From Model-Centric to Data-Centric: A Practical MPC Implementation Framework for Buildings

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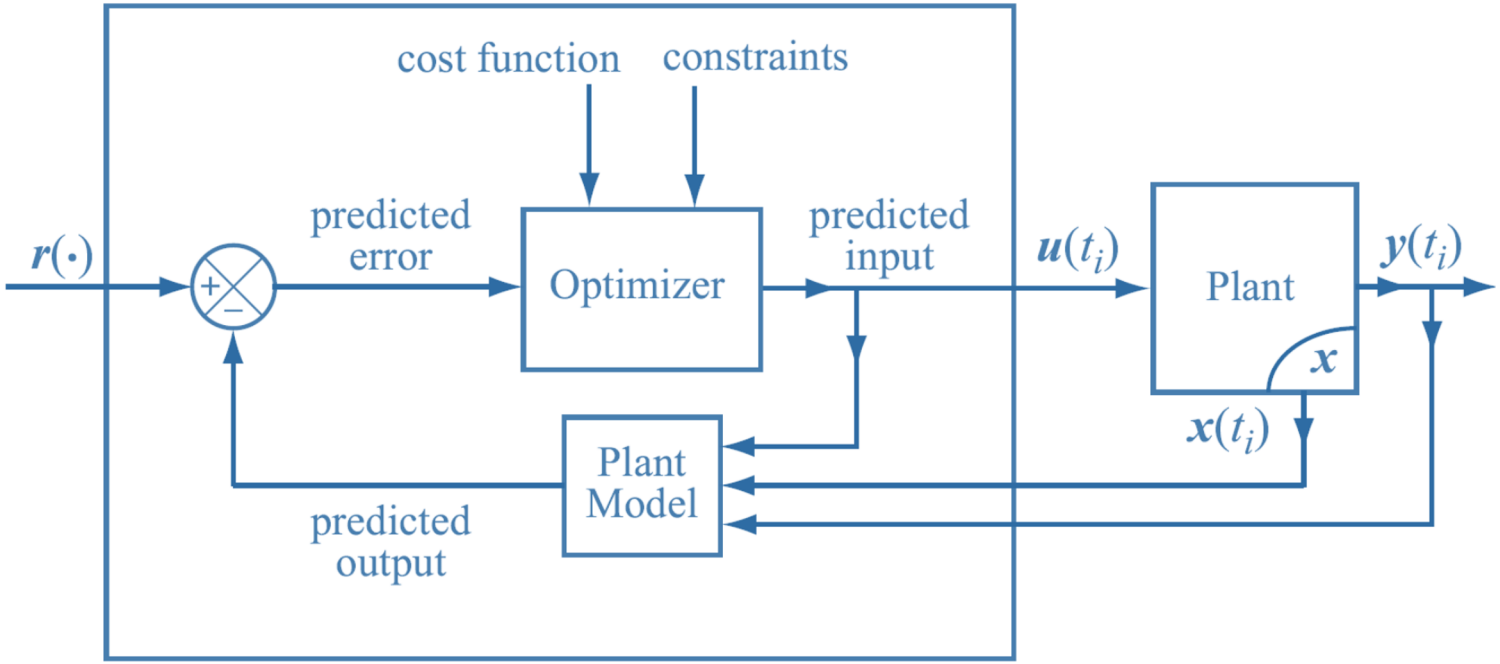
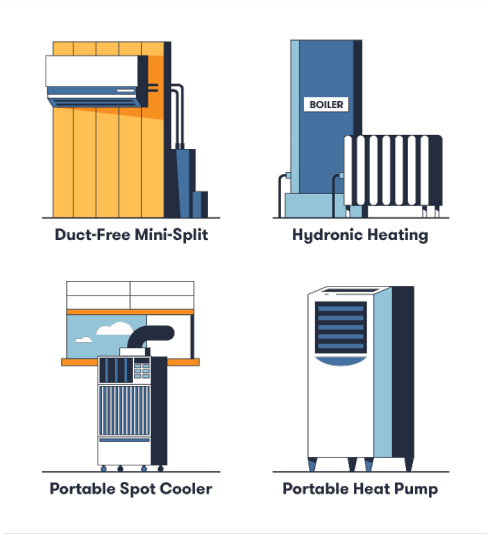


Model predictive control ———— in buildings

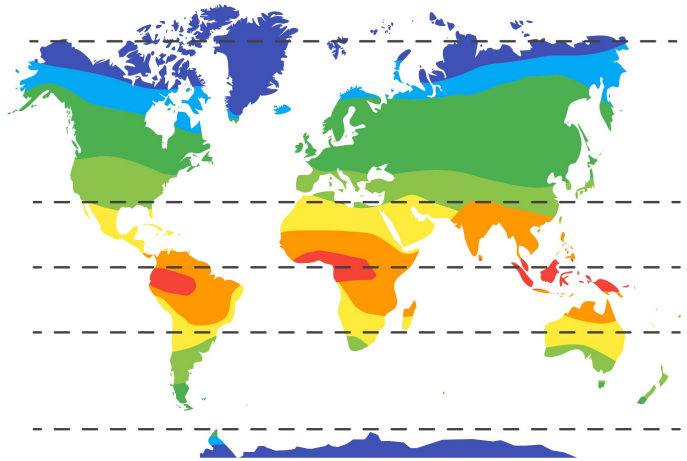
- ✓ Well-established optimal control framework
- ✓ Successfully implemented in places such as industrial process control

- Research since the 90s
- >70% studies were simulation
- >60% studies less than 5 zones
- Why?

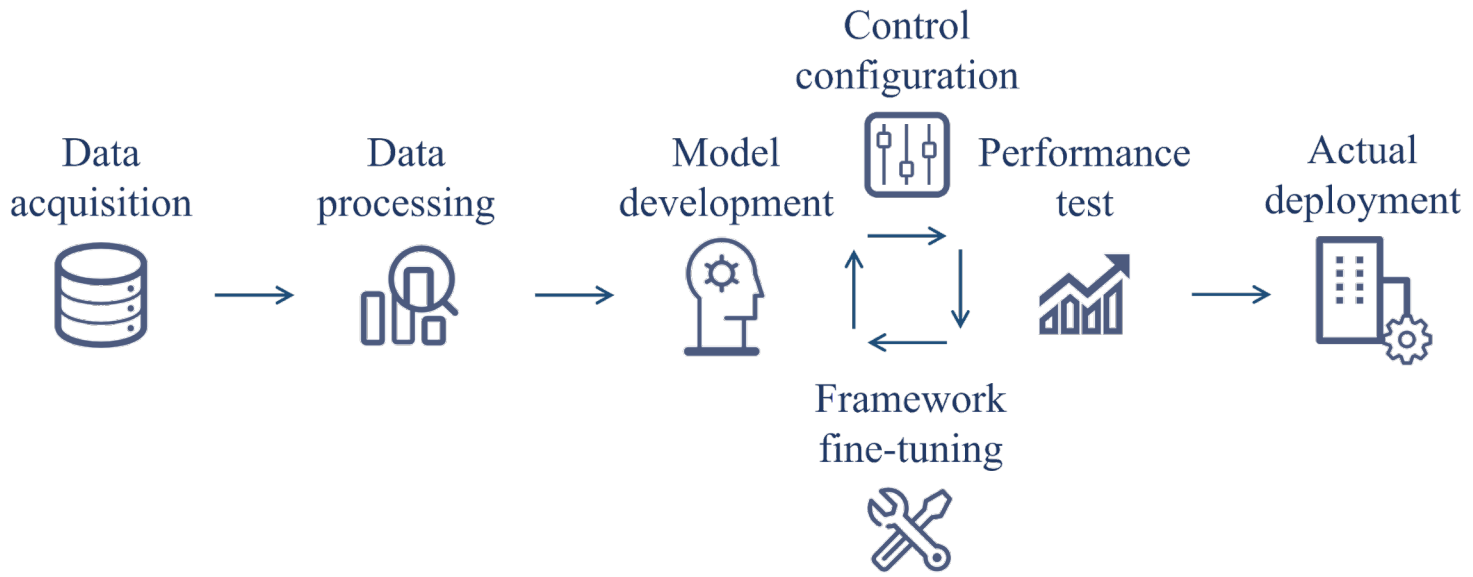
Heterogeneity across buildings



- Building type
- Climate condition
- HVAC systems
- BMS systems



Model-centric/data-driven configuration procedure



- Work with the given data
- New models developed in each study
  - White/gray/black box models
- Expert-driven procedure to be repeated every time

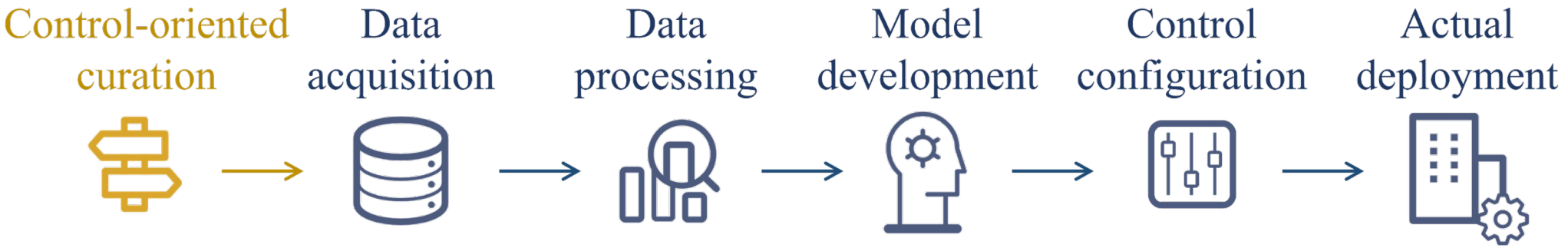
x Ungeneralizable experimental results

x Key data points missing, many unused

x Unpredictable implementation cost and control performance

Buildings have potential, and data decides how much can be realized.

Data-centric configuration procedure

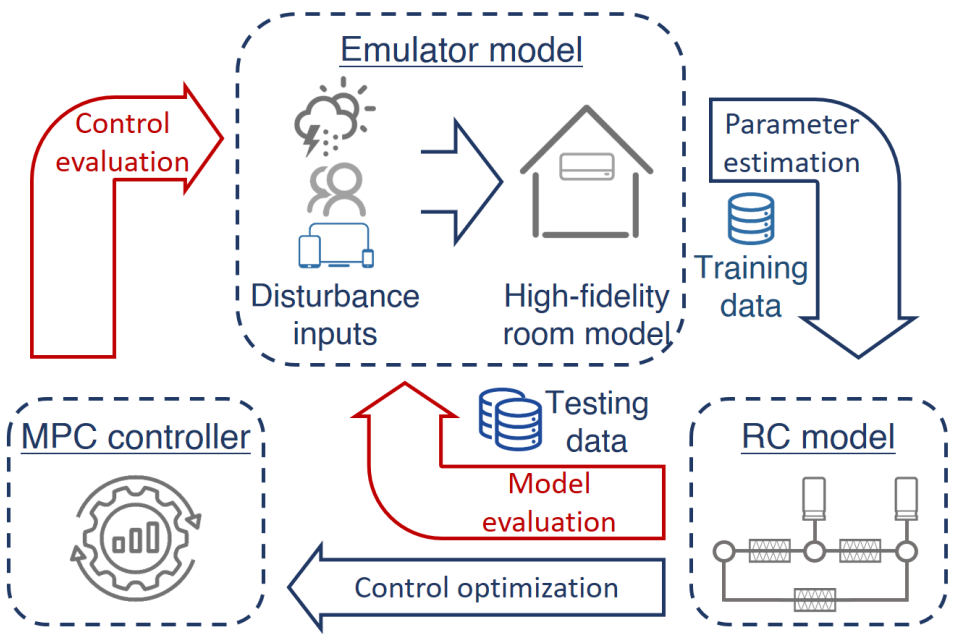


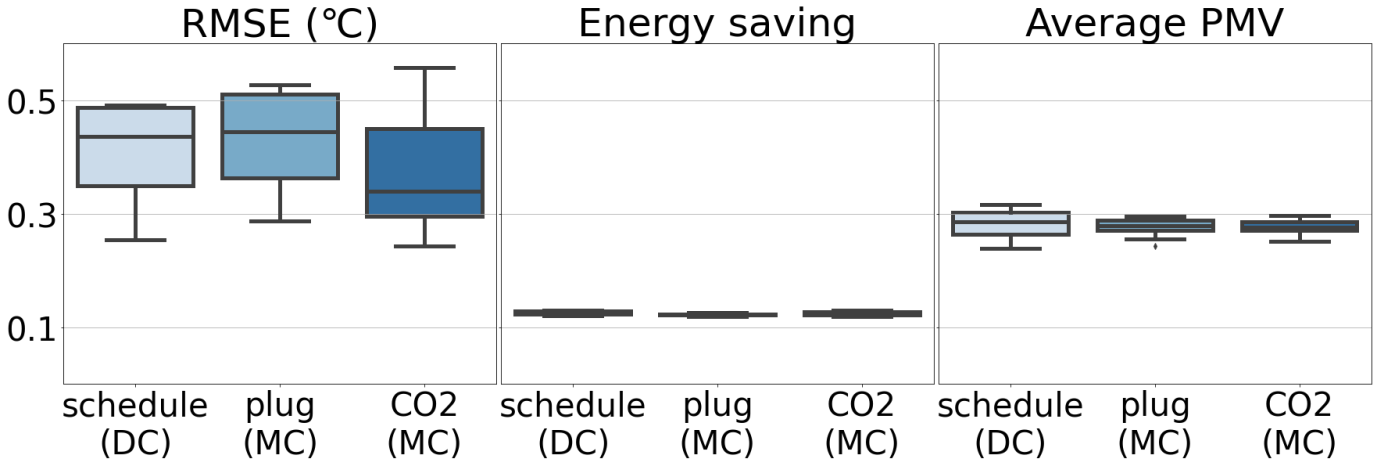
Control-oriented curation

- Data acquisition based on the need of control scenario
- Established relationship between data and performance

- Informed model and control configuration
- Performance subject to data availability
- Reproducible for a certain type of buildings

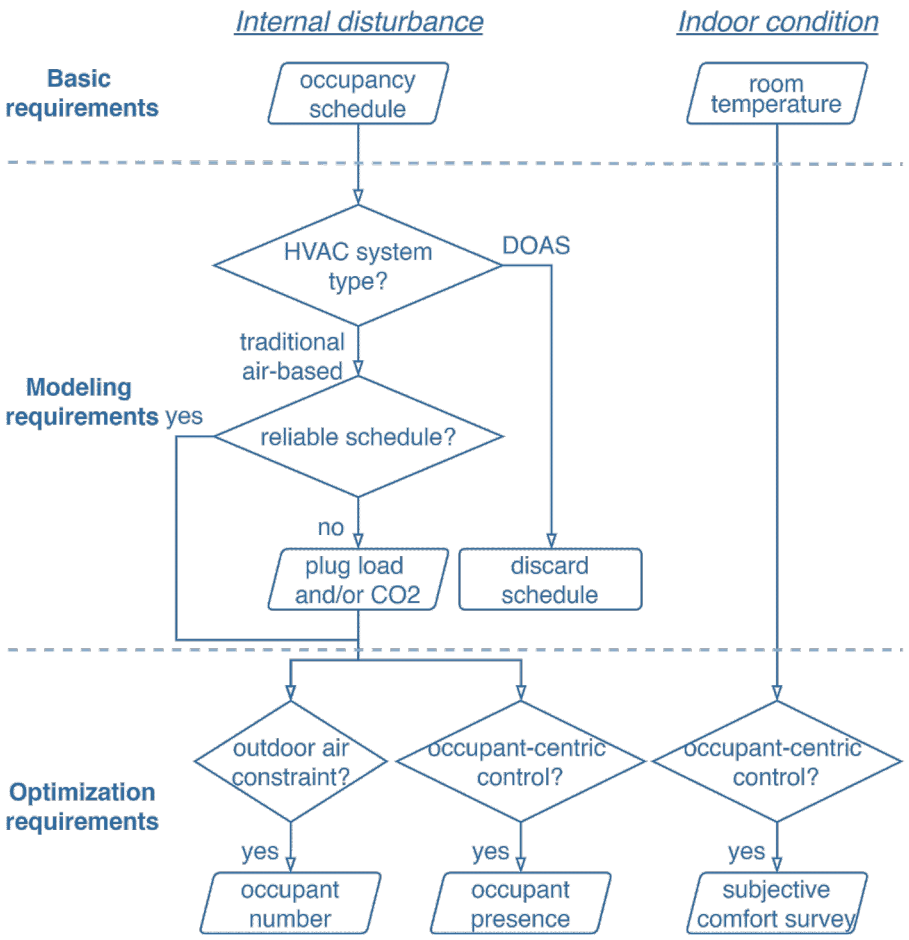
Showcase #1: is real-time occupant-related data necessary?

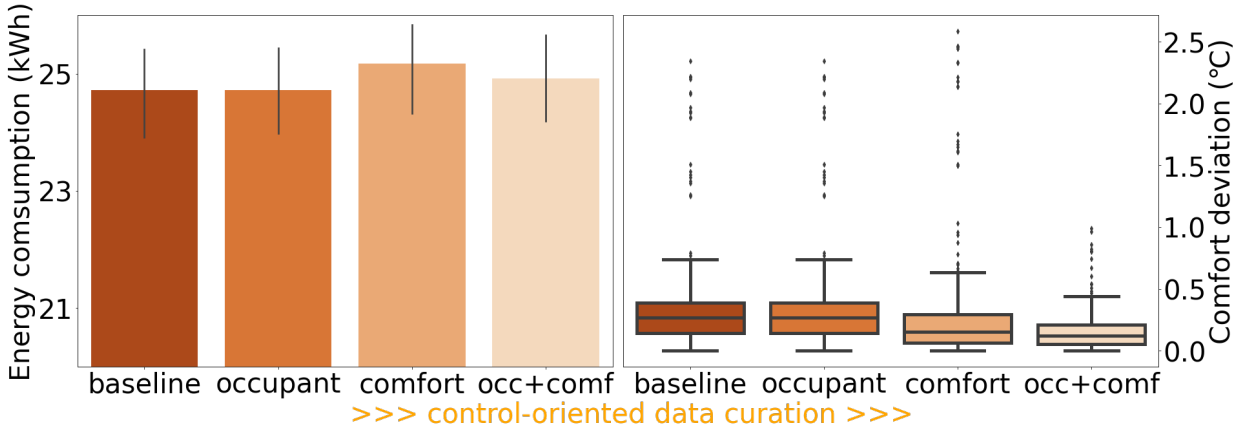




- Static design schedule was found sufficient for offices in the tropics
- Good control performance achieved without the cost of real time measurement for internal disturbances

Showcase #2: how to account for personal thermal preference in offices?



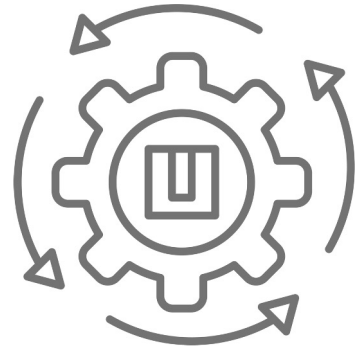


Occupant-centric control in an office

- Time-varying thermal preference to capture
- Data requirements of occupant presence (who is there) and comfort survey (personal preference)
- Data-centric approach achieved over 50% of reduction of comfort deviation

Future work

Absolute quantification of data informativeness



Automation of active data acquisition

Thank you!