[NOTA]

Self Introduction

2022.04.04

Lee Seong-Jin

Ⅰ. Personal Information

Academic background

Period	School	Major	Representative Study
2013.02 - 2015.02	Sejong Science High School	Physics	Improvement of Subway Screen Door Structure
2015.03 - 2020.02	KAIST (Bachelor)	Mechanical Engineering	3D Printer Development
2020.03 - 2022.02	KAIST (Master)	Traffic Engineering	Traffic Signal Optimization

Master's thesis

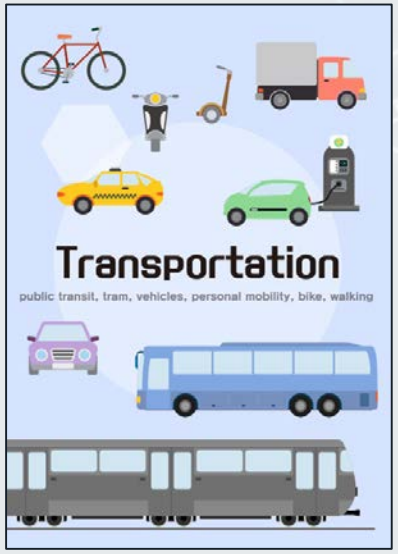
Thesis subject

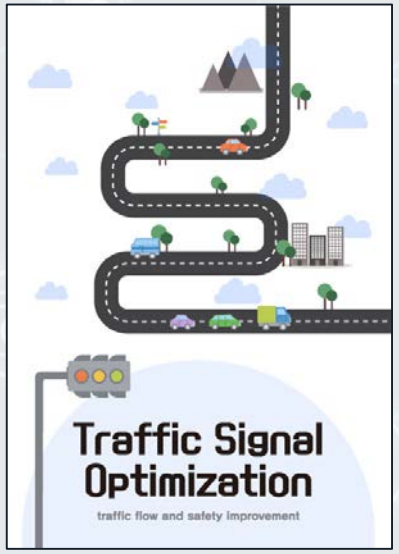
E – BAND : Extended Range Traffic Signal Coordination for Public Transit

Overview

Development of large-scale signal coordination models to ensure continuous traffic of public transportation

Research Field





Ⅱ. Projects

1. Main project list
2. Signal optimization projects
3. Other research experiences

KAIST

Main Project List

Signal Optimization

Project name	Period	Type
대전트램 운영계획 수립 및 도로영향분석	2019.12. ~ 2021.06.	Project
Development of traffic volume measurement methodology based on DSRC data	2020.03. ~ 2020.08.	Class
Predicting Earthquake based on Temporal Dependency: LSTM-Attention Network Approach	2020.09. ~ 2021.02.	Class
부산광역시 스마트 감응신호시스템 구축사업	2020.11. ~ 2021.10.	Project
클라우드 엣지 기반 도시교통 브레인 핵심기술 개발(2차년도)	2021.01. ~ 2021.12.	Project
2021 Smart City Challenge	2021.05. ~ 2022.03.	Project
Traffic Signal Reinforcement Project	2021.07. ~ 2022.02.	Project
무가선 트램 안전 운전 및 운영 고도화 기술 실증 기획연구	2021.10. ~ 2021.12.	Project

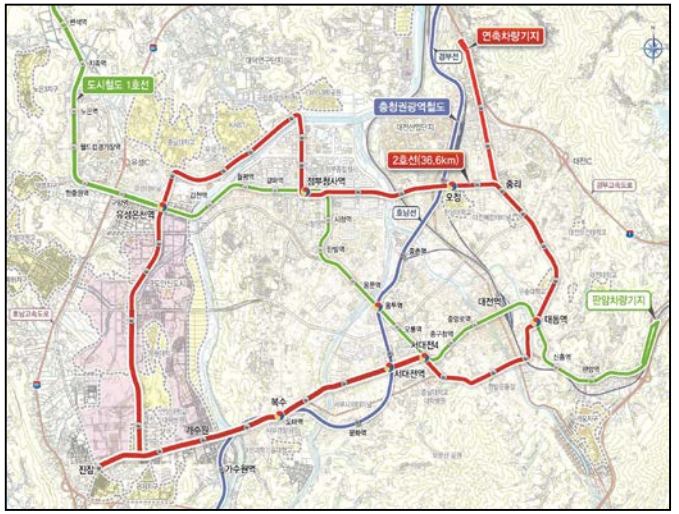
HiX 3D printer development

Project name	Period	Type
IoT Education arduino coding education content development	2017.03.~2017.06.	Project
Multi-Extruder 3D Printer development	2017.04.~2017.09.	Development
Multi-SLA 3D Printer development	2017.11.~2018.08.	Development
Pipelining DLP-SLA 3D Printer development	2017.11.~2018.10.	Development
Capsule SLA 3D Printer development	2018.02.~2018.10.	Development
Educational coding robot ‘byto’ development	2018.02.~2018.08.	Development

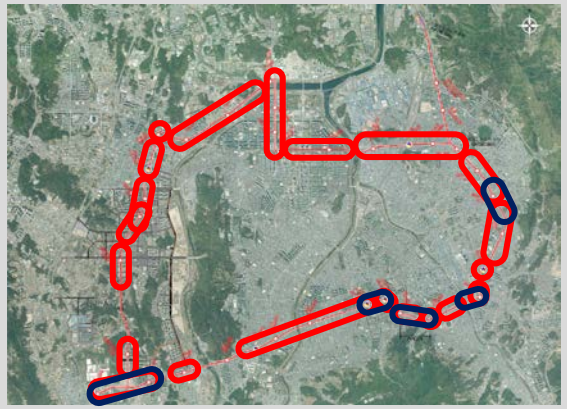
Signal Optimization Projects

대전트램 운영계획 수립 및 도로영향분석

Research
• Development of traffic priority signal strategies for Daejeon tram • Positioning the tram station considering priority signal • Road traffic impact assessment by simulation
Differentiation
✓ Establishing a signal coordination model capable of long road ✓ Establishment of signal cycle selection methodology ✓ Discuss real-world problems such as geometry, minimum green constraints, etc.



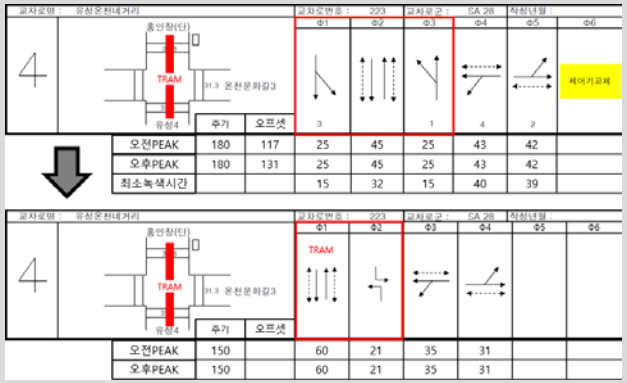
<Daejeon Tram Route>



〈Coordination Group and Gradient Section〉

As-Is	To-be	Lane Configuration
2-lane	1-lane	
3-lane	2-lane	
4-lane	3-lane	
5-lane	4-lane	

〈Lane Configuration〉



〈Signal Design Reflecting Constraints〉

<Real Constraints>

Signal Optimization Projects

대전트램 운영계획 수립 및 도로영향분석

Research
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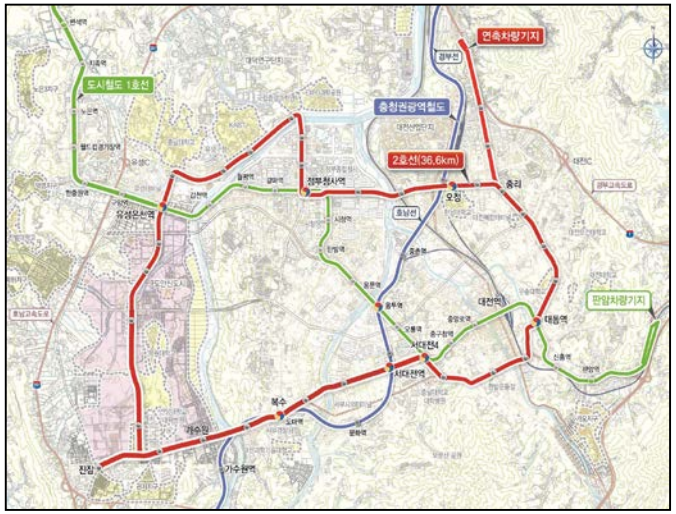
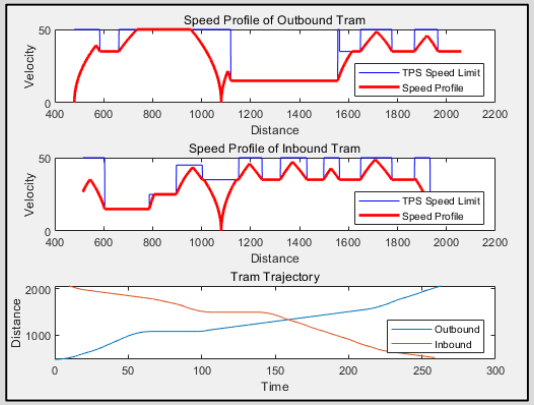
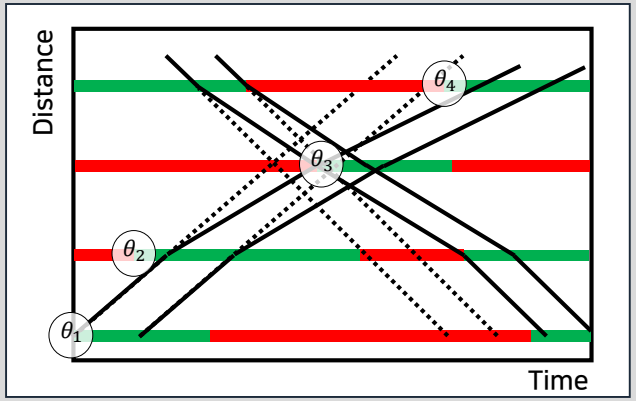


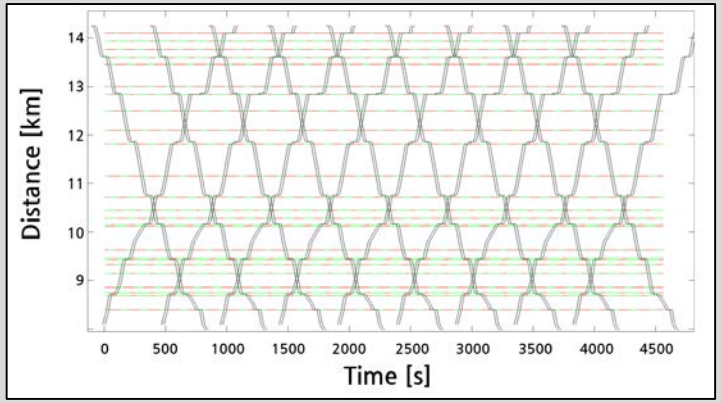
<Daejeon Tram Route>



〈t–x Diagram Considering Speed Limit〉



〈Signal Coordination Model〉



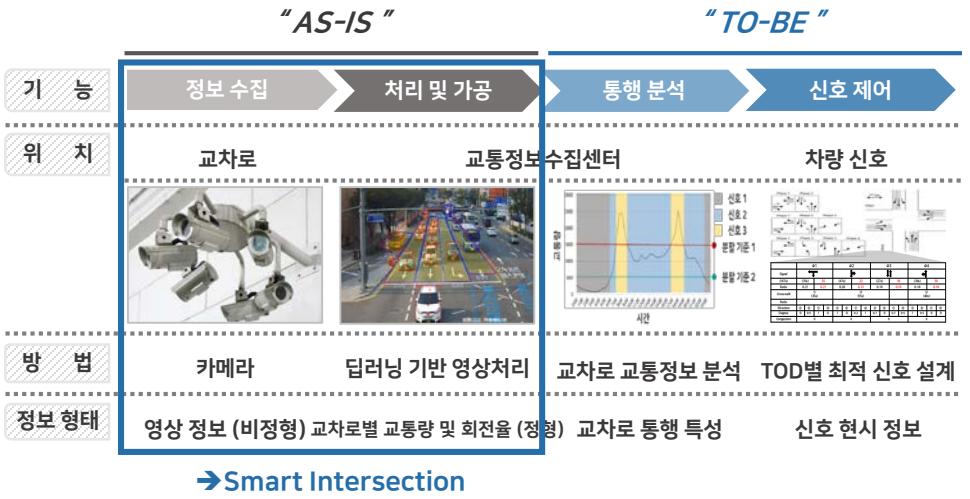
〈Offset and Tram Trajectory Calculation〉

<Research Outcome>

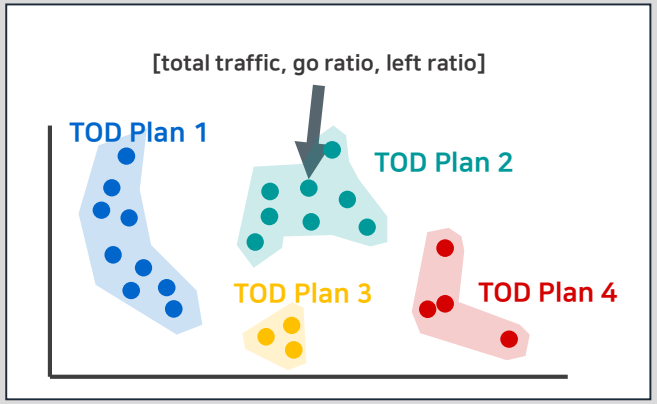
Signal Optimization Projects

부산광역시 스마트 감응신호시스템 구축사업

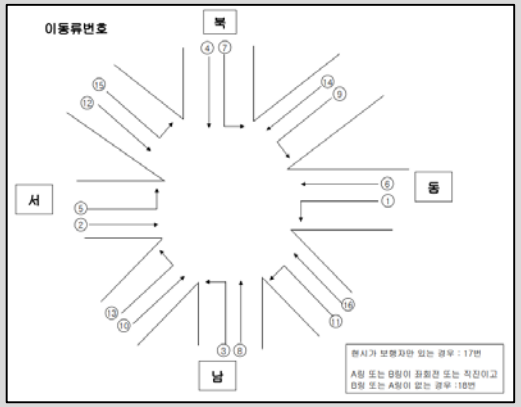
Research
• Development of TOD selection method based on traffic pattern • Development of optimum signal derivation for independent intersection based on traffic rotation rate • Development of data-based signal coordination Model
Differentiation
✓ Development of python-based executable programs that can be operated in the field ✓ Development of a methodology for optimizing secondary bandwidth based on 'Full Constraint Intersection'



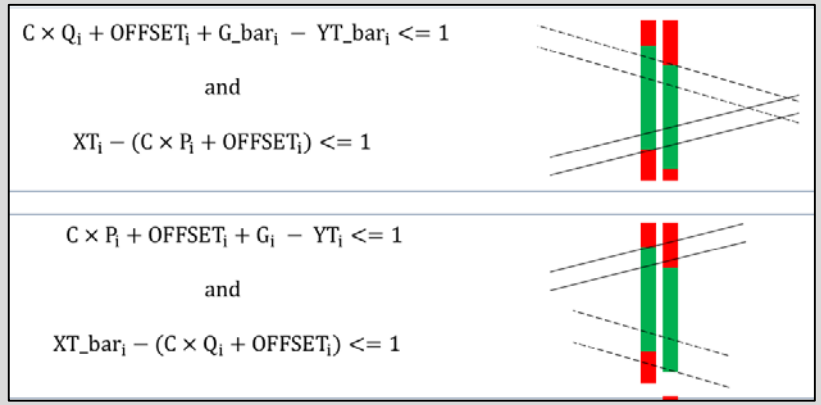
<Smart Intersection Signal Control>



〈TOD Selection Through K-means Clustering〉



〈Signal Design by Rotational Ratio〉



〈2nd Optimization of Critical Intersection〉

<Research Outcome>

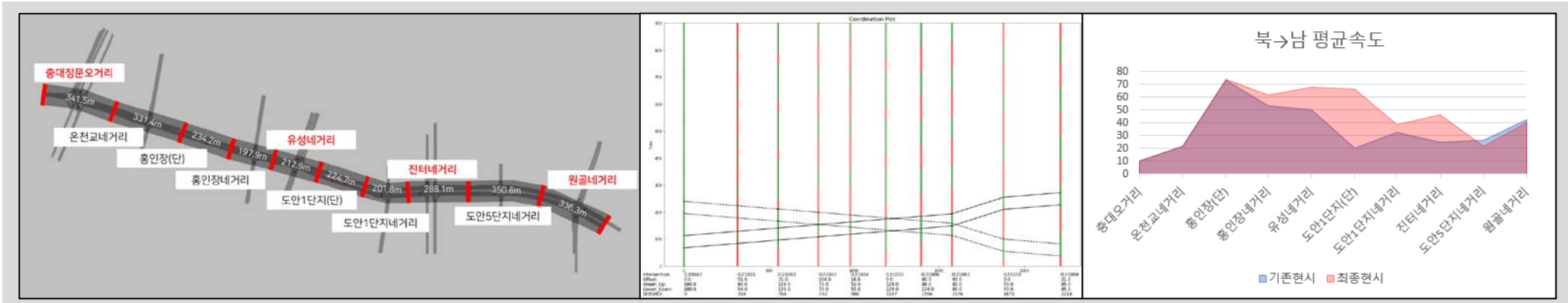
Signal Optimization Projects

클라우드 엣지 기반 도시교통브레인 핵심기술 개발

Research
• Development and application of smart intersection

Differentiation
✓ Data-based signal coordination model
✓ Development of a bandwidth-based control delay estimation model
✓ ALPHA-BAND development for bandwidth optimization
✓ Validation using VISSIM simulation
✓ Demonstration in Daejeon Doan street

< Smart Intersection Signal Design and Verification>



〈VISSIM Simulation Network〉 〈Trajectory Outcome〉 〈Effect Validation〉

<Research Outcome>

Signal Optimization Projects

2021 Smart City Challenge

Research
• AI-based urban transportation innovation • AI signal system development
Differentiation
✓ Validation using VISSIM simulation ✓ Demonstration in Daegu Seodaegu-ro/Taepyeong-ro

<AI-based urban transportation innovation>

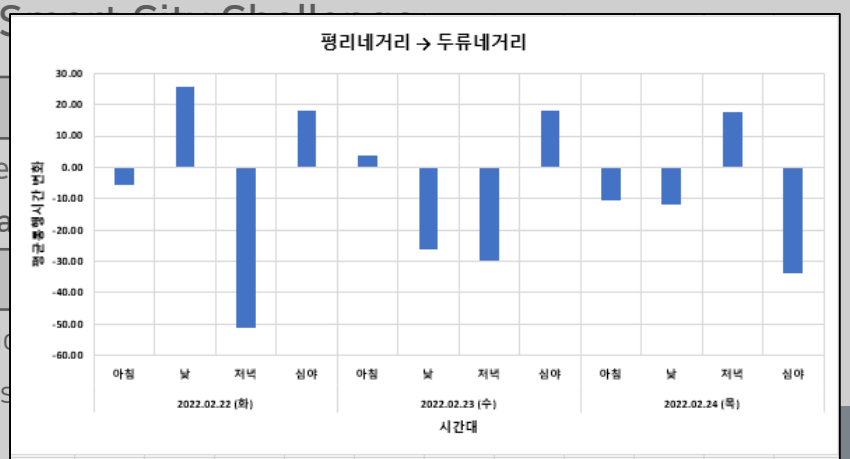
오전첨두(8-9시)					낮(14-16시)				오후첨두(17-19시)				야간(22-23시)			
	0.66	5.96	-(-)			0.27	0.80	-(-)		0.11	5.15	-(-)		0.24	0.11	-(-)	
0.55(-)	서부소방서 네거리			-	0.55(-)	서부소방서 네거리		(-)	0.44(-)	서부소방서 네거리			-	0.05(-)	서부소방서 네거리		-
0.63				0.60	0.38			0.18	0.76				0.46	0.33			0.47
0.95				0.40(-)	0.58			0.29(-)	0.42				0.62(-)	0.71			0.08(-)
	1.42(-)	2.70	1.38			0.54(-)	1.71	0.55		0.10(-)	0.41	0.07			0.39(-)	2.92	0.62	
	2.30	3.78	1.70(-)			1.48	1.74	0.12(-)		0.61	1.80	0.49(-)			0.83	1.66	0.48(-)	
0.51(0.38)	평리 네거리			0.08	0.16(0.64)	평리 네거리		0.47	0.50(0.10)	평리 네거리			0.02	0.29(0.19)	평리네거리		0.06
0.63				0.09	0.50			0.15	0.44				0.04	0.37			0.40
0.04				0.04(0.64)	0.00			0.23(0.54)	0.02				0.11(0.39)	0.17			0.73(0.12)
	1.55(0.04)	2.22	1.69			2.19(0.04)	4.08	3.00		1.94(1.91)	5.34	3.82			0.65(1.49)	1.19	0.83	
	1.80	3.79	1.42(4.01)			0.63	2.86	0.48(0.58)		2.88	14.42	2.80(2.45)			0.33	1.26	0.40(-)	
-(-)	평리광명 네거리			0.25	-(-)	평리광명 네거리		0.16	-(-)	평리광명 네거리			0.07	-(-)	평리광명 네거리		0.32
0.25				0.10	0.44			0.07	0.01				0.91	0.26			0.07
0.17				0.00(-)	0.08			0.00(-)	0.32				0.10(-)	0.15			0.47(-)
	1.07(-)	5.51	1.72			0.10(-)	1.21	0.52		2.90(-)	10.65	2.07			0.72(-)	3.68	0.20	
	2.83	5.74	2.05(-)			2.32	4.73	1.65(-)		3.48	8.29	2.96(-)			0.92	2.43	0.09(-)	
0.42(0.36)	신평리 네거리			0.47	0.78(0.18)	신평리 네거리		0.57	0.01(-)	신평리 네거리			0.86	0.04(0.26)	신평리 네거리		0.45
0.28				0.04	0.45			0.56	0.21				0.44	0.39			0.81
0.11				0.52(-)	0.22			0.33(-)	0.07				0.71(-)	0.44			0.50(-)
	0.09(-)	0.29	0.72			0.09(-)	0.39	0.25		0.15(-)	0.28	0.23			0.42(-)	0.09	0.11	

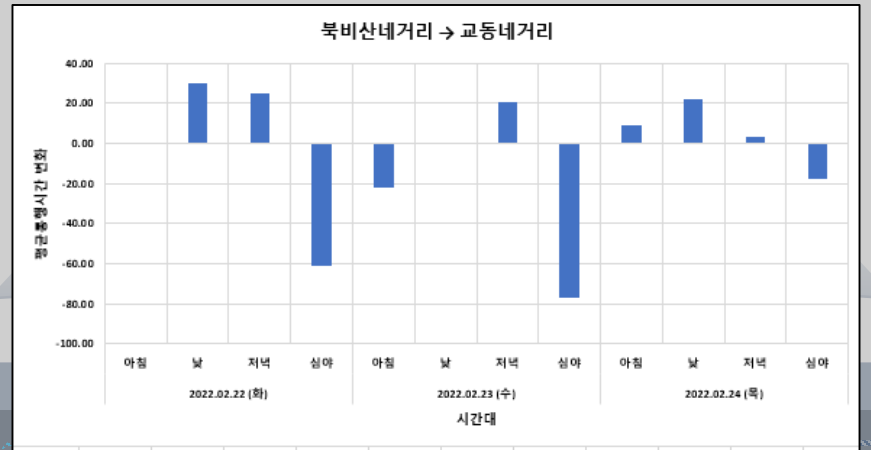
〈Validation of Simulation GEH〉

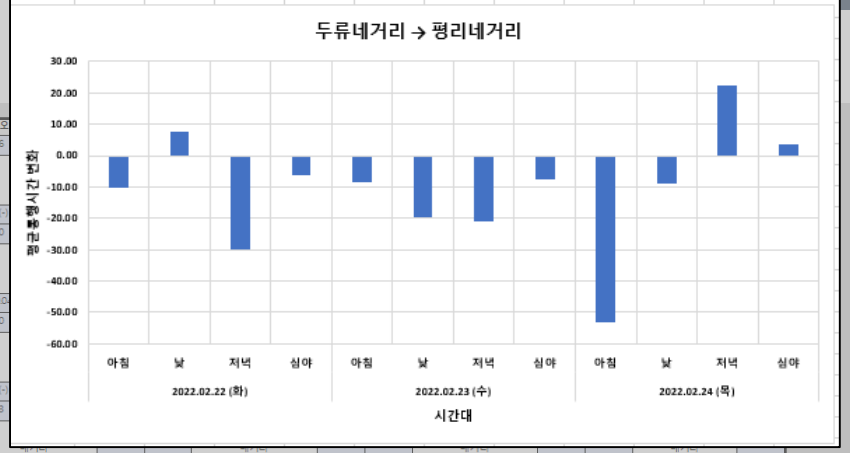
〈Demonstration Areas〉

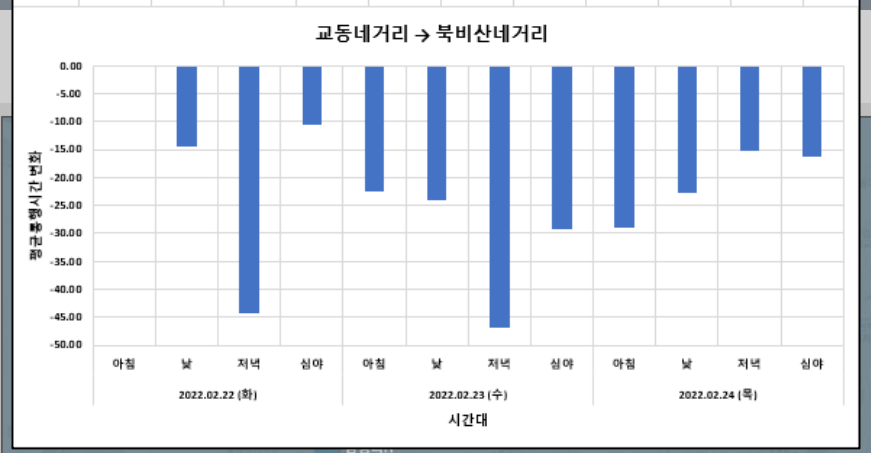
<Research Outcome>

Signal Optimization Projects









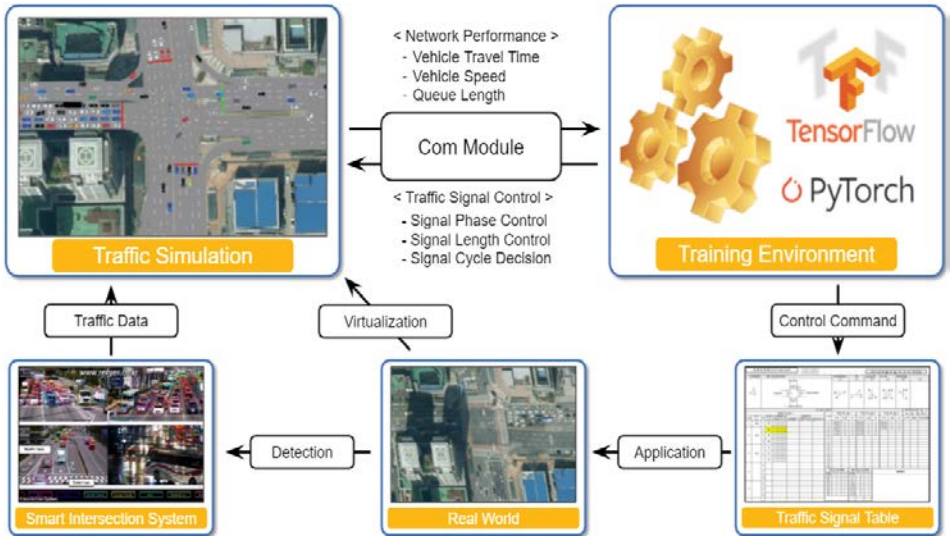
Average daily travel time to Seodaegu-ro reduced by 143 hours and 95.2 hours to Taepyeong-ro

Economic effects of about 1.9 billion won per year (based on 12,000 won/hour, 1.9 people/unit)

Signal Optimization Projects

Traffic Signal Reinforcement Learning Project

Research
• Traffic signal optimization based on reinforcement learning (DQN, A2C)
Differentiation
✓ VISSIM com module system ✓ Development of a model that meets the minimum green time condition



<Com module-based learning model framework>

$A_t = \{ 0, 1 \}$

0 : keep current phase

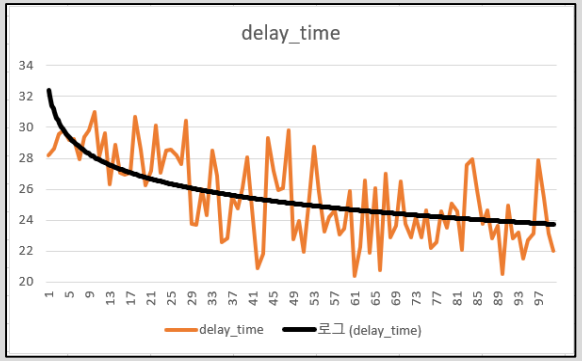
1 : move to next phase

〈DQN Action Setting〉

$$-\sum_{i=1}^{n} d_{i,t}$$

$d_{i,t}$: delay time of lane I at time t

〈DQN Reward Setting〉



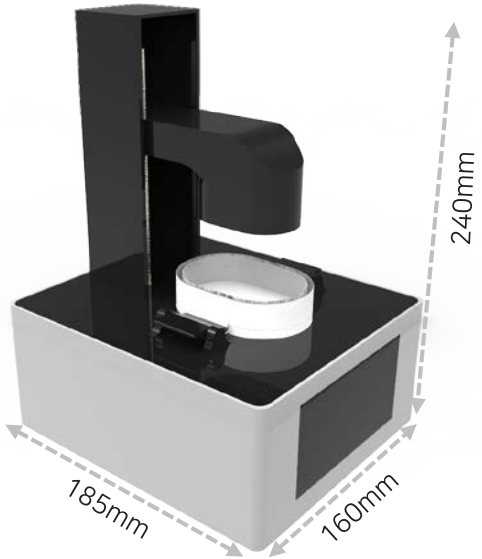
〈Learning Result〉

<Research Outcome>

Other Research Experiences

HiX 3D Printer Development

Research
• 3-vat Pipelining 3D printer development • Capsule SLA 3D printer development • Coding Education Robot, ‘byto’ development
Differentiation
✓ Domestic and international patent ✓ Comprehensive understanding of prototyping and mass production processes



Capsule SLA 3D Printer

Coding Education Robot

HiX

VS

Carbon3D

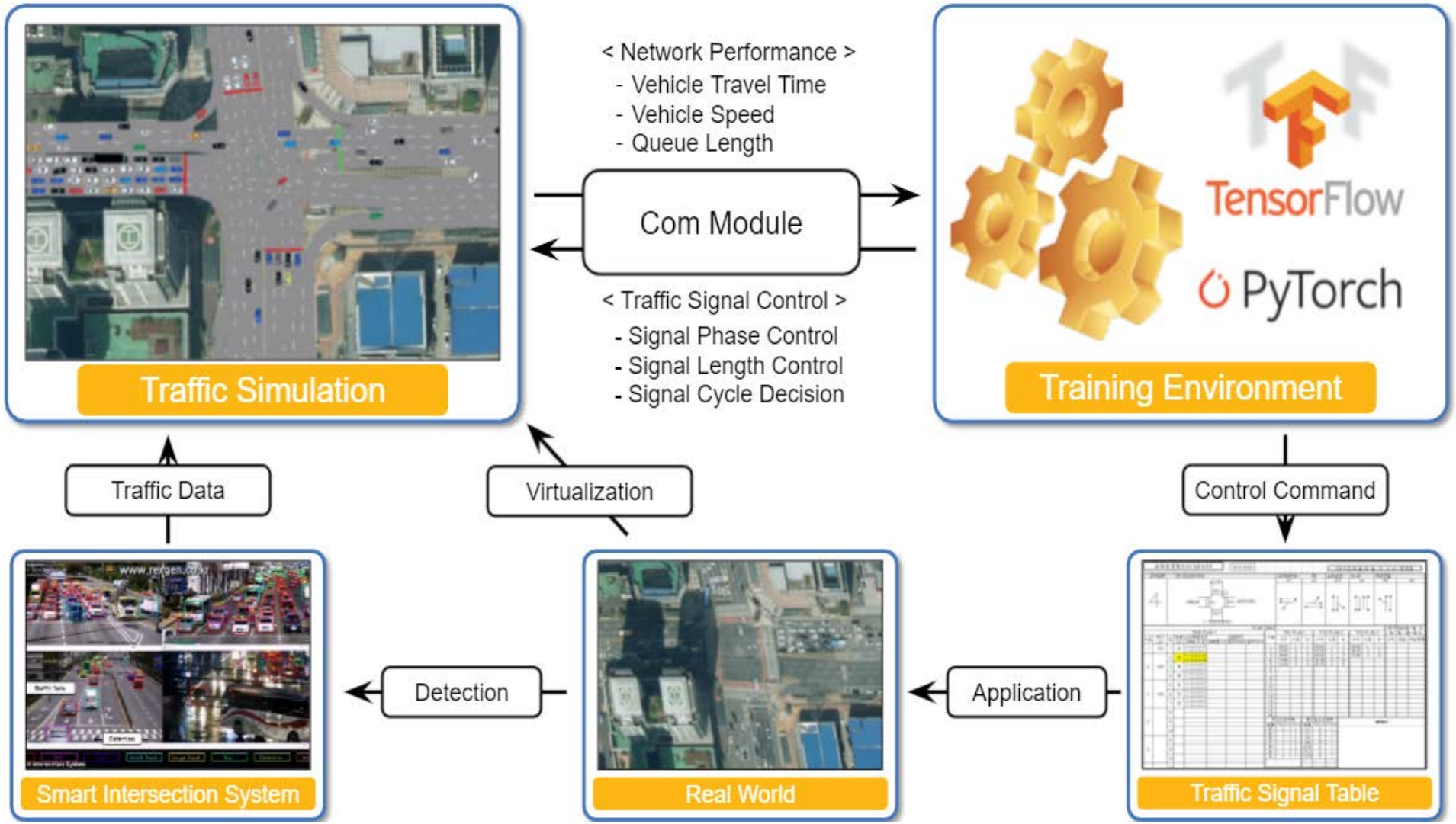
Pipelining 3D printing has the similar productivity as the world's fastest Carbon3d product when printing dental models.

Ⅲ. What to do in NOTA

1. What I want to do
2. What I can do

What I want to do

Further study on traffic signal reinforcement model

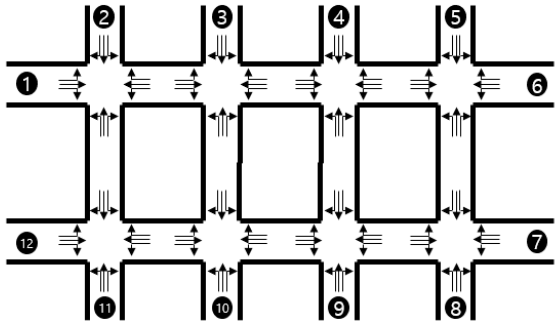


What I want to do

Development of network traffic signal optimization model

Network Traffic Signal Optimization

1 Rotational Rate



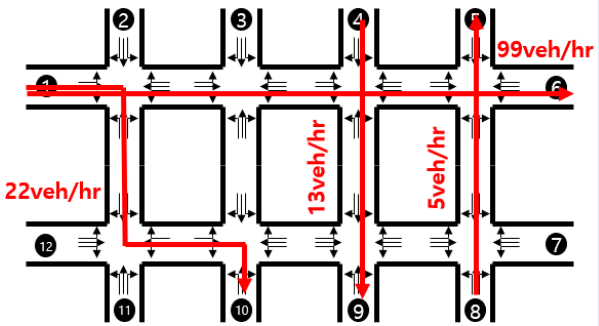
N nodes

2 OD Traffic Matrix

	1	2	3	4	5	6	7	8	9	10	11	12
1	0	13	27	52	47	99	3	24	13	22	45	1
2	36	1	3	4	8	2	7	9	10	11	84	22
3	21	1	4	32	2	48	23	53	52	98	21	34
4	81	23	21	0	23	24	48	21	13	21	15	43
5	24	47	1	51	13	23	21	5	84	23	45	64
6	47	22	2	41	10	1	24	14	32	45	21	54
7	98	23	32	21	20	74	0	19	54	24	23	78
8	12	11	48	78	54	46	4	4	56	78	92	21
9	2	47	24	41	9	14	21	84	0	54	54	13
10	48	53	21	21	48	21	23	21	14	2	21	8
11	69	56	47	24	54	8	48	87	62	31	0	21
12	4	5	8	65	89	47	78	51	12	21	31	0

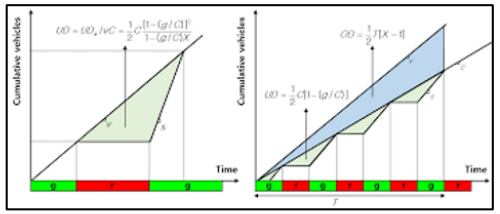
N×N matrix

3 Trajectory Matching



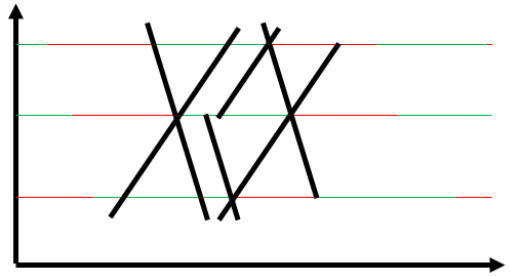
$_NC_2$ representative trajectories
i.e. shortest path

4 Optimization



Objective function
control delay/queue Length of all possible trajectories with traffic volume weight
Design Variable
Green split/offset
Constraints
bandwidth inside the green signal
Estimation Theory
Queuing theory based on cumulative curve

5 t-x diagramming

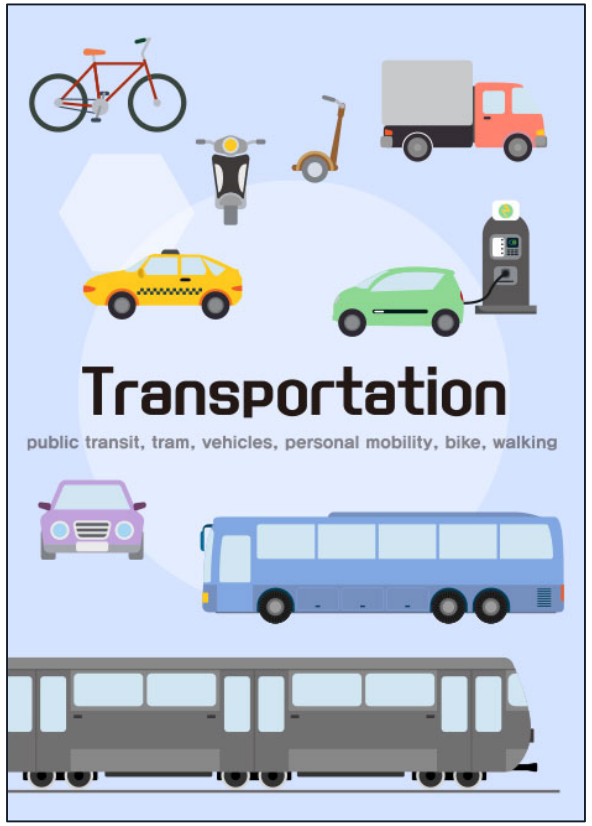


$_NC_2$ trajectories

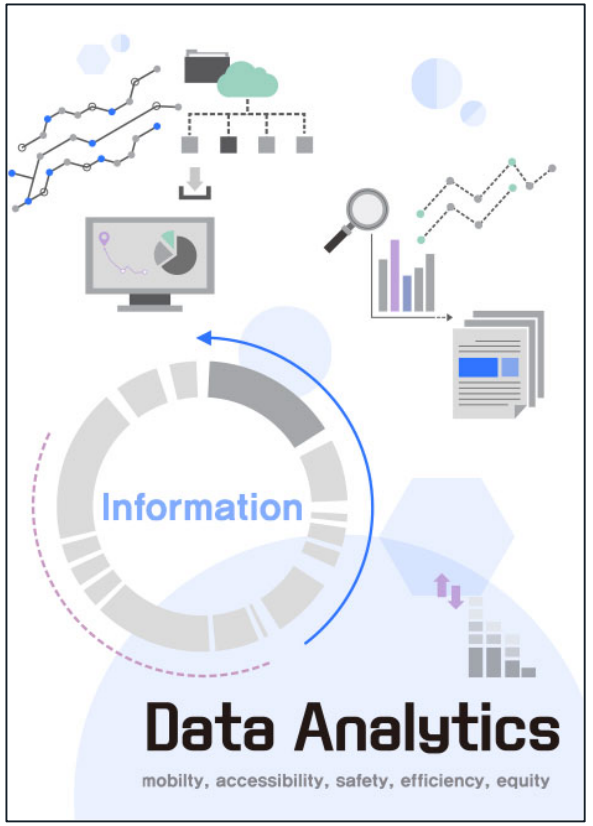
What I can do

What I can do

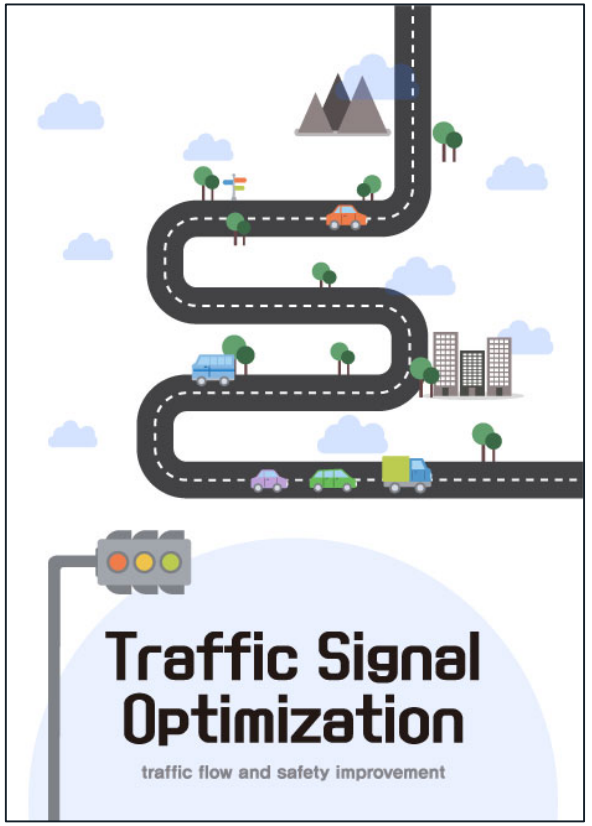
Public Transit



Data Analysis



Signal Optimization



Q&A

감사합니다