Emulator description

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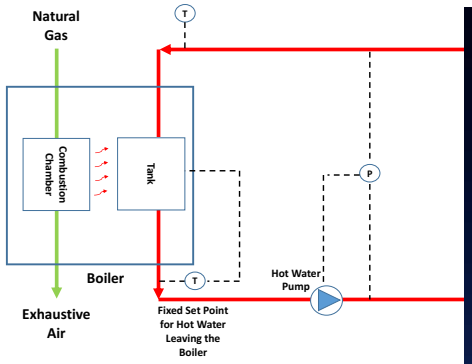
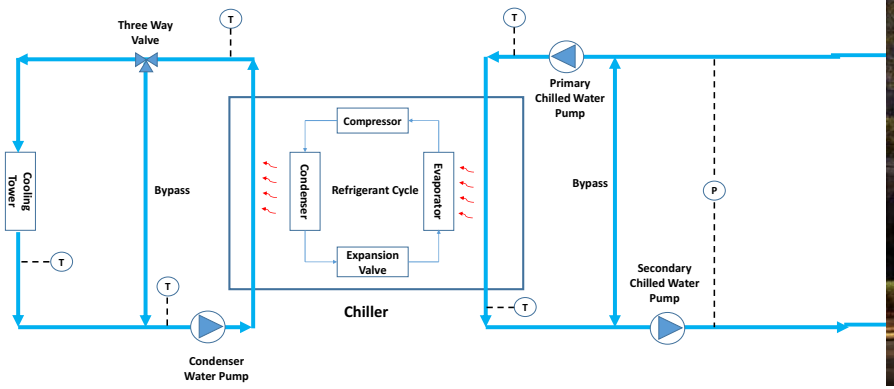
A virtual testbed for the design and evaluation of advanced control methods



Hot Water System



Chiller Water System

Large Office Building

Emulator description

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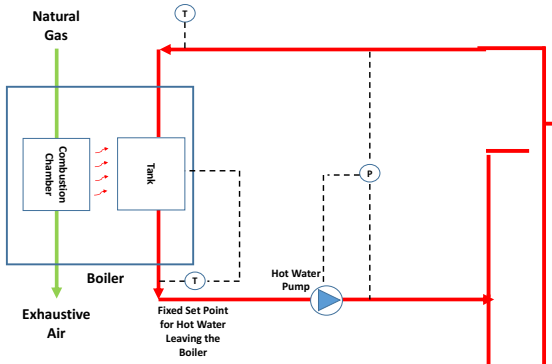
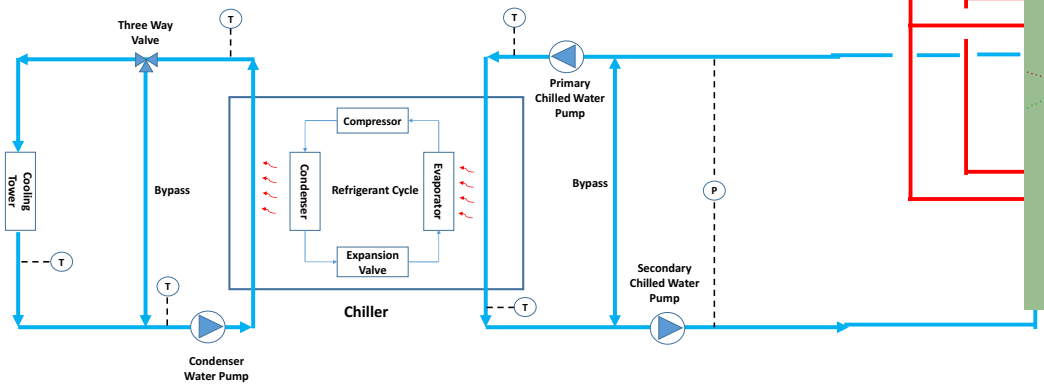
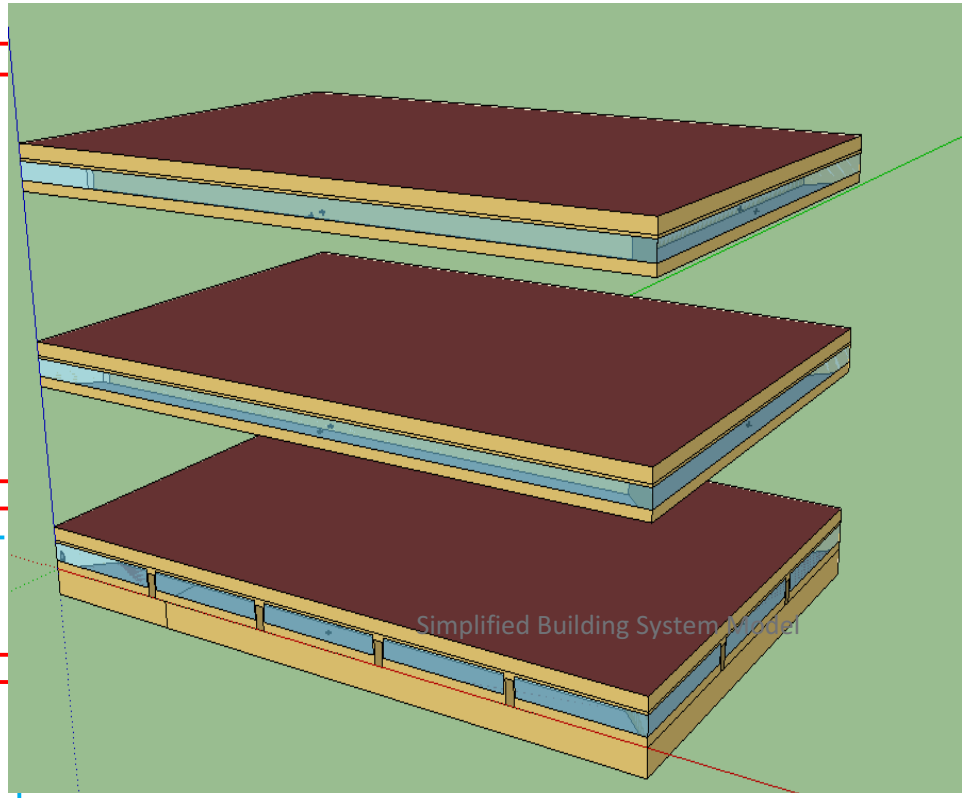


Hot Water System



Chiller Water System



Large Office Building

Emulator description

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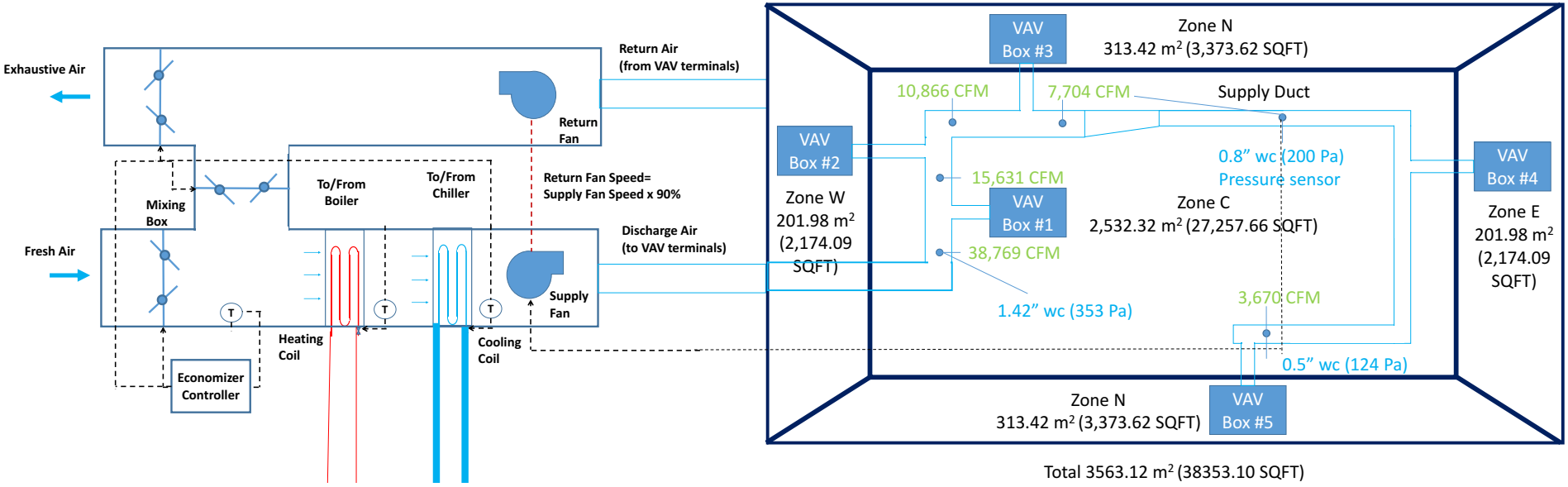

Air Handling Unit

Floor layout and air distribution system

Emulator - control interface

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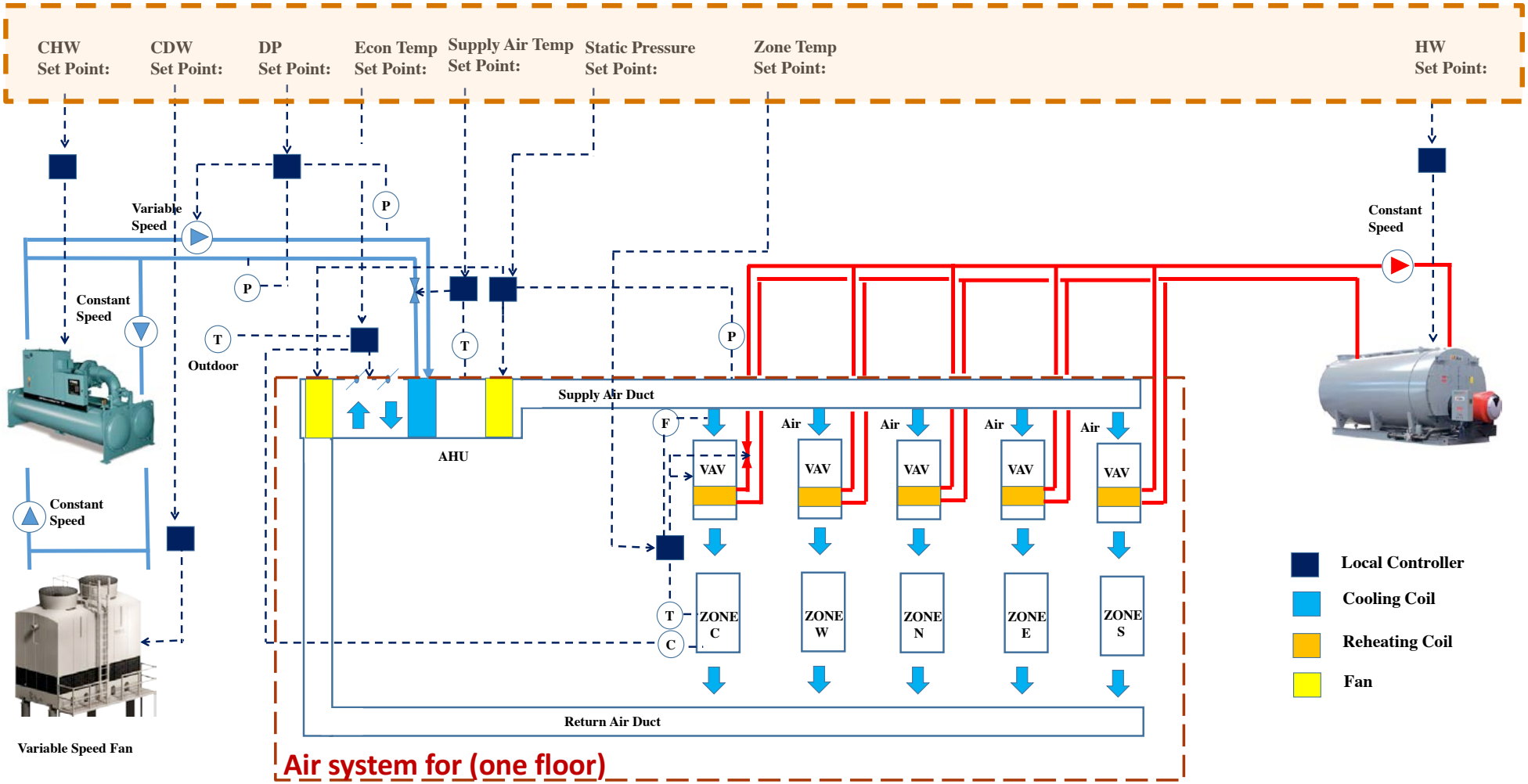
Set-points available for supervisory control



Control baseline

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	Control / Operation Specifications	"Typical Building" Control	"New Building" Control
System Operation Mode	Occupied Mode	Start the HVAC system 2 hr ahead of occupancy schedule	Same
	Cool down /Warmup Mode (Optimal start)	No optimal start	Optimal start (start system 2 hours before occupied mode)
	Unoccupied Mode	Unoccupied heating and cooling setpoint	Same
Air Handling Unit	**Supply /Return fan control**	Fixed static pressure	Static pressure reset based on terminal box status
		Fixed differential speed ratio between supply and return fan.	Same
	Supply air temperature control	Fixed supply air temperature	Supply air temperature reset (VAV box status based)
	Minimum outdoor air control	Fixed minimum OA damper position	Minimum OA flow reset using Demand Control Ventilation
	Economizer	Fixed dry bulb	Fixed Enthalpy
Terminal Box	Discharge Air temperature control	Modulating based on heating demand	Same
	Airflow control	Single maximum control logic (Fixed heating airflow, and modulating cooling airflow)	Dual maximum (Heating max airflow and cooling max airflow)
Relevant ASHRAE standard		Modified based on ASHRAE 90.1-1989 and 1999	Modified based on ASHRAE 90.1-2013

Emulator - fault insertion

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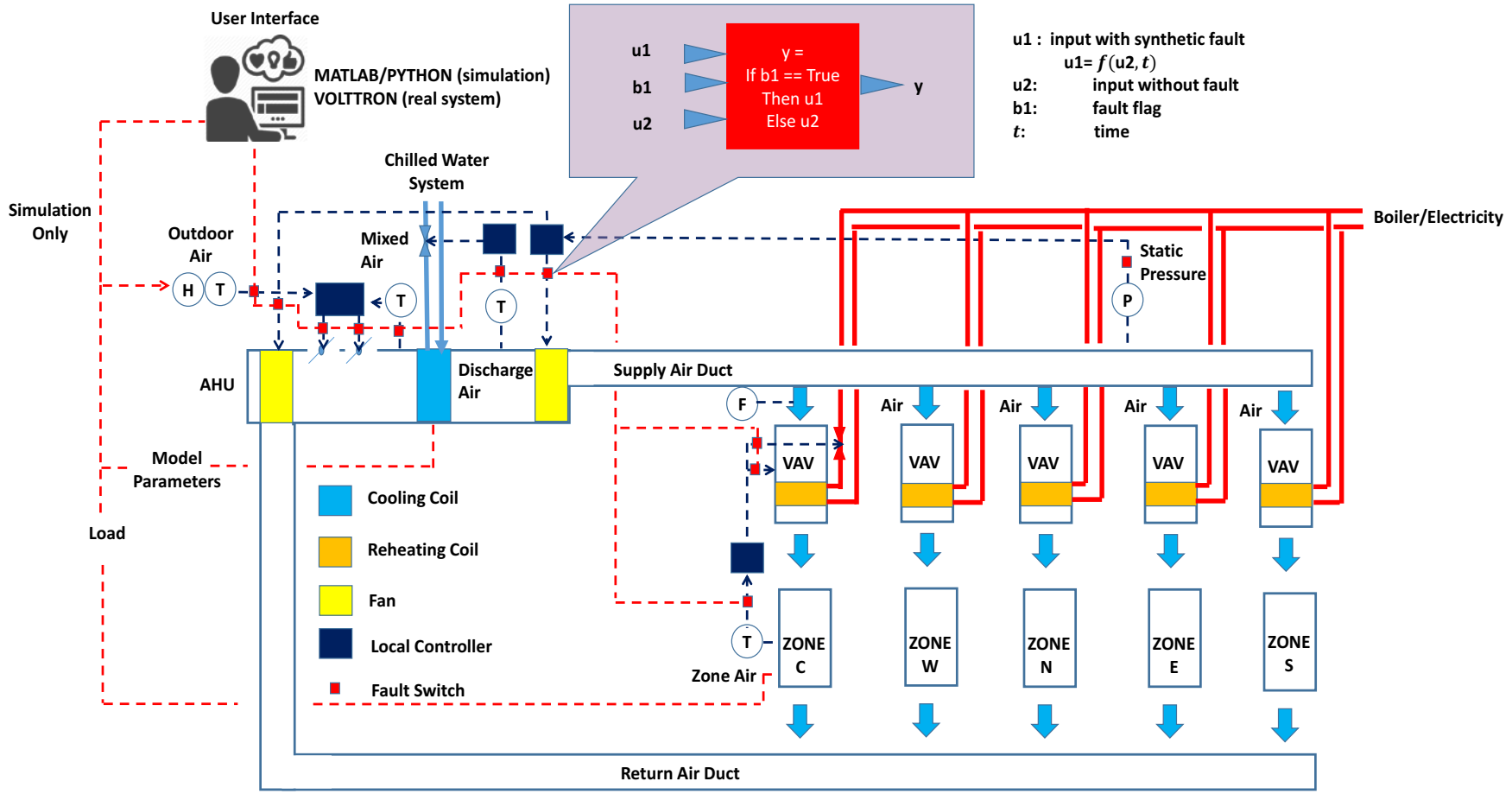
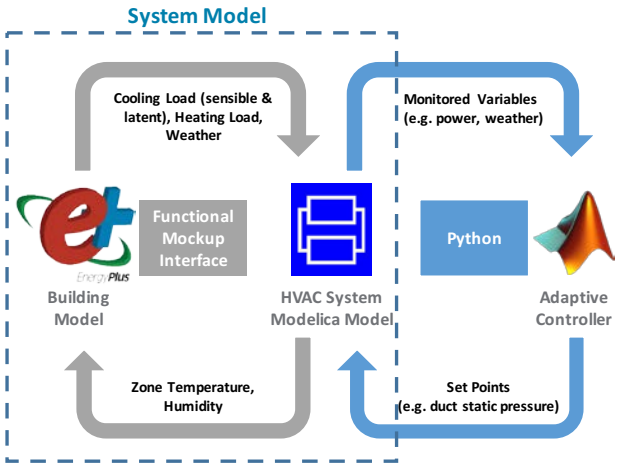
Current fault insertion capability for air handling unit and terminal box

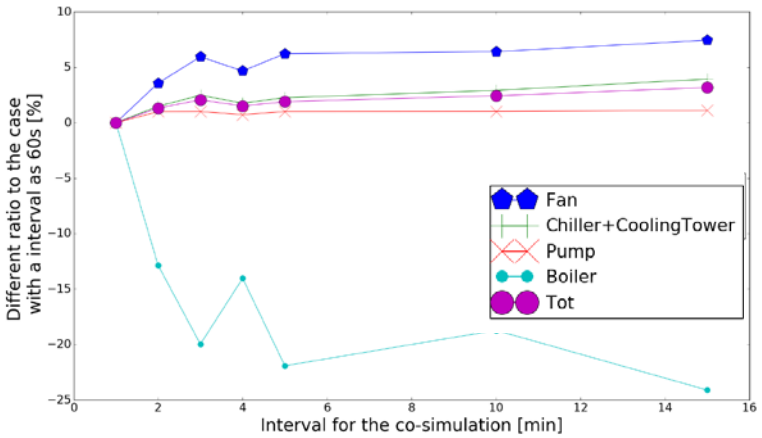


Emulator performance evaluation

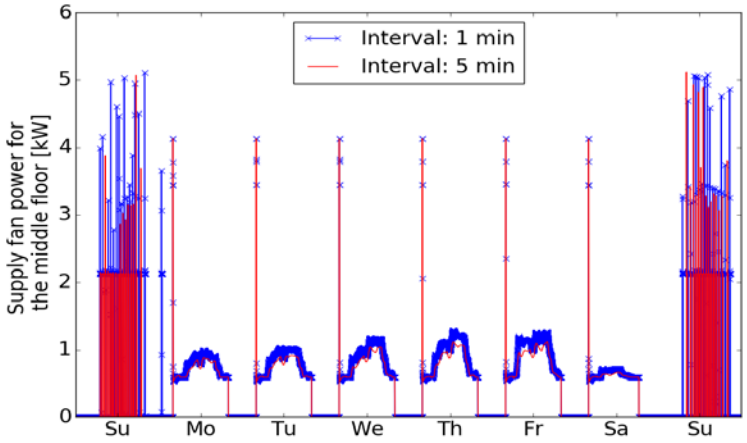
Effect of co-simulation interval ("typical building" control sequence)



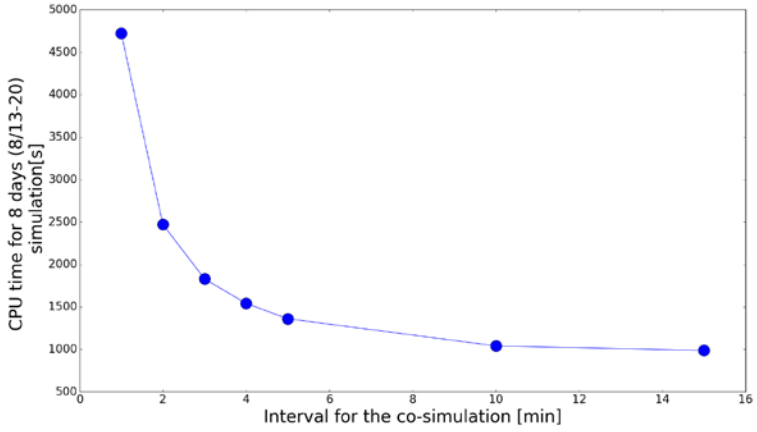
Energy performance



Transient performance



Computational performance



PNNL participation in IBPSA Project 1

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BOPTEST

FY18 proposed contributions

- Existing emulator: large commercial building with single duct AHU and VAV
- Enhance emulator
  - Complex building floor layout (increase number of zones and usage diversity)
  - Integrate with occupancy simulation - to test advanced occupancy-based control
  - Develop the water side system to a chiller plant
  - Evaluate numerical simulation performance (accuracy and computation time)
- Integrate the emulator within the BOPTEST framework
- Specification of performance evaluation metrics and evaluation procedures
- MPC control formulations
- Disseminate capability and results through publications and presentations