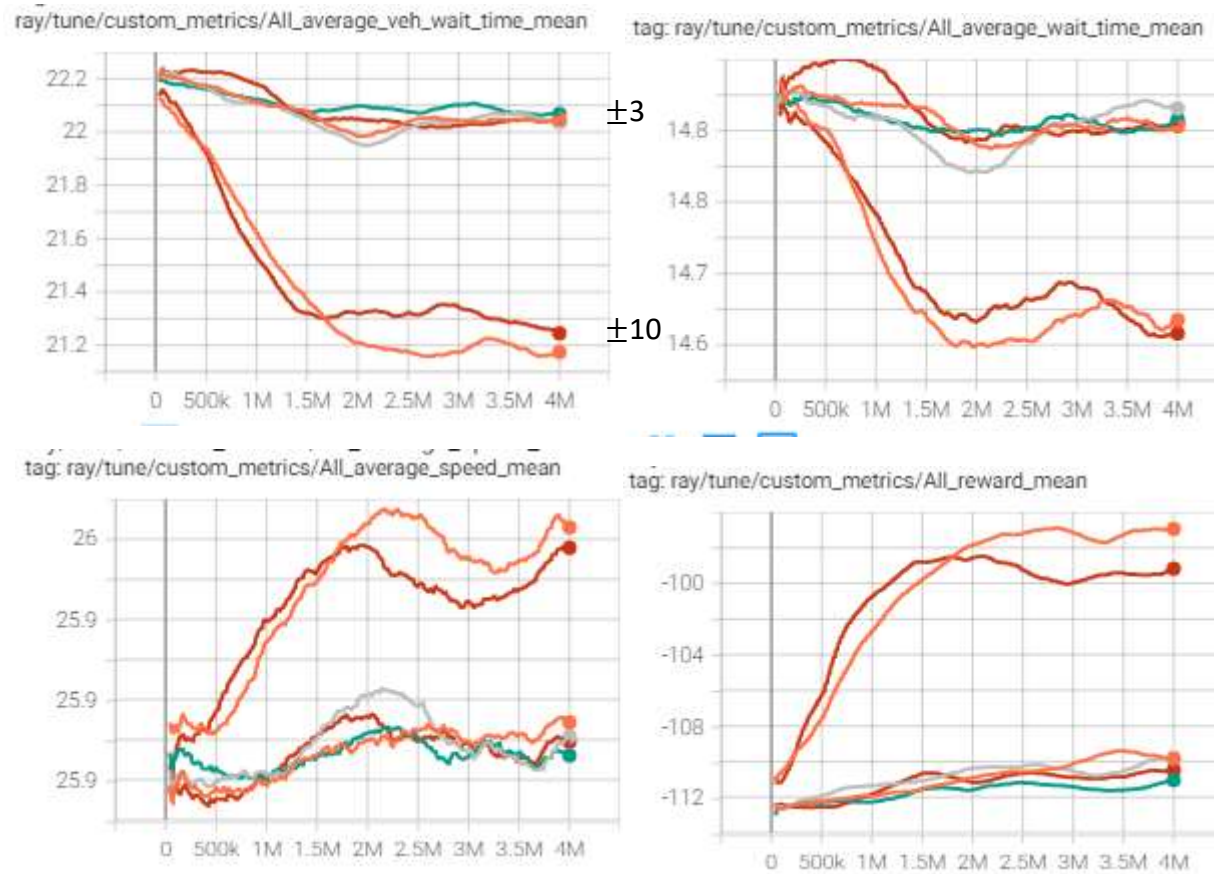
거의 유사

Q1 : 평균 대기시간이 cycle_length보다 작다 --> 원활하다... ?

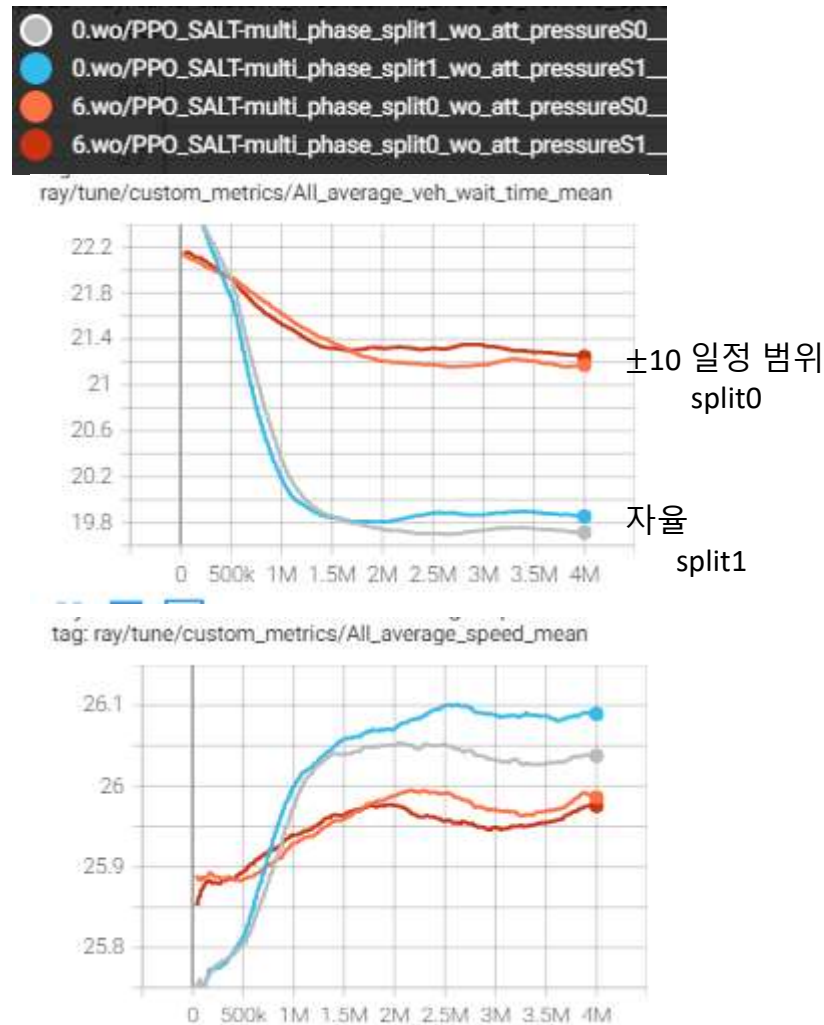
Q2 : 사이클 시작 이후 보다 최근 600초동안의 대기시간이 짧다. --> 지나간 차량들도 포함되어서 짧다?

Q3: VWT는 많이 개선되었는데... WT는 비슷하다. 이럴 수 있나?

지속시간 변경 범위의 영향 : (-3,0,3) .vs. (-10, -5, 0, 5, 10)



분할 방법의 영향 : 일정 범위 .vs. 자율



		Exp.0.2	Exp.0.3	Exp.6.0	Exp.6.1
VWT	Average	24.91	24.30	< 25.09	25.20
차량	Doan.4	19.93	19.73	24.81	26.54
평균	Doan12	27.81	29.67	27.87	28.02
대기	Doan1Danji.4	17.50	18.64	17.34	18.61
시간	Doan28.4	20.17	18.87	20.71	20.06
	Doan5Danji.4	49.84	47.77	48.86	49.03
	Doan9Danji.4	12.73	9.03	12.44	11.92
	DoanSub.4	34.51	34.62	36.04	35.77
	Insamol.4	32.74	31.57	32.67	30.51
	Jinter.4	33.31	31.96	29.58	28.85
	MokwonUniv.4	19.38	19.58	15.76	17.62
	Sangda.4	15.66	14.23	16.12	17.30
	Wongol.4	36.76	36.40	38.91	39.08
	YusungMid.3	3.48	3.81	5.08	4.31

		Exp.0.2	Exp.0.3	Exp.6.0	Exp.6.1
WT	Average	15.25	14.94	> 14.92	14.75
평균	Doan.4	17.55	17.70	18.92	20.29
대기	Doan12	16.52	17.69	16.76	16.77
시간	Doan1Danji.4	10.43	10.37	9.51	10.16
	Doan28.4	14.10	13.92	14.76	13.68
	Doan5Danji.4	28.52	28.31	28.38	27.97
	Doan9Danji.4	9.16	5.39	6.38	6.37
	DoanSub.4	20.16	19.33	20.38	18.84
	Insamol.4	15.70	15.78	16.03	15.05
	Jinter.4	17.79	17.96	17.82	16.17
	MokwonUniv.4	10.10	9.46	7.54	8.44
	Sangda.4	11.58	11.28	10.47	11.77
	Wongol.4	20.08	20.68	20.36	20.52
	YusungMid.3	6.53	6.32	6.67	5.68

		Exp.0.2	Exp.0.3	Exp.6.0	Exp.6.1
Speed	Average	23.73	23.82	23.78	23.67
평균	Doan.4	25.90	26.13	24.58	24.27
속도	Doan12	26.57	26.30	26.82	26.40
	Doan1Danji.4	24.38	24.15	25.61	25.21
	Doan28.4	30.63	30.79	30.35	30.53
	Doan5Danji.4	17.69	17.84	17.73	17.74
	Doan9Danji.4	25.49	25.41	26.46	25.47
	DoanSub.4	20.47	20.81	20.55	20.68
	Insamol.4	21.32	21.31	20.97	21.27
	Jinter.4	24.66	25.01	24.96	25.52
	MokwonUniv.4	26.73	26.83	26.64	26.28
	Sangda.4	24.43	24.23	24.35	24.32
	Wongol.4	25.93	26.02	26.00	25.90
	YusungMid.3	14.28	14.90	14.18	14.08

Q1. 큰차이는 아니지만... Exp.0._ 과 Exp.6._를 비교할때 VehicleWaitingTime 과 WaitingTime 의 비교 결과가 반대인 이유는?