ICML 2025

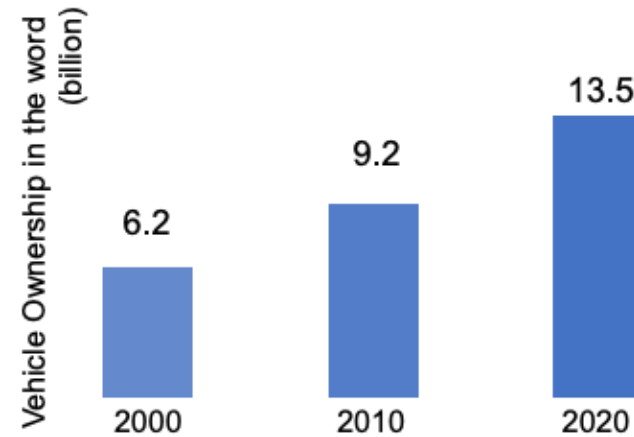## RobustLight: Improving Robustness via Diffusion Reinforcement Learning for Traffic Signal Control

by:

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BackGround

Urban population and vehicle ownership have dramatically increased, posing challenges to regulating road traffic
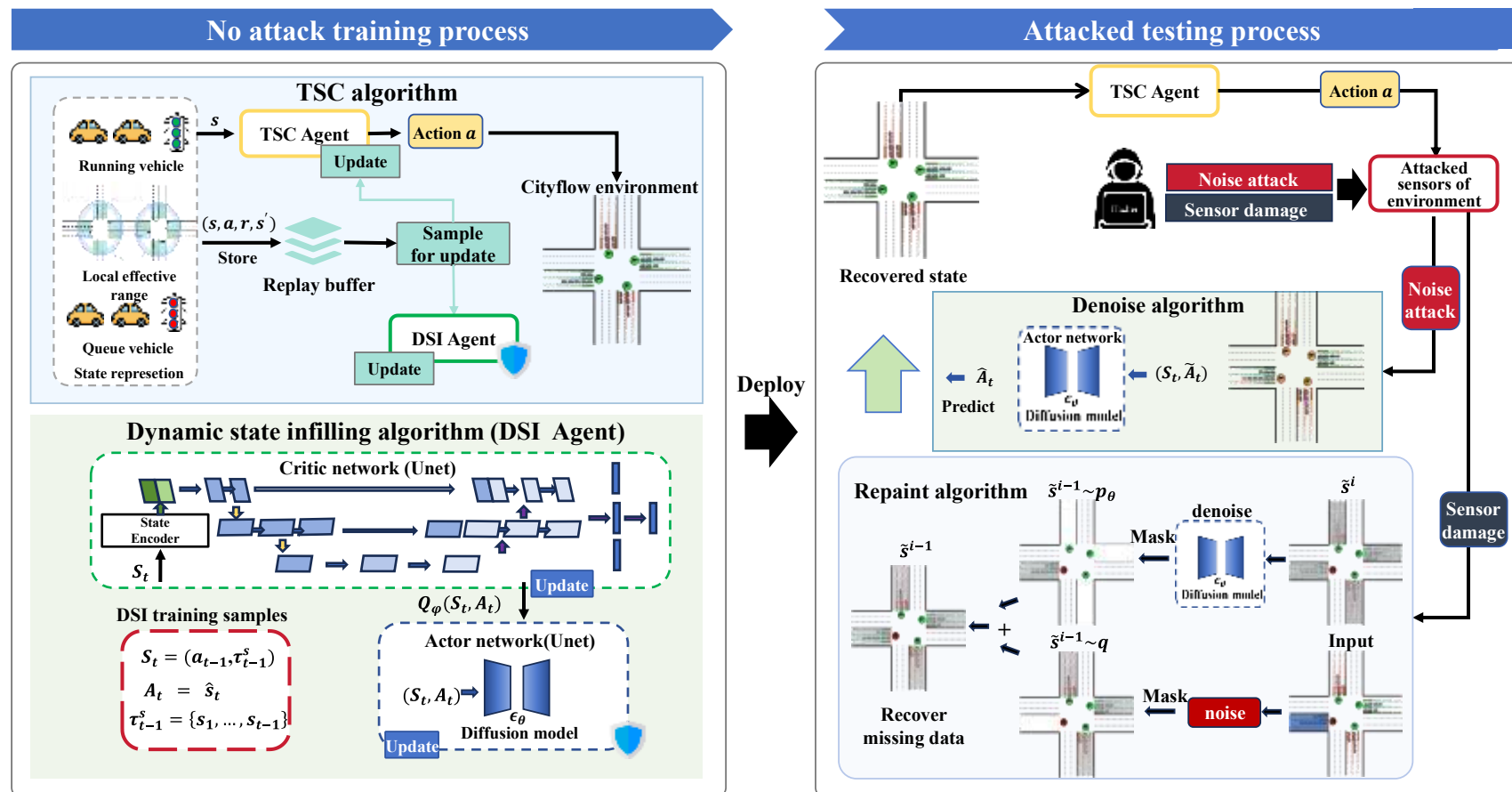

The vehicles are increasing in the world

Traffic congestion is getting worse in big cities

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Method

No attack training process

TSC algorithm

Running vehicle

Local effective range

Queue vehicle

State represetion

s → TSC Agent → Action a

Update

(s, a, r, s') Store → Replay buffer → Sample for update

Cityflow environment

DSI Agent

Update

Dynamic state infilling algorithm (DSI Agent)

Critic network (Unet)

State Encoder

S_t

DSI training samples

$S_t = (a_{t-1}, \tau^s_{t-1})$

$A_t = \hat{s}_t$

$\tau^s_{t-1} = \{s_1, ..., s_{t-1}\}$

$Q_\varphi(S_t, A_t)$ Update

Actor network(Unet)

(S_t, A_t) → ϵ_θ Diffusion model

Update

Deploy

Attacked testing process

TSC Agent → Action a

Recovered state

Noise attack / Sensor damage → Attacked sensors of environment

Noise attack

Sensor damage

Denoise algorithm

Actor network

$\hat{A}_t$ ← Predict

ϵ_θ Diffusion model

$(S_t, \tilde{A}_t)$

Repaint algorithm

$\tilde{s}^{i-1} \sim p_\theta$

$\tilde{s}^i$

denoise

Mask

ϵ_θ Diffusion model

$\tilde{s}^{i-1}$

$+$

$\tilde{s}^{i-1} \sim q$

Input

Recover missing data

Mask ← noise

THANK YOU

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