

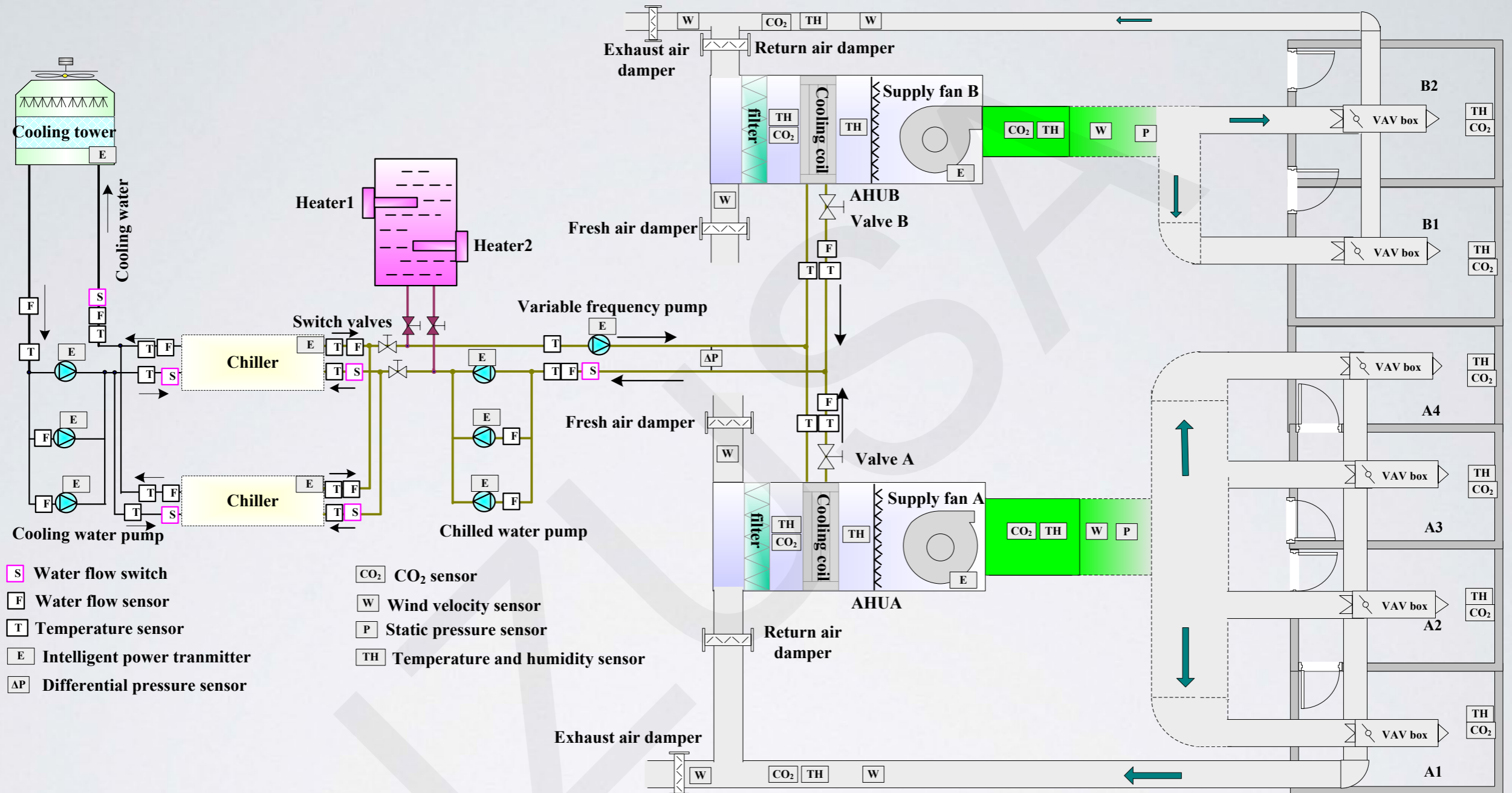
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## **Global optimal control of VAV air-conditioning system with iterative learning: an experimental case study**

### **Key words:**

air-conditioning system, large scale systems, iterative learning control, global optimization

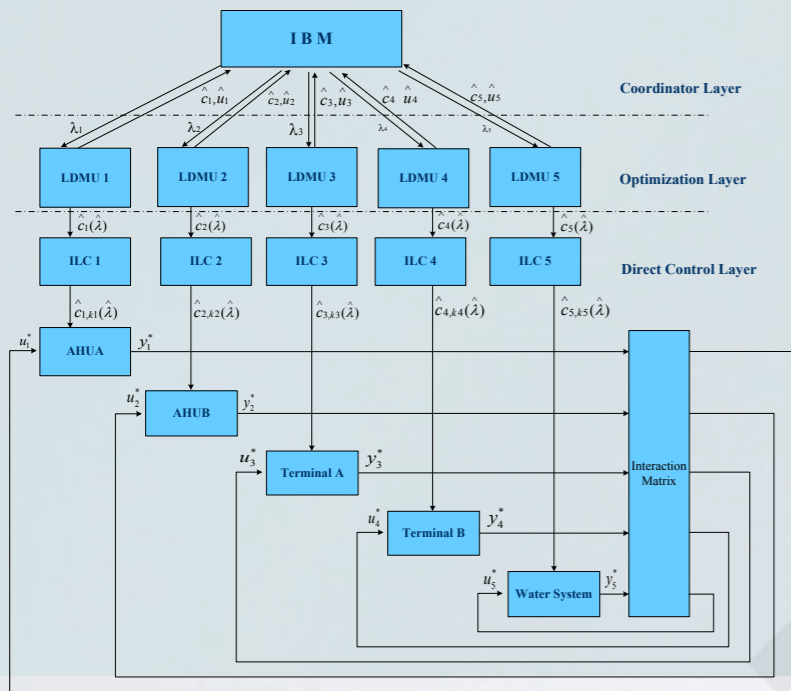
# Experimental Platform



The experimental platform is a multi-zone VAV-VWV air-conditioning system. There are six test rooms identified as A1 to A4 and B1 and B2 (Fig. 1, right). The six rooms are separated by insulation steel plate with polyurethane foam inside. The rooms have interior walls only (they are not adjacent to any exterior wall), so they are not affected by solar radiation. AHUA is responsible for rooms A1 to A4, and AHUB for rooms B1 and B2.

# Optimization, models and control strategies

## Optimization



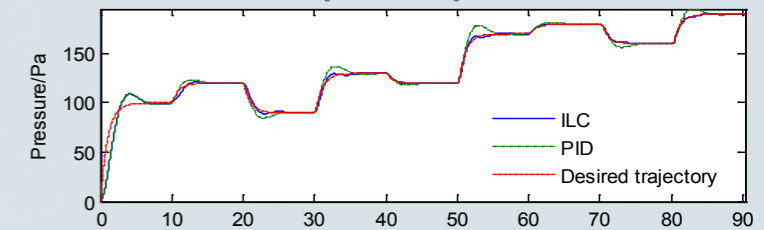
The hierarchical control structure is shown in Fig. 4.

## Models of the plant

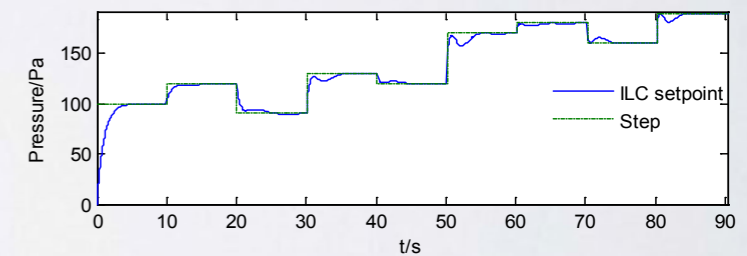
- Steady state models
- Dynamic models
- (1) Secondary pump differential pressure model
- (2) Air supply air temperature control
- (3) Static pressure control model
- (4) Energy Consumption Models

## Control strategies

- Gearshift integral PID
- Self-tuning PID
- Iterative Learning control (ILC)

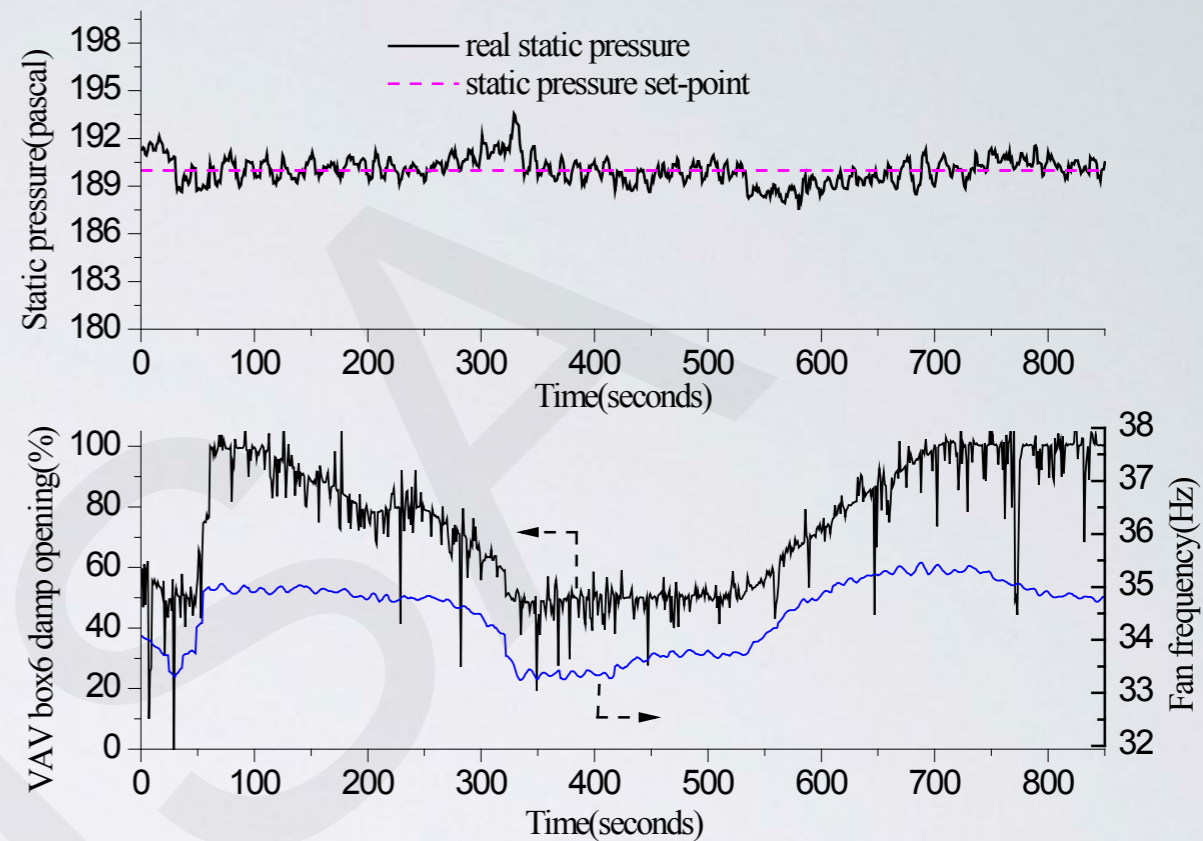
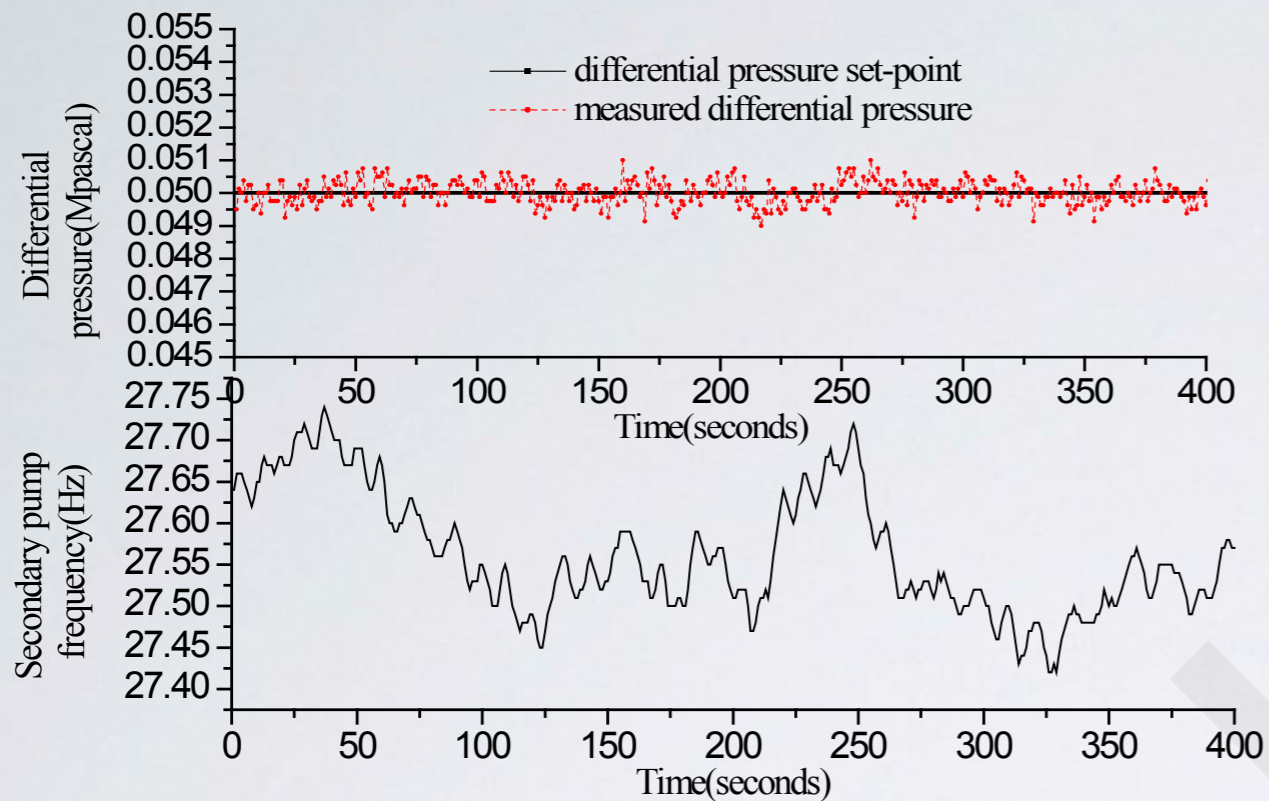


(a) Responses of the ILC strategy and step function-type



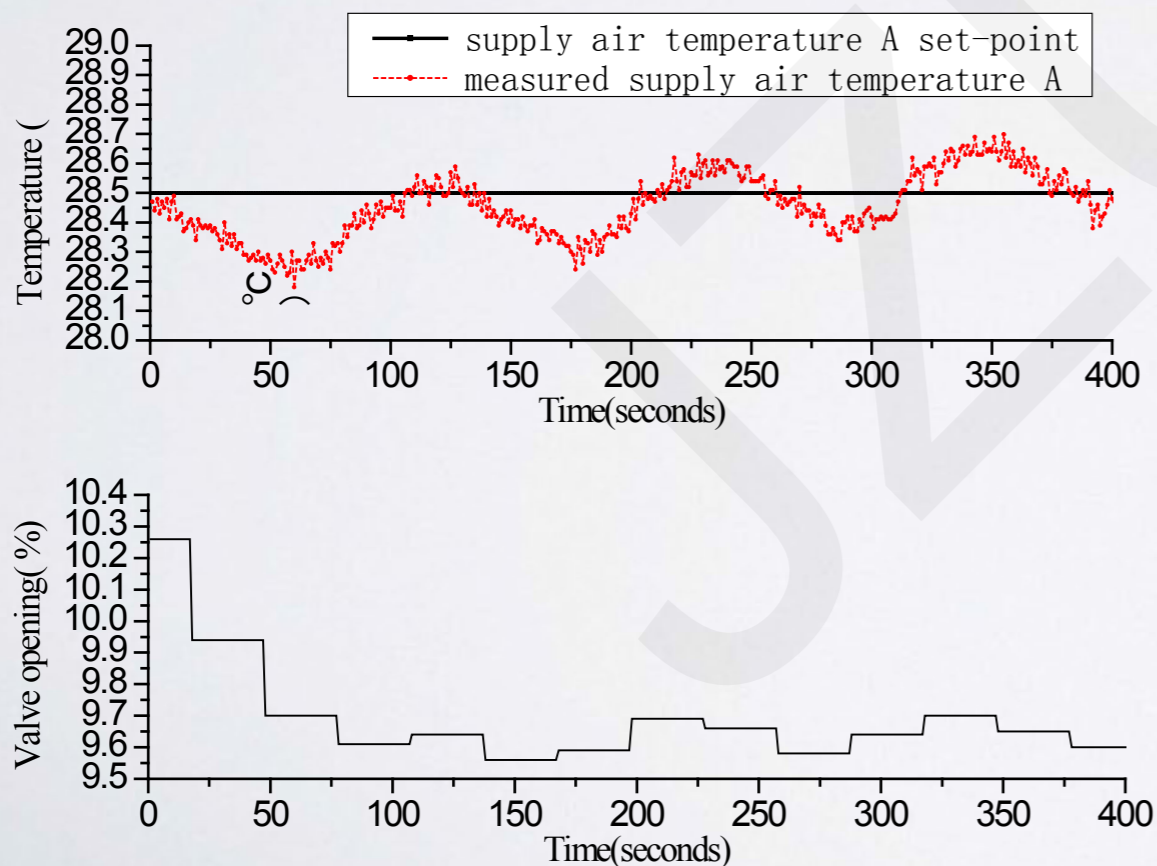
(b) Steady state of ILC control input and step input  
Fig. 8 Simulation results for ILC

# Results

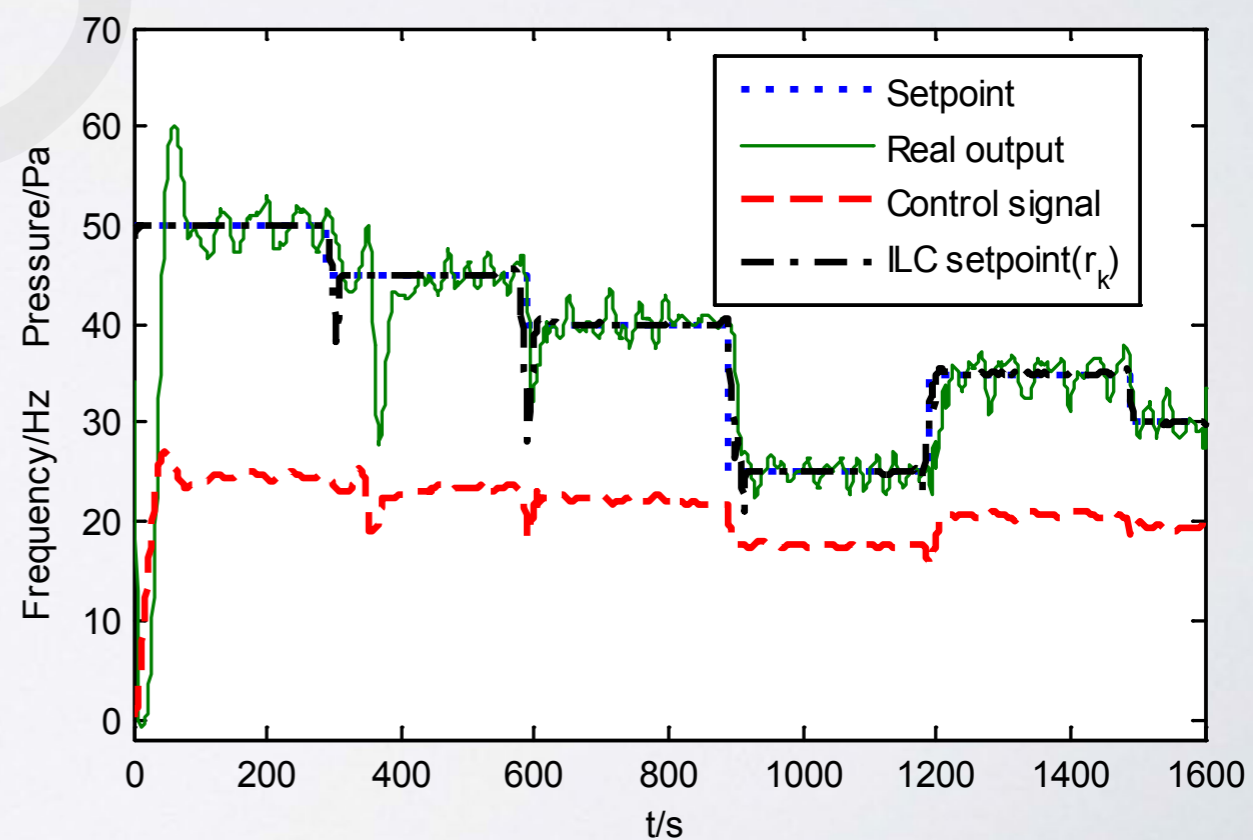


Control performance of secondary pump differential pressure

Closed-loop control of VAVBOX6 in AHUB

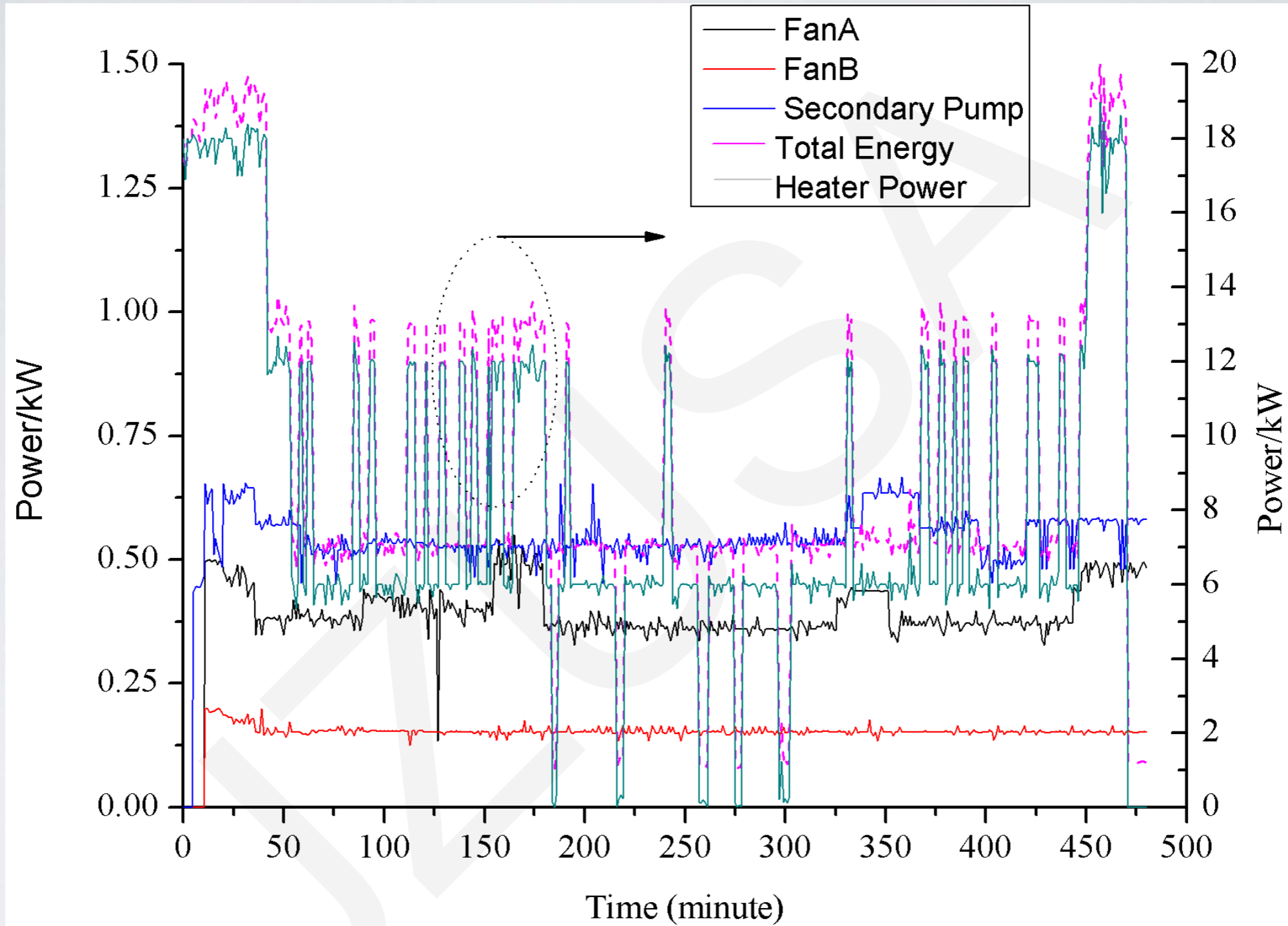


AHUA supply air temperature



Experimental results for ILC

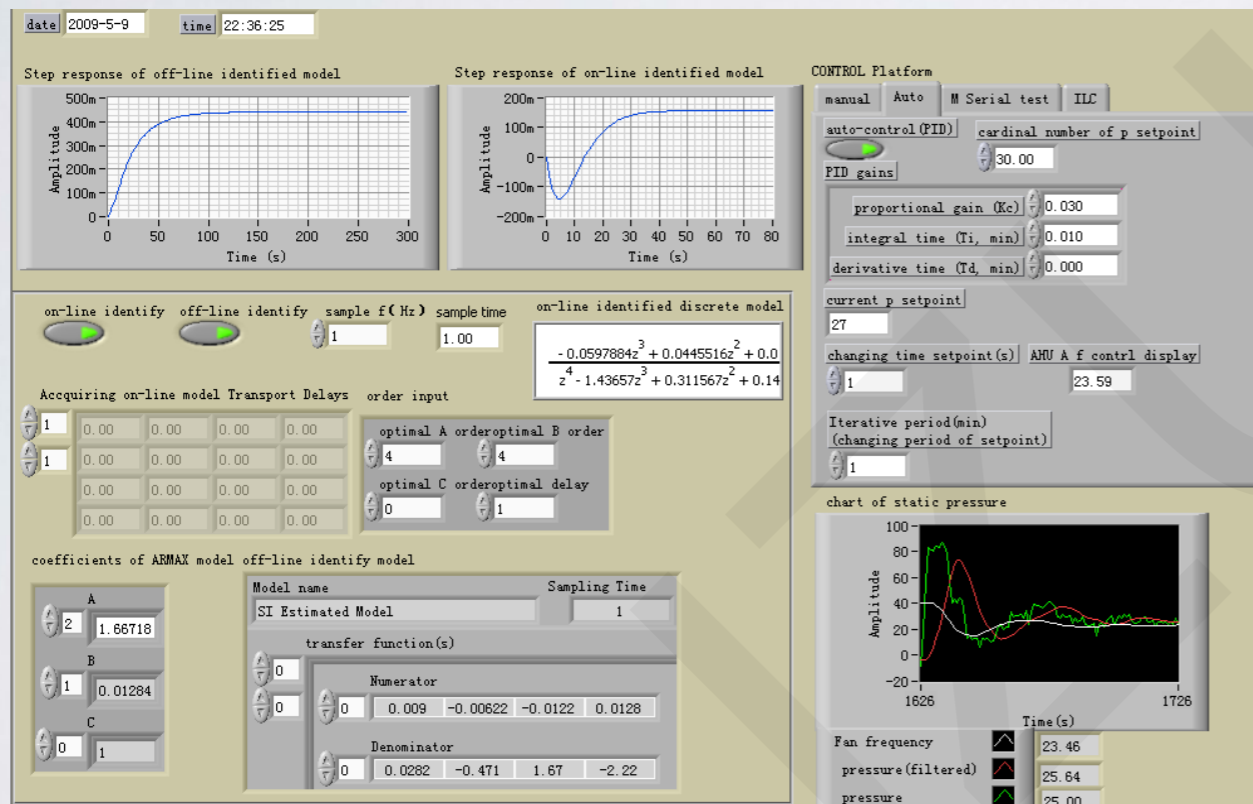
# Optimization Results



Energy consumption for one day

# Perspectives

How to coordinate the control loops is a big problem for application in a real system and requires further research. HVAC is a dynamic system, and sudden changes, such as opening of doors and windows or fluctuations in indoor occupant numbers, have great effects on indoor contaminant concentration. How to deal with such dynamic situations in buildings is our future research issue.



Partial Interface for Monitoring and Control



Partial photo of experimental platform