# Advanced Data Analytics and Optimal Control of Multi-zone Air Handling Units

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**Objective:** To apply advanced data analytics and optimization algorithms for energy-efficient control of AHUs.

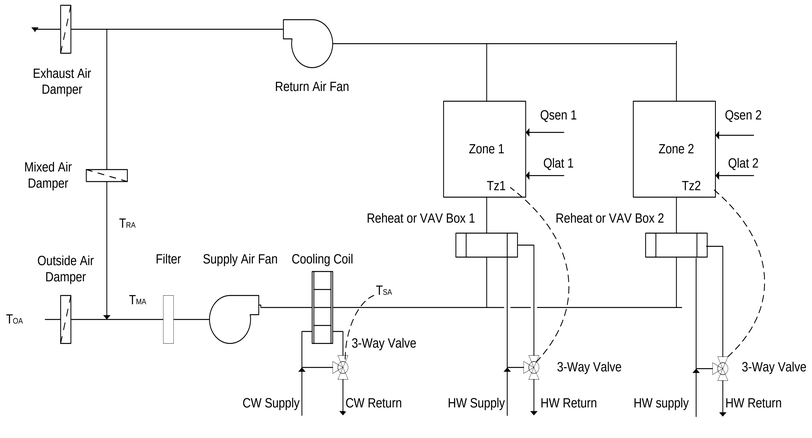
## Motivation:

- Buildings-related energy use is 10% of total US energy, 50% of which is HVAC.
- Traditional rules-based controls are the norm but require extensive system level knowledge and continuous M&V for efficient operation.
- There is a clear need for a powerful yet generic framework for intelligent and optimal control of energy systems.

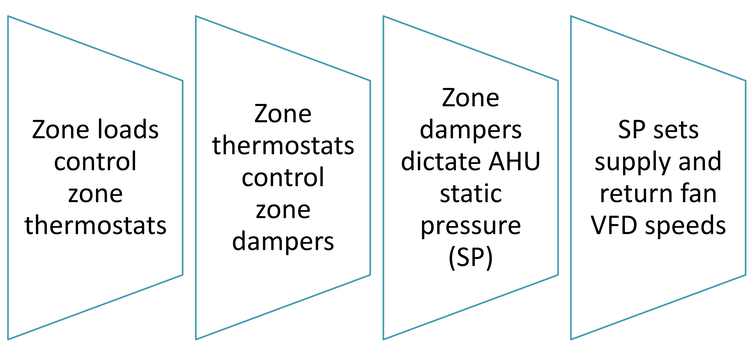
## Methodology:

- Acquire, clean and warehouse data.
- Detect faulty data points and discard.
- Generate a system emulator model using ANN or other advanced machine learning algorithms to develop a control surface.
- Use a reinforcement learning framework to navigate the control surface to reach operational optimality while improving the system emulator over time using transfer learning.

## System:



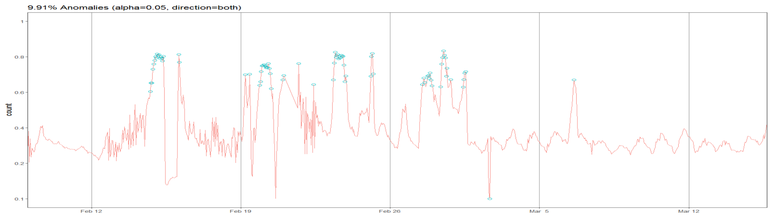

## System Operation Intuition



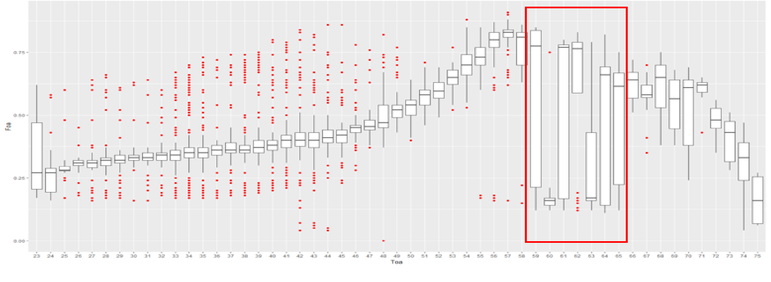

## Results:

### *Faulty Data Detection:*

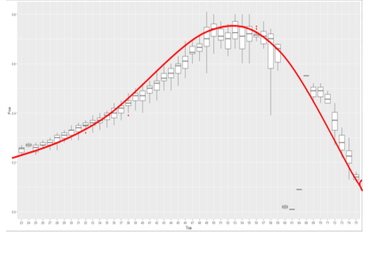
#### *a. Time-series Anomaly Detection*

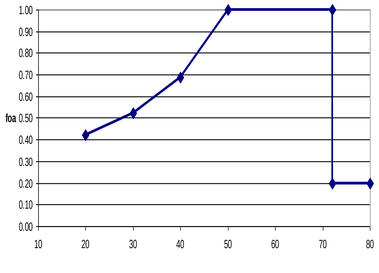



#### *b. Statistical Outliers and Inferential Variance Bands*

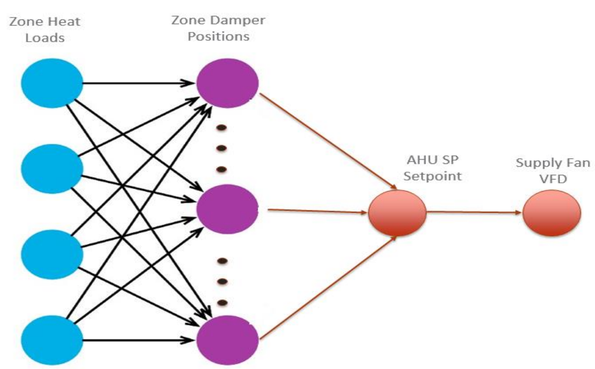



#### *c. Naïve Estimation vs. Expected Operation Curve*

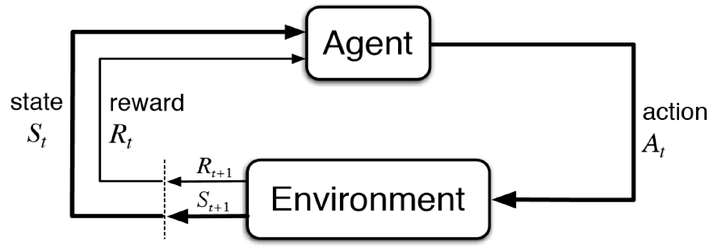


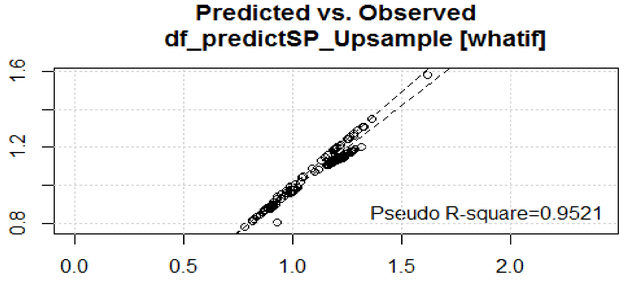



## *System Model:*




## *Reinforcement Learning Framework:*




## *Optimal AHU SP Setpoint Profile:*