

# Influence-Augmented Local Simulators:

A Scalable Solution for Fast Deep RL in Large Networked Systems

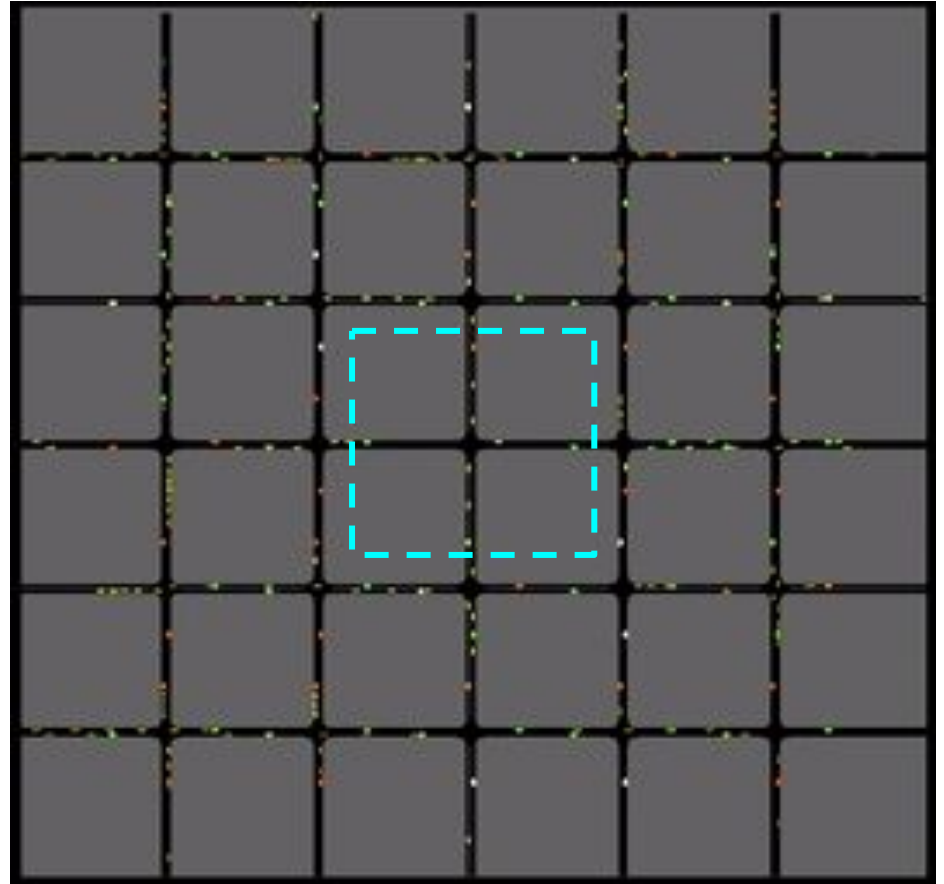
Miguel Suau, Jinke He, Matthijs T. J. Spaan, Frans A. Oliehoek.

# Context

1. Deep RL has poor sample complexity.
2. Deep RL can only be applied through simulation.
3. Simulators of large systems (if available) are very slow.

# Goal

Build compact simulators  
of large network systems  
that can run sufficiently fast



# Background

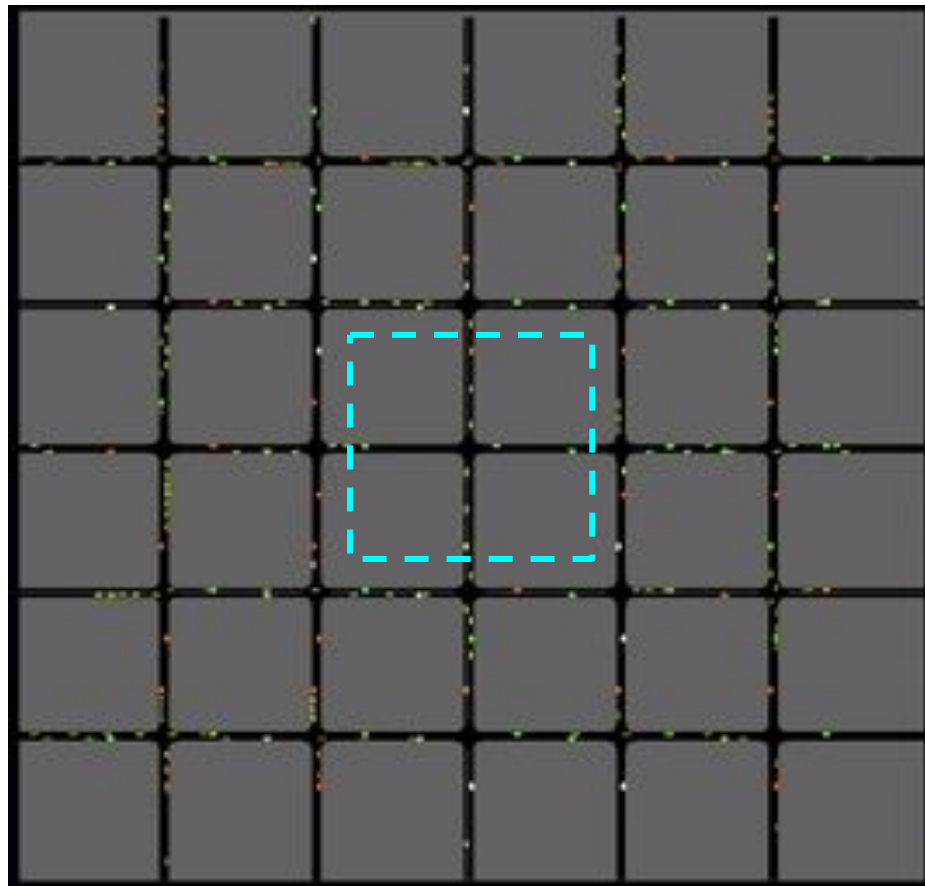
Local-FPOMDP

$\langle S, A, T, R, \Omega, O \rangle$

$X = \{X^1, \dots, X^j\} \subseteq S$

$O(\bar{o}_t | s_t) = \dot{O}(o_t | x_t)$

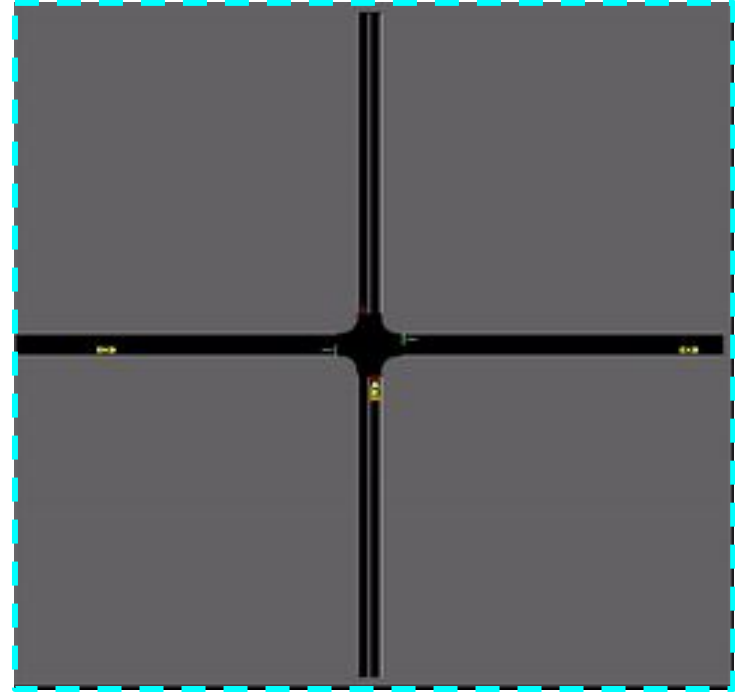
$R(\bar{s}_t, a_t) = \dot{R}(x_t, a_t)$



# Background

Local-FPOMDP

$$\bar{T}(x_{t+1} | x_t, a_t)$$

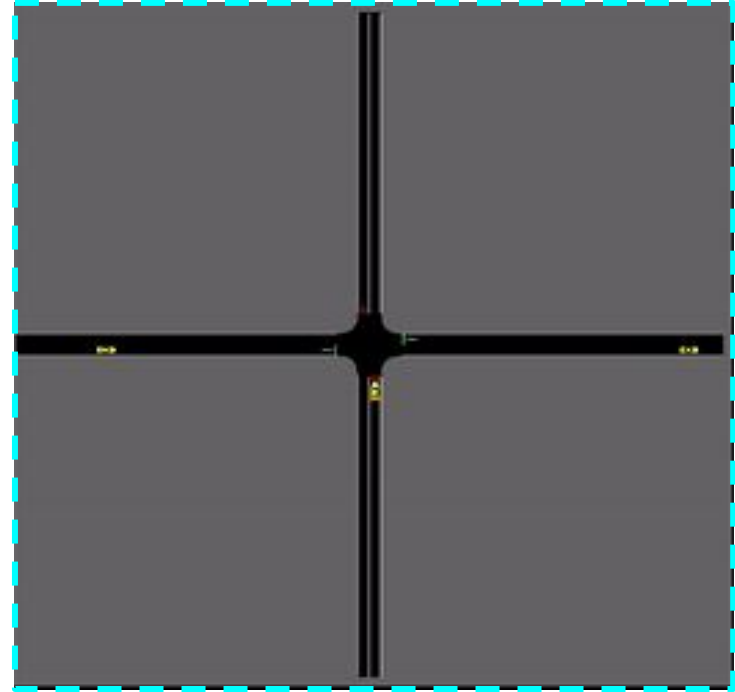


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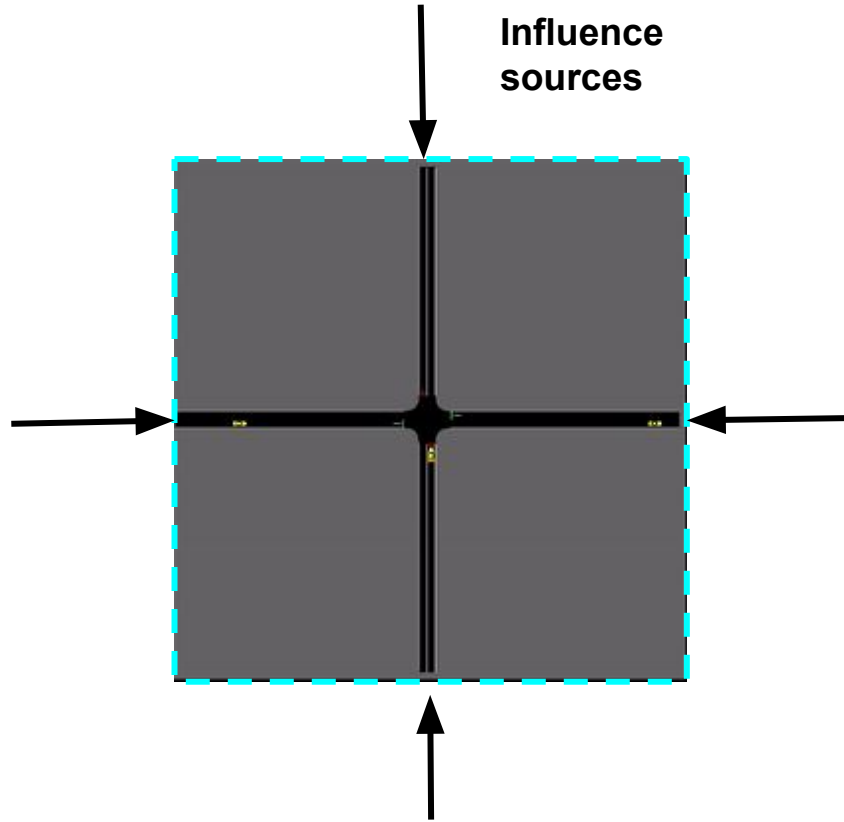
Local-FPOMDP

$$\bar{T}(x_{t+1} | a_t, a_t)$$

$$T(x_{t+1} | s_t, a_t)$$

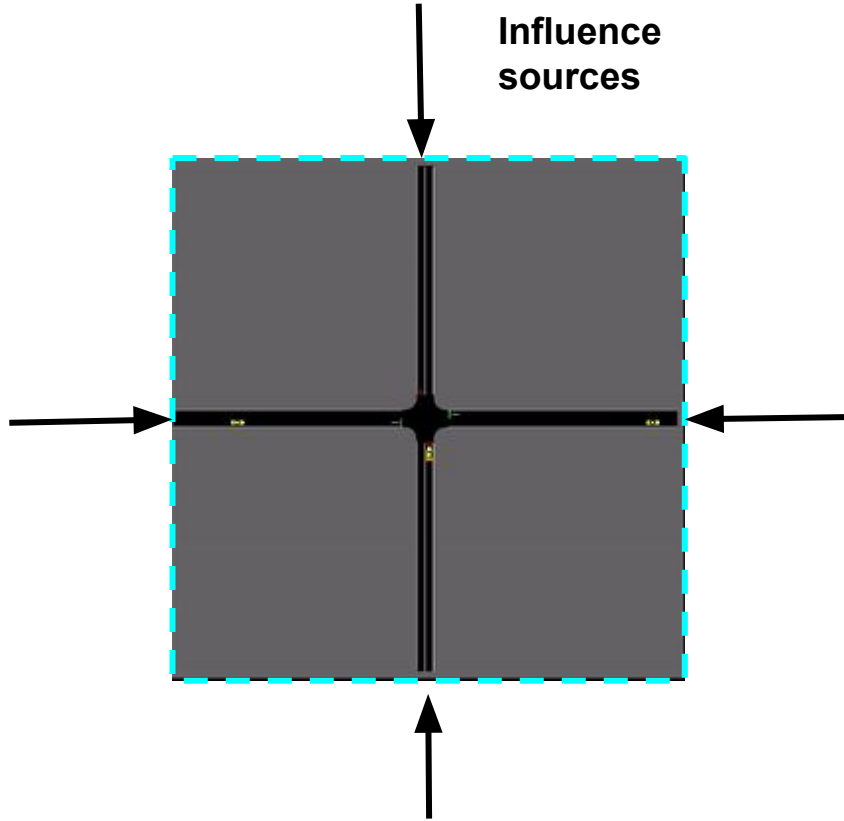


# Influence-augmented Local Simulators



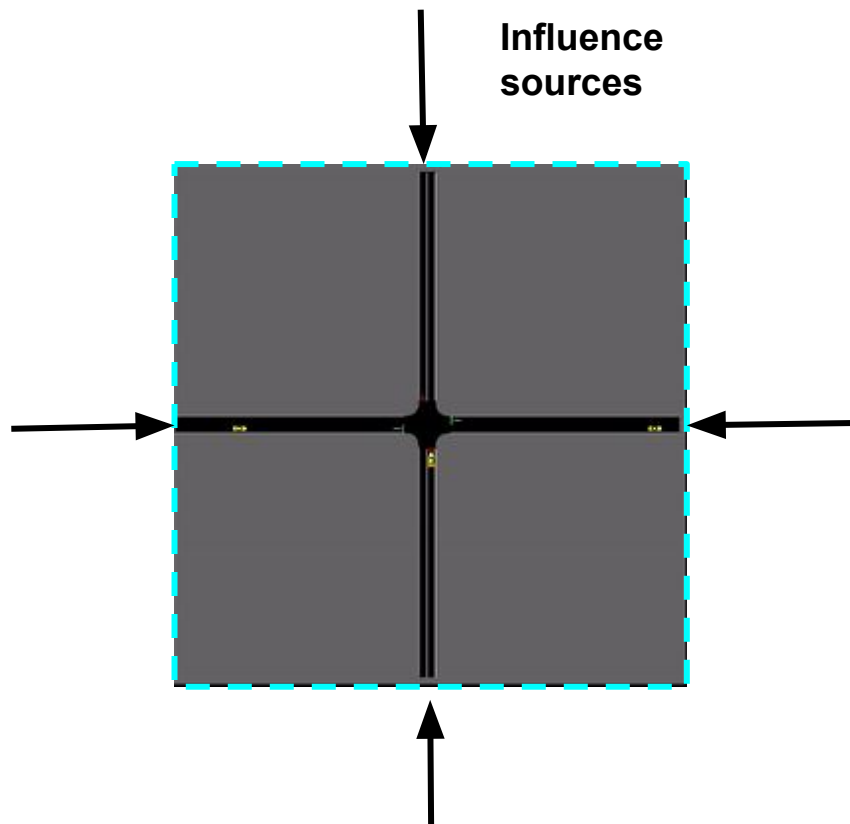
# Influence-augmented Local Simulators

$$\bar{T}(x_{t+1}|s_t, a_t) = \dot{T}(x_{t+1}|x_t, a_t, u_t)$$

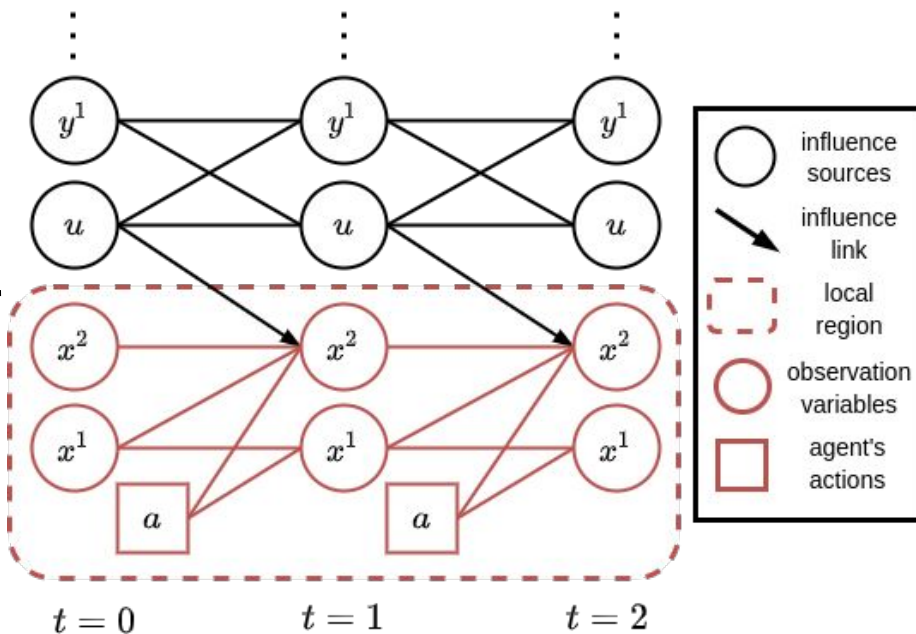




# Influence-augmented Local Simulators



$$\bar{T}(x_{t+1}|s_t, a_t) = \dot{T}(x_{t+1}|x_t, a_t, u_t)$$



# Influence-augmented Local Simulators

$$P(x_{t+1}|l_t, a_t) = \sum_{u_t} \dot{T}(x_{t+1}|x_t, u_t, a_t)I(u_t|l_t)$$

# Influence-augmented Local Simulators

$$P(x_{t+1}|l_t, a_t) = \sum_{u_t} \dot{T}(x_{t+1}|x_t, u_t, a_t) I(u_t|l_t)$$

$$D^{\pi_0} = \{(l_1, u_1), \dots, (l_N, u_N)\}$$

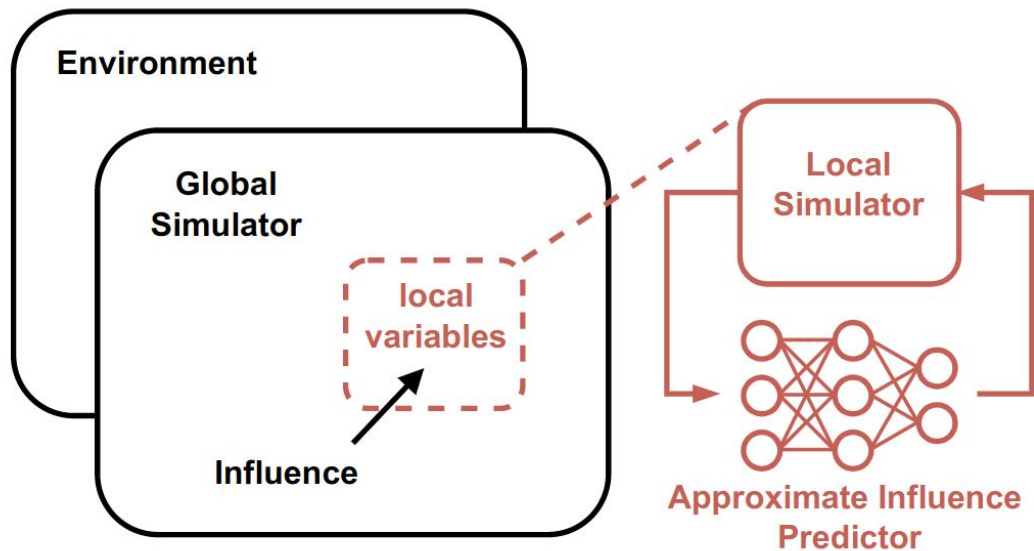
$$L(\hat{I}_\theta) = -\frac{1}{N} \sum_{n=0}^N \log \hat{I}_\theta(u_n|l_n)$$

# Influence-augmented Local Simulators

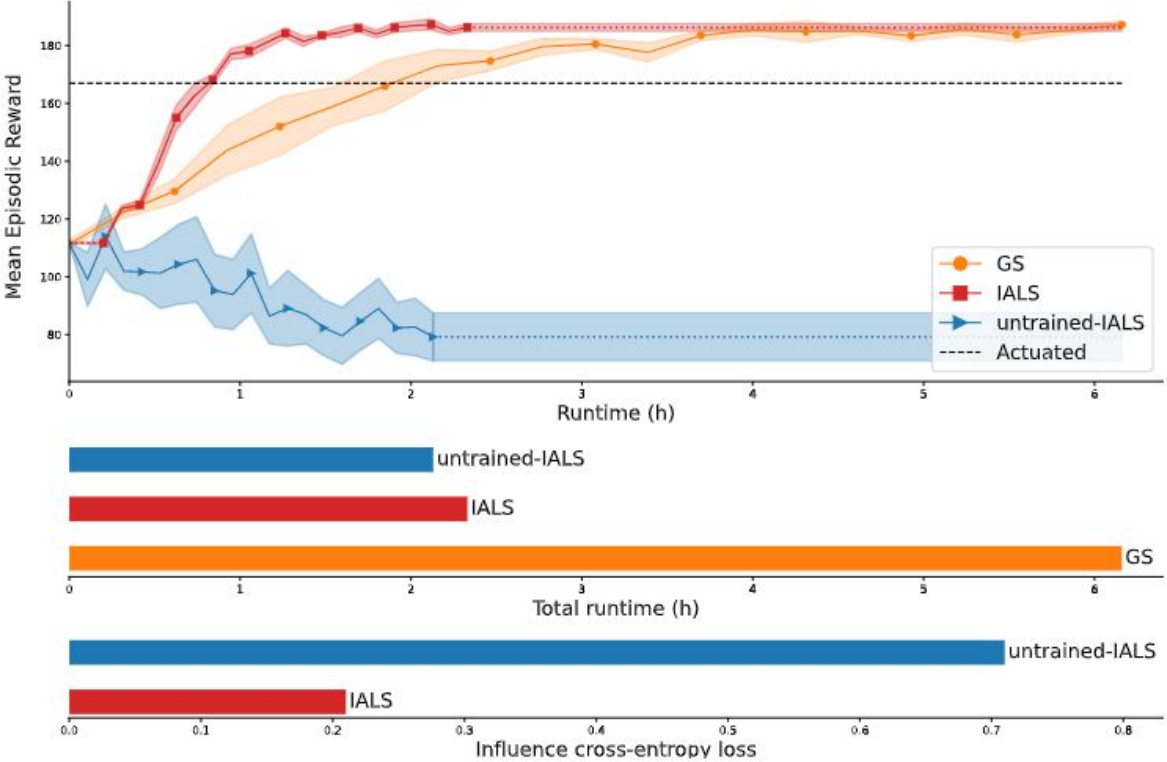
$$P(x_{t+1}|l_t, a_t) = \sum_{u_t} \dot{T}(x_{t+1}|x_t, u_t, a_t) I(u_t|l_t)$$

$$D^{\pi_0} = \{(l_1, u_1), \dots, (l_N, u_N)\}$$

$$L(\hat{I}_\theta) = -\frac{1}{N} \sum_{n=0}^N \log \hat{I}_\theta(u_n|l_n)$$



# Experiments



# Thank you!

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