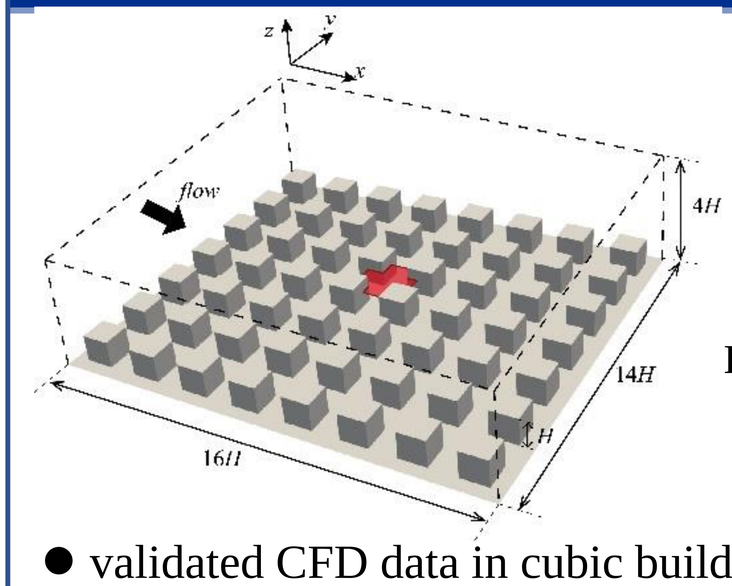
# Study on estimation of urban airflow distribution using sensor network

*Estimation of airflow distribution in urban models using machine learning*

## 1. Introduction

- Predictions of the airflow distribution in urban areas with high spatial resolution and high real-time nature are needed to rapidly respond to dangers around buildings.
- Calculation costs are high to obtain good accuracy using Computational Fluid Dynamics. Sensors can be used to measure airflow distributions in real time, but with very low spatial resolution.
- This study used the Conditional Wasserstein Generative Adversarial Network with Gradient Penalty (CWGAN) method.
- CWGAN can be used to estimate urban airflows with high spatial resolution and real-time performance from sensors information.

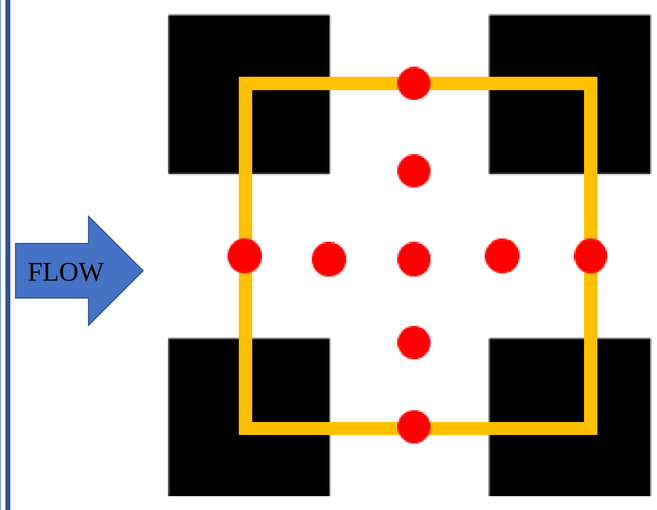
## 2. Airflow distribution data




Estimated region(red part)

- validated CFD data in cubic building models were selected as the database.

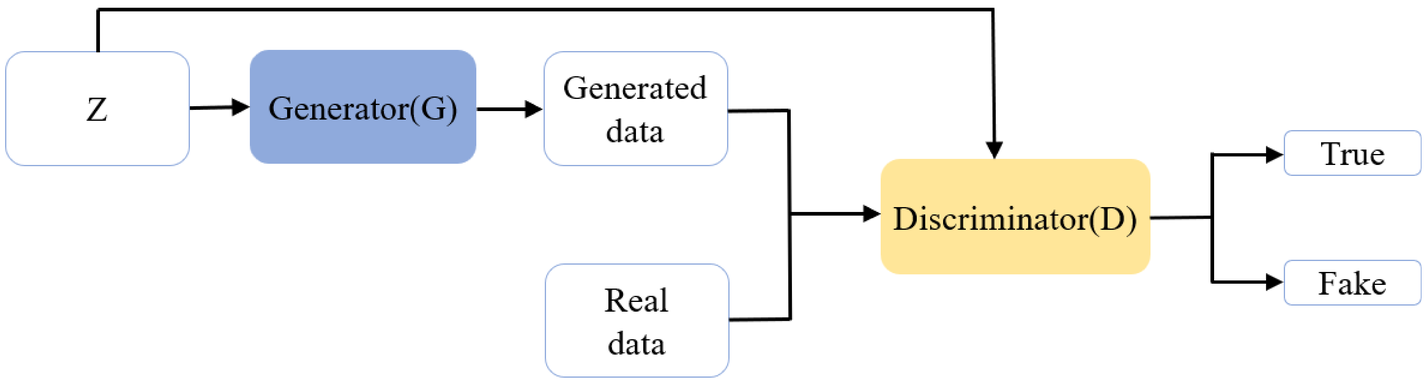
## 3. Measurements




Location of sensors
(red dots: sensors,
Black blocks: buildings)

- The velocity on the sensor were measured and used as input.

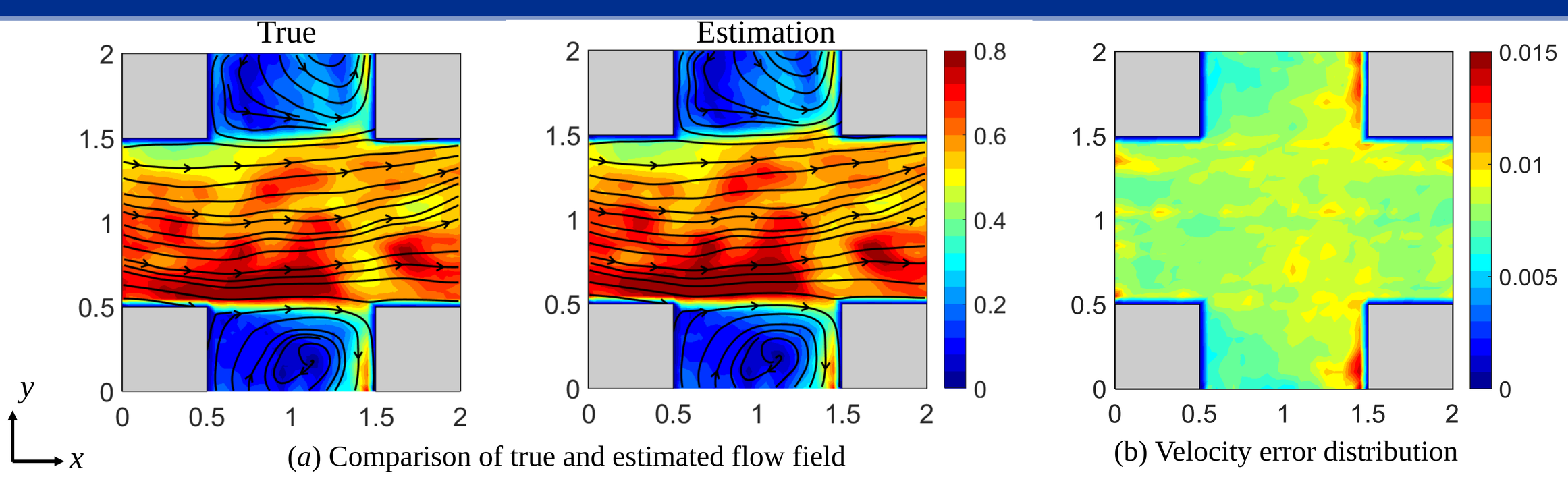
## 4. The method




Z: a matrix about sensor data
True: flow field data (CFD)
Fake: Generated flow field data

- ➢ G generates airflow distribution data based on sensor measurements.
- ➢ D not only distinguishes whether the input data is data produced by G or CFD data, but also determines whether the input data matches Z.
- ➢ G and D compete in learning, allowing G to generate estimates that are close to the CFD data.

## 5. Resluts




(*a*) Comparison of true and estimated flow field

(b) Velocity error distribution

- ➢ CWGAN can be used to estimate airflow distribution in urban areas.



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