



Behaviour-Aware and Data-Driven Building Control Strategies

Neil Yorke-Smith | TU Delft



Take home message

- Intelligent climate control strategies → increased building energy efficiency
- Leverage flexibility of energy sources, storage, user demand
- Combine data, machine learning, control algorithms

Why



Why: Supply variation



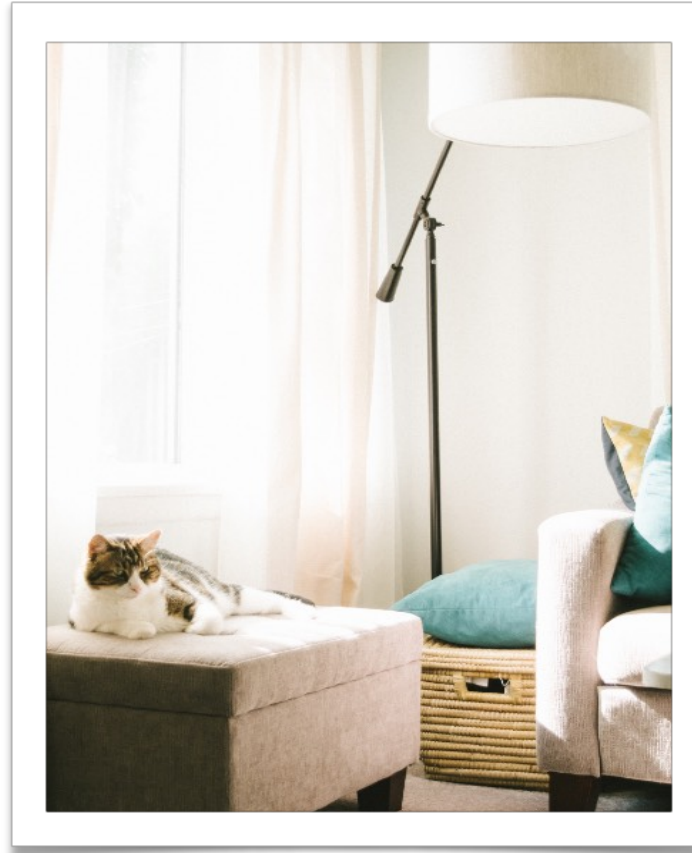
Why: Demand variation



Why: Dynamic balancing



Why: Building user comfort



What



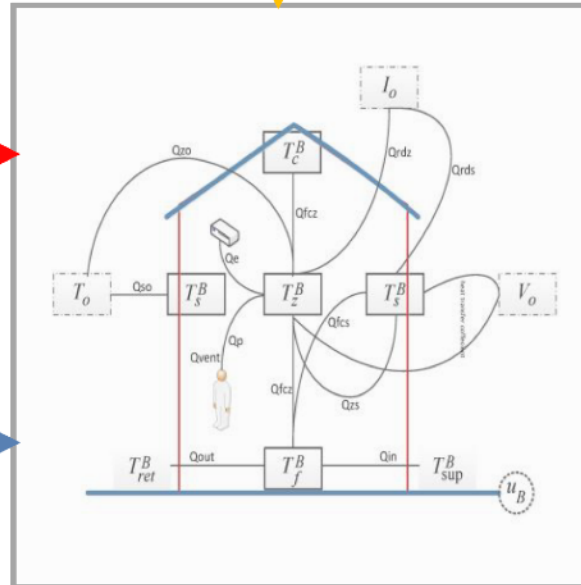
Desired
Building
Temperatures



Heating Energy Demand



Cooling Energy Demand



Environmental Variables



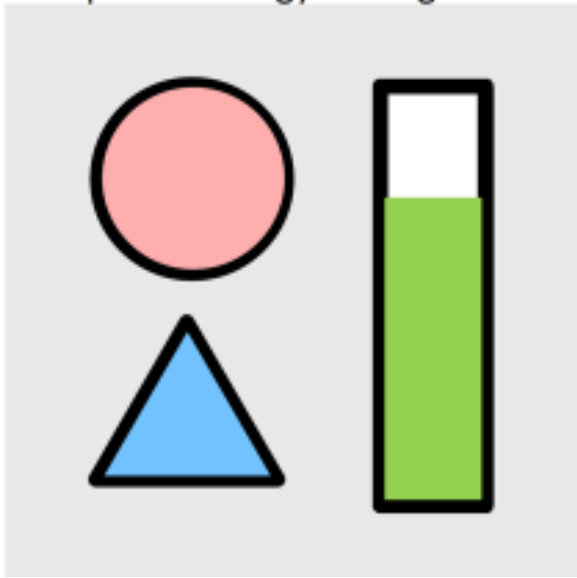
Specific
Weather
Realization

Building Demand Energy Generator
Based on Desired Comfort Service
and Weather Conditions

Desired Building Temperatures

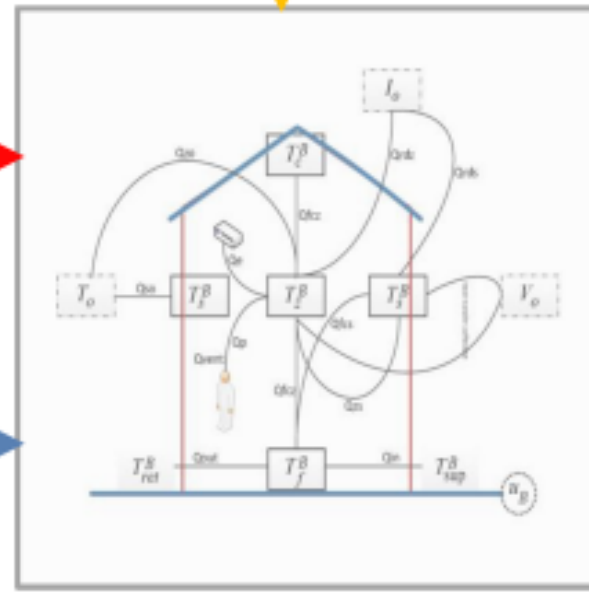


Building Control Unit
Optimal Energy Management



Heating Energy Demand

Cooling Energy Demand



Building Demand Energy Generator
Based on Desired Comfort Service
and Weather Conditions

Environmental Variables



Uncertain
Weather
Conditions

How



How



- optimise production schedule of main building components for comfort, thermal energy balance, total energy efficiency
- boiler, HP, HE, micro-CHP, hot/cold water storage, PV, battery, ...
- e.g. using stochastic predictive controllers



How: Key ideas

Predict demand,
supply, weather,
prices

Algorithms with
uncertainty

Physical models
tuned by data

Guarantee a
baseline

Storage =
decouple supply
and demand

Users matter...
but hardware
matters too



Case studies

- Multi-agent learning for coordination of local grid - De Teuge
- Seasonal thermal energy storage coordination - Utrecht



Take home message

- Intelligent climate control strategies → increased building energy efficiency
- Leverage flexibility of energy sources, storage, user demand
- Combine data, machine learning, control algorithms

- Sensitive to building users' behaviours?
- Robust to uncertainty and extremes?
- Depends on physical plant, integrated into control software?



Acknowledgements

- T. Keviczky, M. de Weerd
- Alliander
- MOOI programme funders
- photographers on unsplash.com

n.yorke-smith@tudelft.nl