Deep Learning-based Urban Traffic Congestion Prediction

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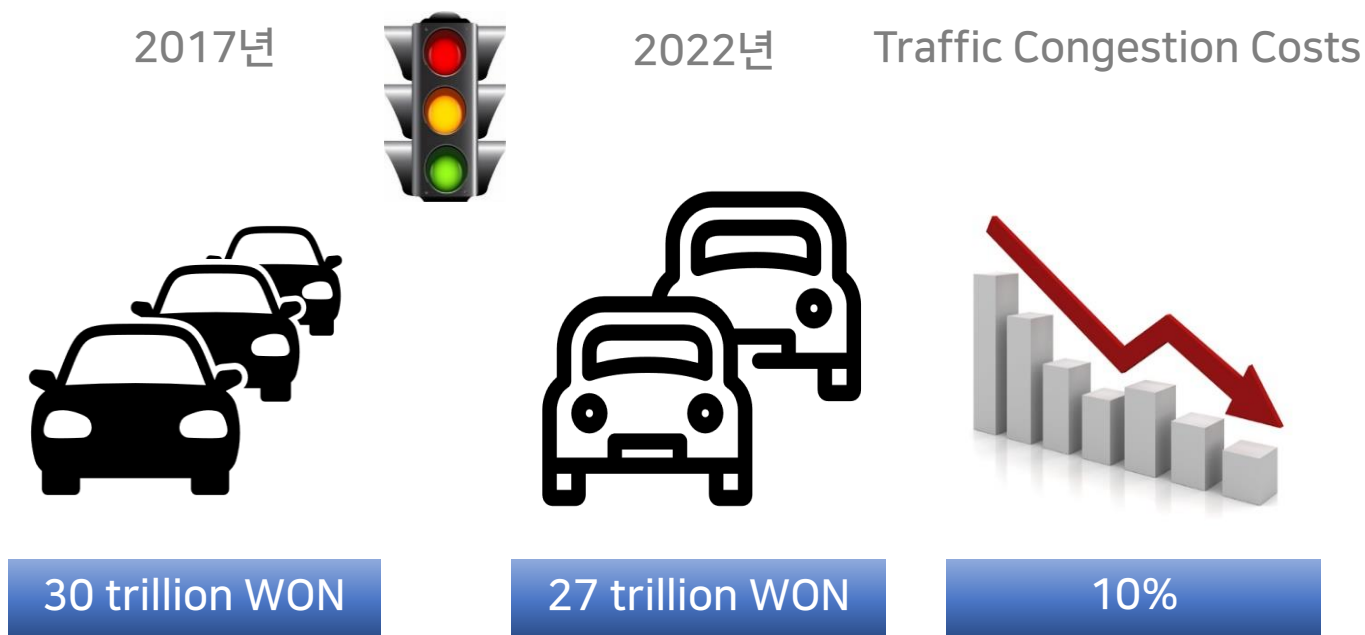Supercomputing Application Center, KISTI

➢ **Traffic Congestion Costs Problem:**

- Though many advanced technologies has been introduced,
- However, traffic congestion are still not improving

➢ **Improvement of traffic congestion cost by 10%**

- Deep Learning
- AI
- Big Data Analysis

2017년   2022년   Traffic Congestion Costs

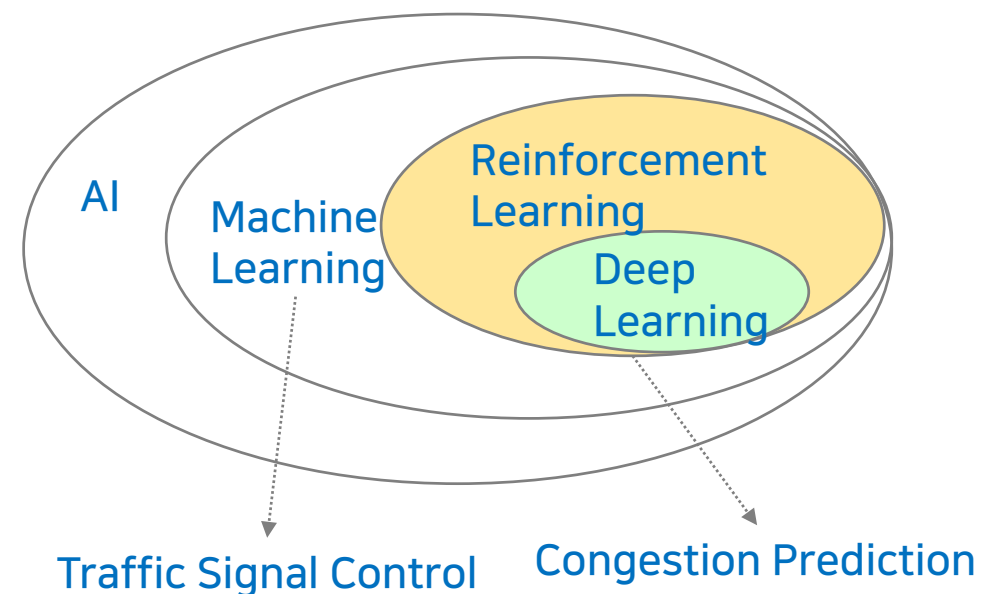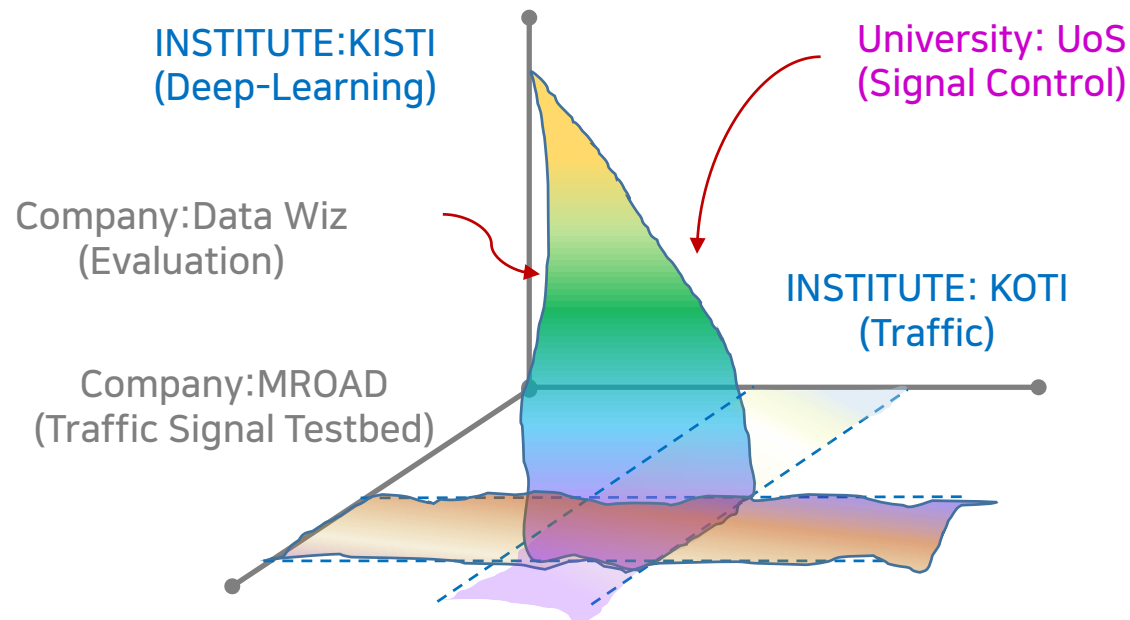| 30 trillion WON | 27 trillion WON | 10% |

➢ **Development of Deep Learning based Traffic Congestion and Signal Control System funded by MSIT (Ministry of Science and ICT)**

- A Deep learning Framework for urban traffic signal control in Intelligent Transportation System
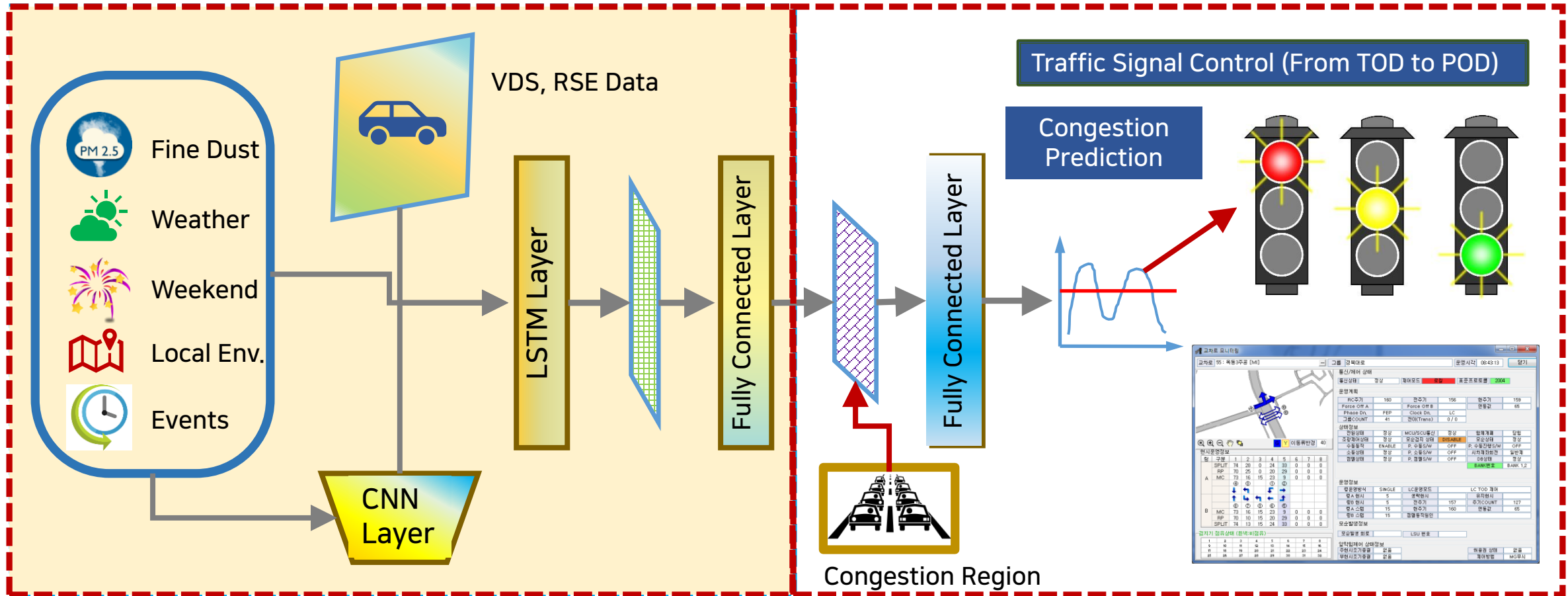- Grant : $3 Million (3.5 Billion WON, 2018.04~2020.12)

INSTITUTE:KISTI
(Deep-Learning)

University: UoS
(Signal Control)

Company:Data Wiz
(Evaluation)

INSTITUTE: KOTI
(Traffic)

Company:MROAD
(Traffic Signal Testbed)

AI

Machine Learning

Reinforcement Learning

Deep Learning

Traffic Signal Control

Congestion Prediction

Overview of Deep-TraC

Traffic Congestion Prediction (LSTM, CNN+LSTM)

Traffic Signal Control & Testbed

VDS, RSE Data

Fine Dust

Weather

Weekend

Local Env.

Events

CNN Layer

LSTM Layer

Fully Connected Layer

Fully Connected Layer

Traffic Signal Control (From TOD to POD)

Congestion Prediction

Congestion Region

KISTI, Daejeon City, and KOTI have signed an MOU to initiate a collective effort to develop smart city strategies for Daejeon in South Korea (2018.07)

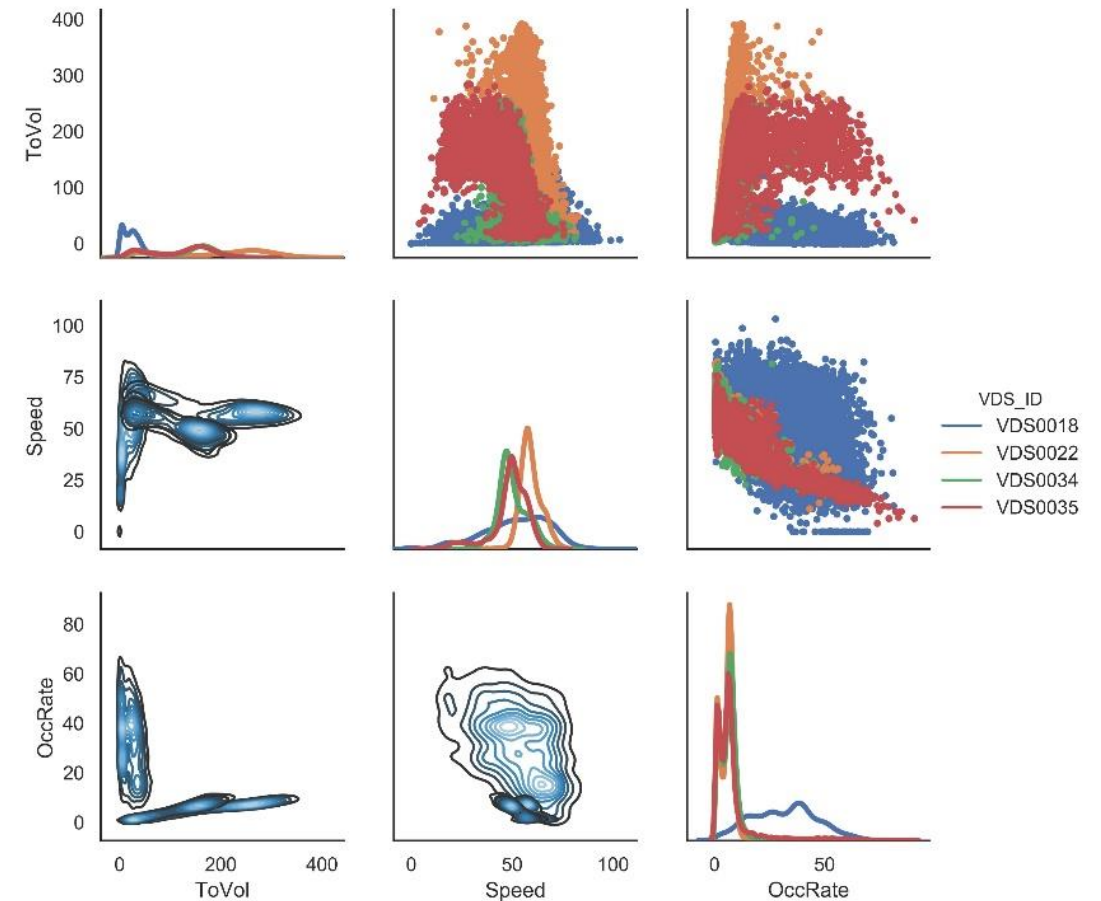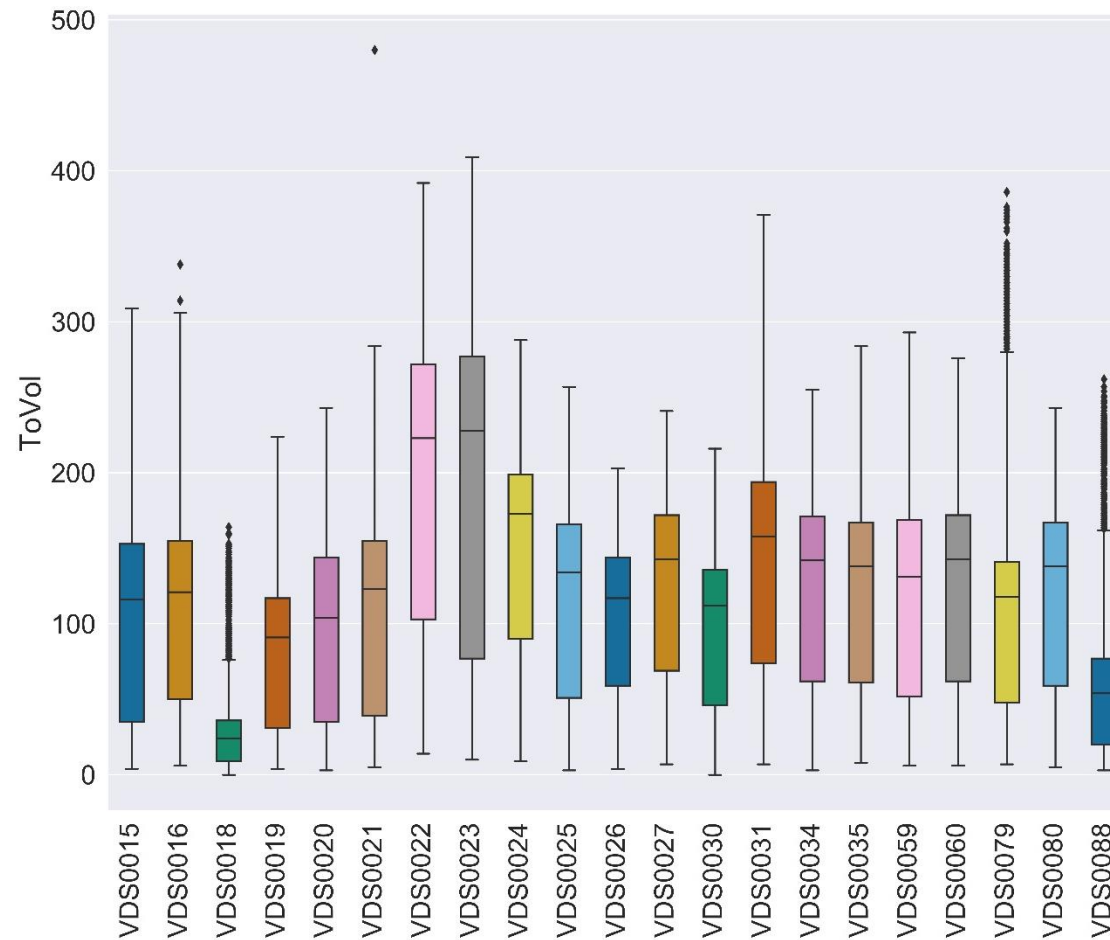> ## Daejeon City Traffic Data Collection

- The scope of the research : Including 181 RSE, 48 VDS, and 924 (signal, non-signal) intersections
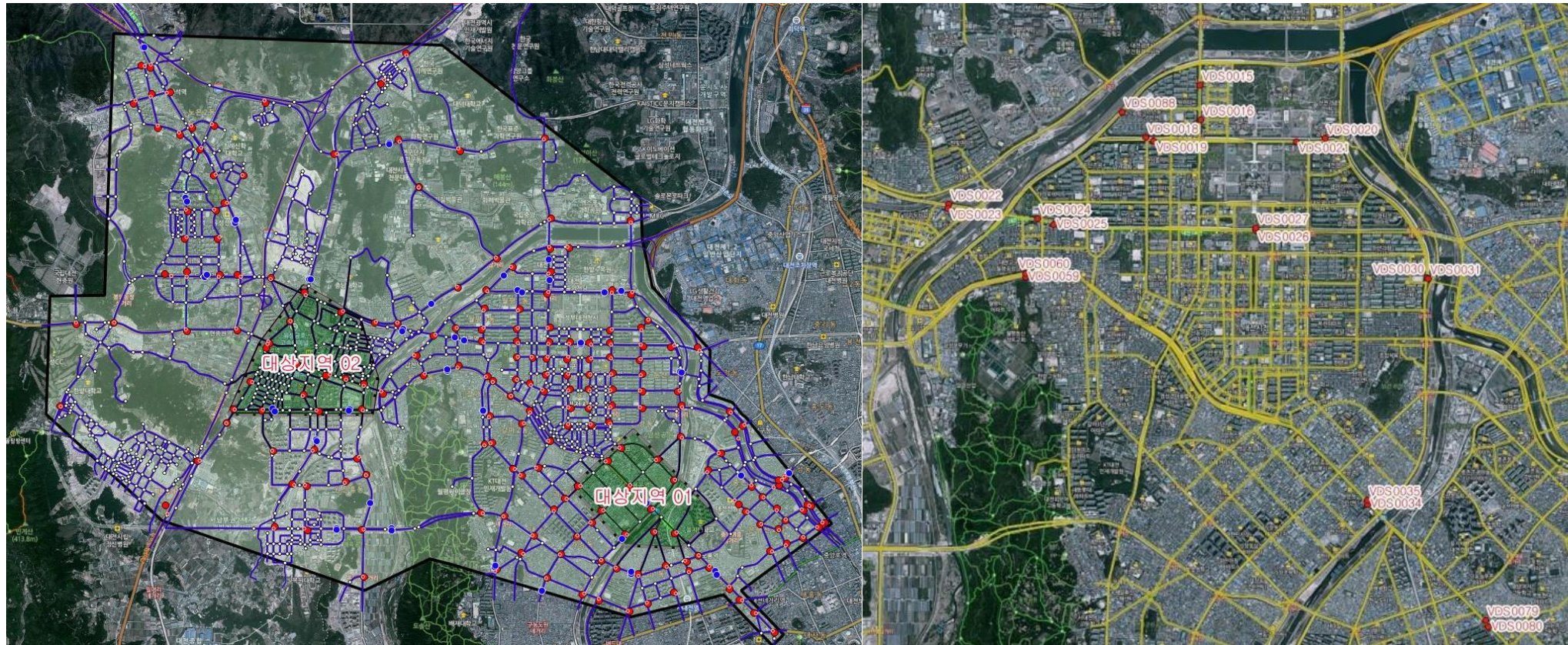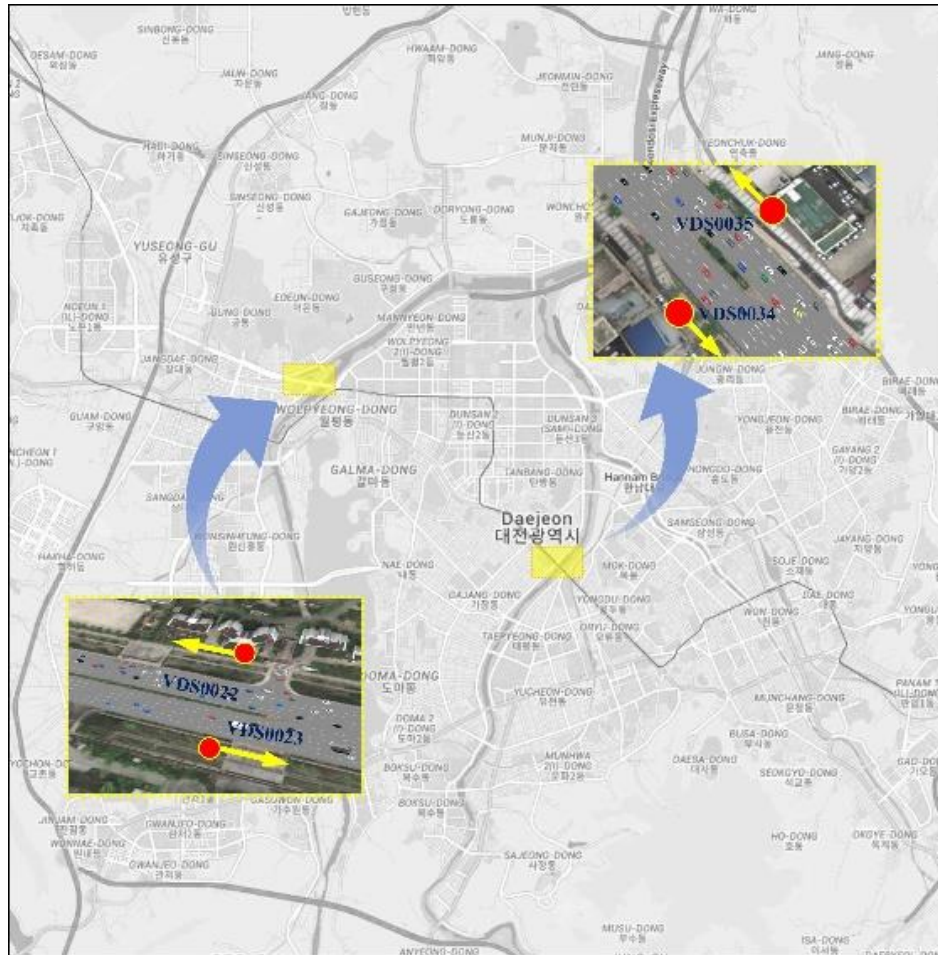

RSE : Road Side Equipment

VDS : Vehicle Detection System

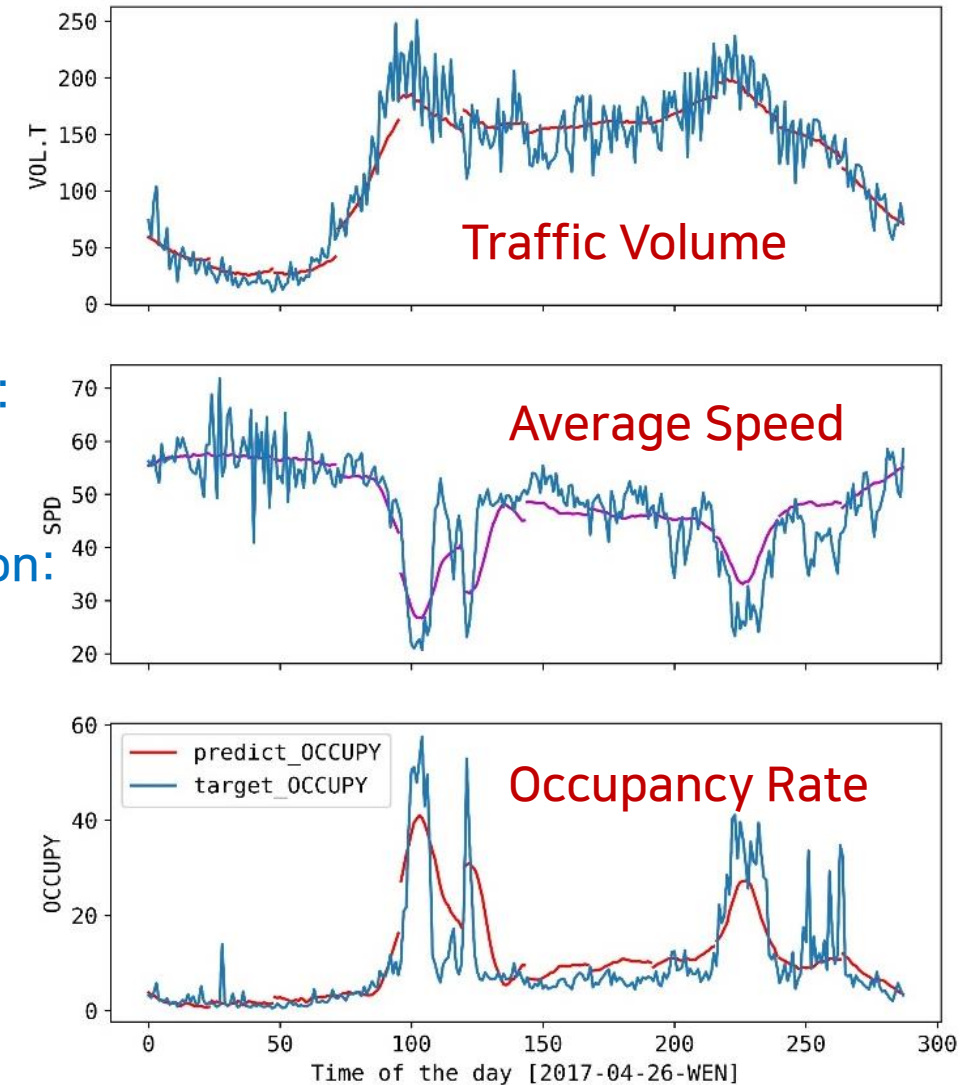# Traffic Flow Prediction with LSTM

➢ **Data Analysis**

Traffic Volumes in all VDS locations

Traffic Volume, Speed, and Occupancy

➢ VDS Data Analysis

LSTM Memory:
Look_B=12H

LSTM Prediction:
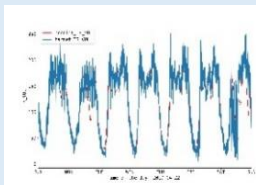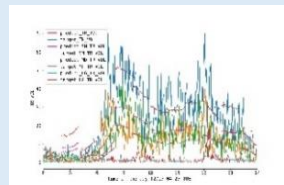Look_F=2H

Traffic Volume

Average Speed

Occupancy Rate

Ref. "Big Data Analytics-based Urban Traffic Prediction using Deep Learning in ITS" (Hongsuk Yi, ICAI 2019)

# Test-bed, Yuseong-Gu (VDS0022), Daejeon

Deep-TraC SW Architecture
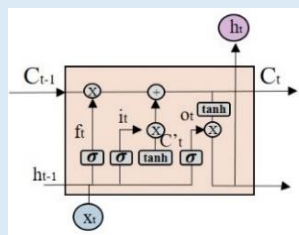

Traffic Flow Prediction

| MSE	MAE	MAPE	RMSE	R2
0.00319	0.03981	18.67132	0.05647	0.63578
0.0048	0.04649	28.57718	0.0693	0.51126
0.01173	0.05991	35.88783	0.10829	0.55472
0.00343	0.04172	26.17659	0.05853	0.75176
0.00318	0.0408	24.49447	0.05637	0.71047
0.00478	0.04708	27.00742	0.06916	0.7016
0.00485	0.04734	23.38833	0.06961	0.69639

LSTM

GAN

GPU (GV100*4)
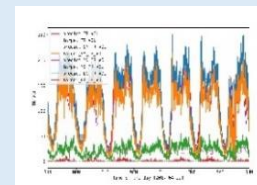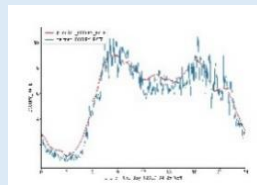
Deep Learning Model

HyperSNet

- Batch Gradient Decent
- Mini-Batch Gradient Decent

α^*

Batch State Controller
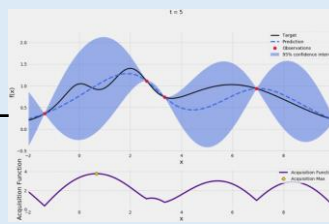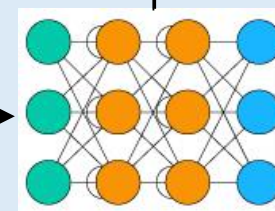
Bayesian Optimization
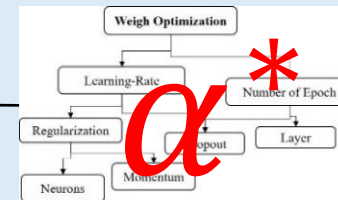
Hierarchical Structure

Reinforcement Learning
+
Bayesian Hyperparameter Optimzation

Input Data

VDS_ID	REG_HM	TR_VOL	SM_TR_VOL	MD_TR_VOL	LG_TR_VOL	TRVL_SPD	OCCUPY_RATE
VDS0015	201704010700	39	6	33	0	48.9	1.79
VDS0015	201704010705	39	11	27	1	48.3	2.18
VDS0015	201704010710	40	5	34	1	49.8	1.96
VDS0015	201704010715	58	12	46	0	59	2.25
VDS0015	201704010720	27	7	19	1	51.7	1.36
VDS0015	201704010725	46	10	36	0	55.6	1.99
VDS0015	201704010730	52	16	36	0	54	2.37
VDS0015	201704010735	64	22	40	2	47.7	3.03
VDS0015	201704010740	29	7	22	0	48.2	1.37
VDS0015	201704010745	54	11	43	0	53.4	2.48

VDS Data
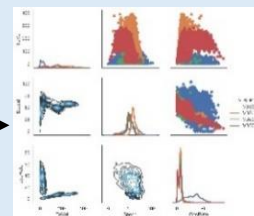
Features

Visualization

Feature Extraction

Thank you!