Introduction

Fine particulate matter (PM2.5) has been identified as the most harmful particles to public health.

Monitoring and forecasting PM2.5 is a critical issue.

Traditional PM2.5 monitoring:
- **Ground stations**: coarse-grained, only 2D monitoring.
- **Mobile devices**: high energy consumption.

Key points:
- Fine-grained monitoring.
- Extends 2D monitoring into 3D.
- Real-time data presentation and future distribution prediction.

**Data Visualization Layer**
- A website-based GUI.
- Historical data charts, real-time and future distribution.

Figure 1. The overall architecture of AQNet.

System Overview

**AQNet**: Aerial-ground WSN system.

**Data Collection Layer**
- **On-ground Nodes**: 200 devices, high energy-efficiency.
- **Aerial Nodes**: A UAV for vertical distribution profiling.
- **Hybrid Nets**: optimize UAV’s operation using saliency analysis.

**Data Analysis Layer**
- **Feature Selection**: 9 features, including 3D location, current time stamp, weather condition, wind speed, wind direction, humidity, temperature.
- **Data Pre-processing**: spatial kNN and temporal kNN, select training samples.
- **Data Prediction**: training deep neural network (DNN) for real-time and future PM2.5 estimation.

Figure 2. The demonstration of AQNet in 2D and 3D scenario, respectively.

Demonstrations

- Real-time estimation in 2D and 3D.
- Future estimation in 2D and 3D.
- Statistical charts visualization in Peking University.

Application Prospects

- Real-time and forecasted fine-grained PM2.5 maps.
- Recommendation for wearing masks, open windows or turn on air purifiers.
- Help design ventilation systems for buildings.
- Recommend suitable sensor deployments.