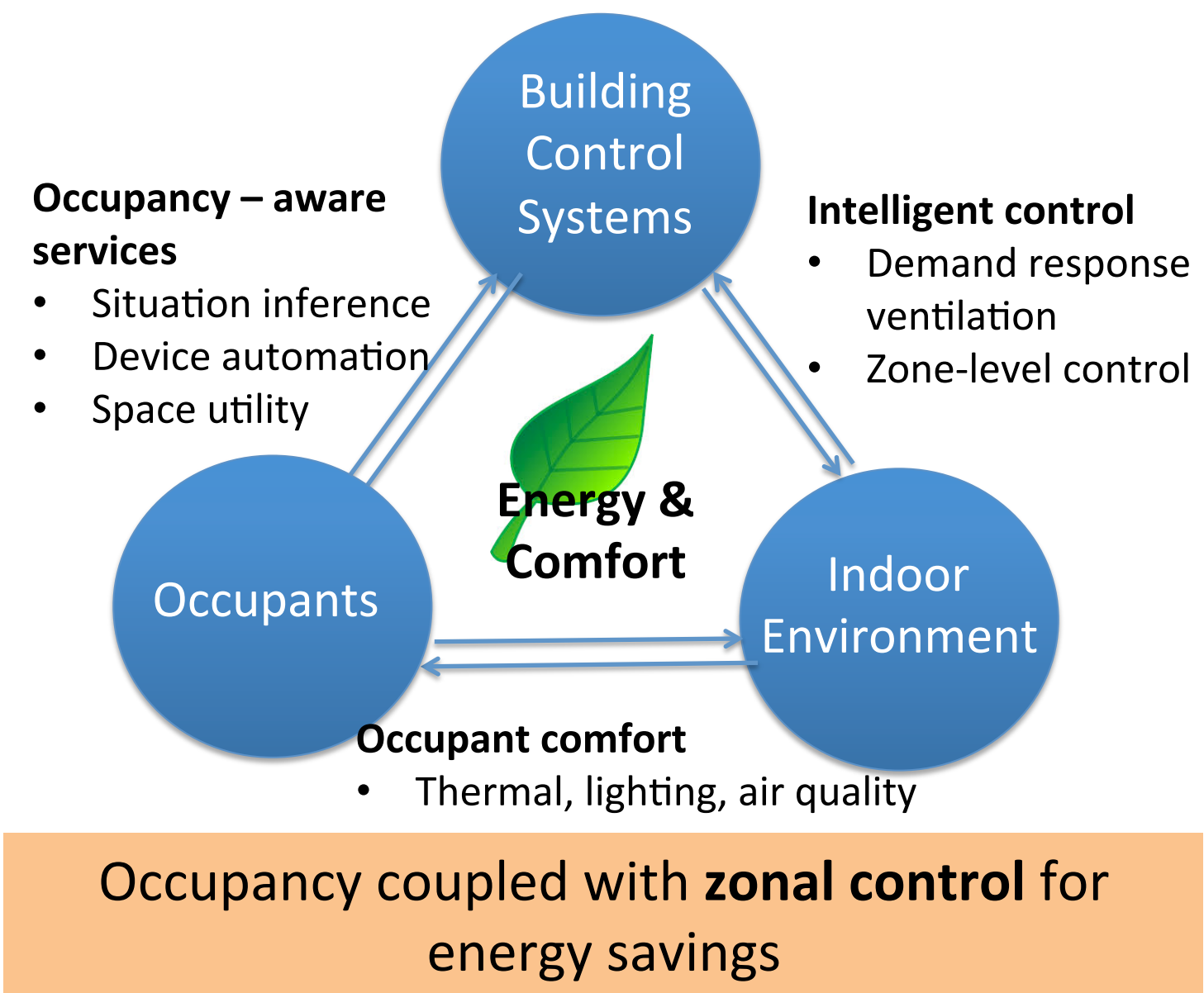




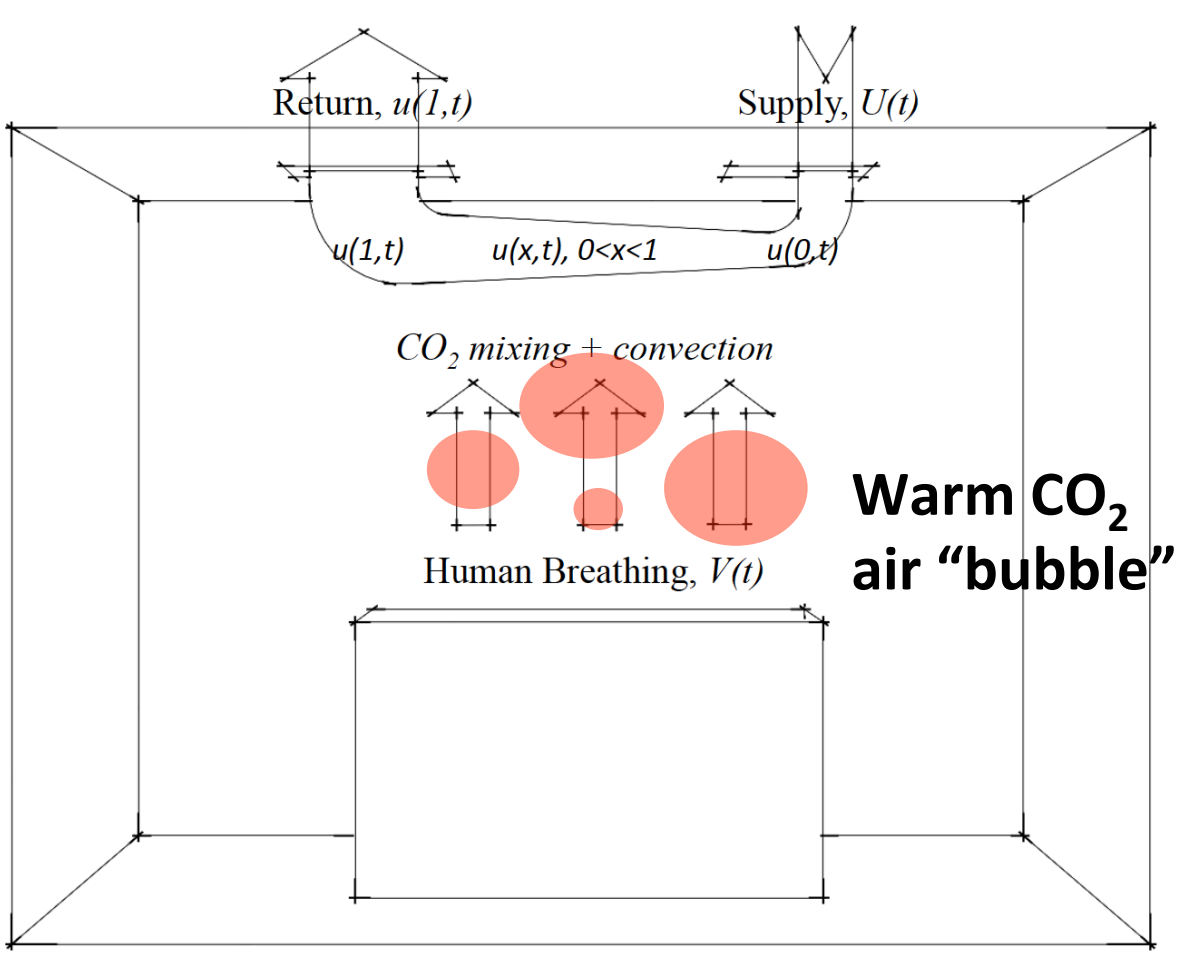
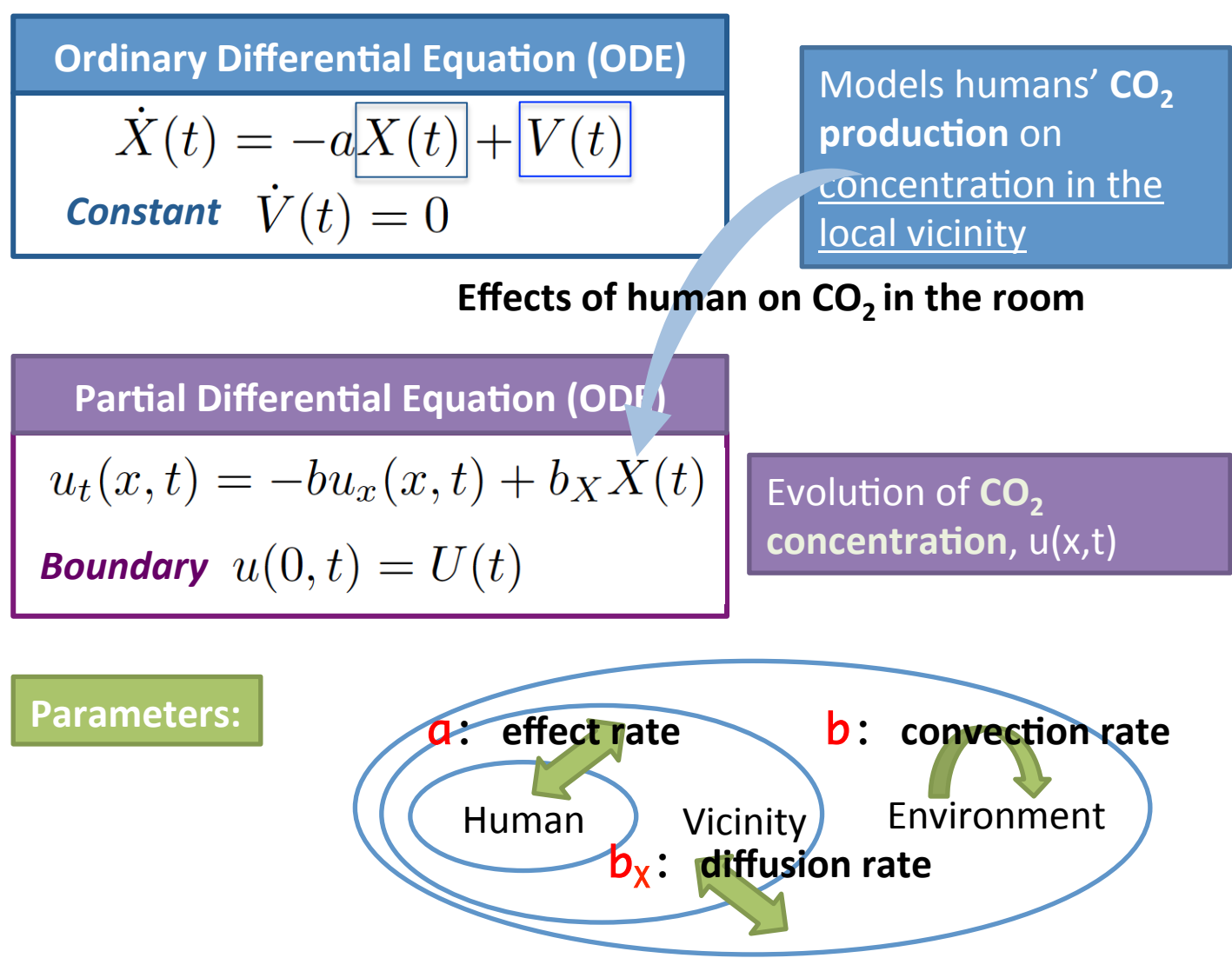
Sensing by Proxy: Occupancy Detection Based on Indoor CO₂ Concentration

Ming Jin, Nikos Bekiaris-Liberis, Kevin Weekly, Costas Spanos, Alexandre M. Bayen

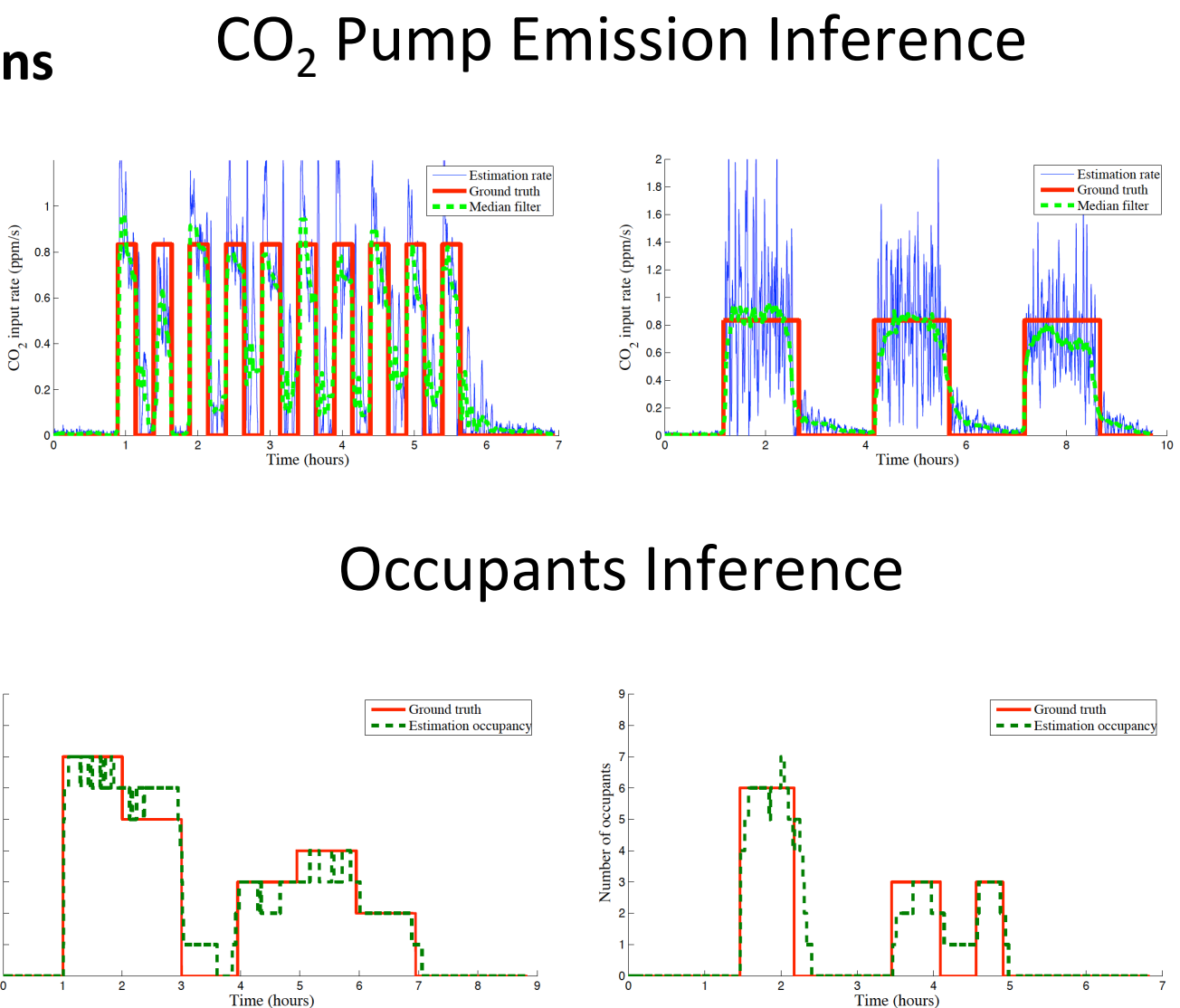
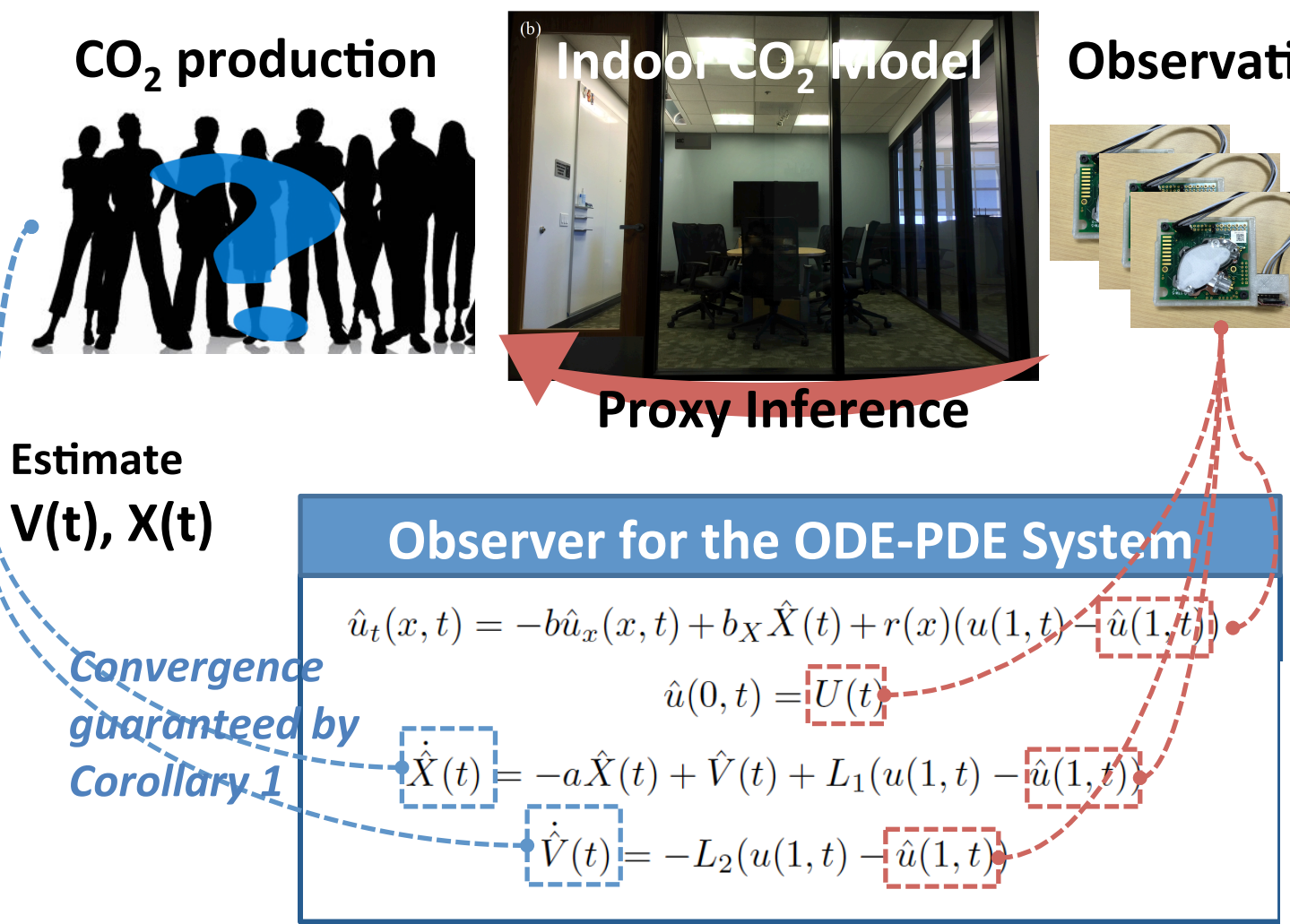
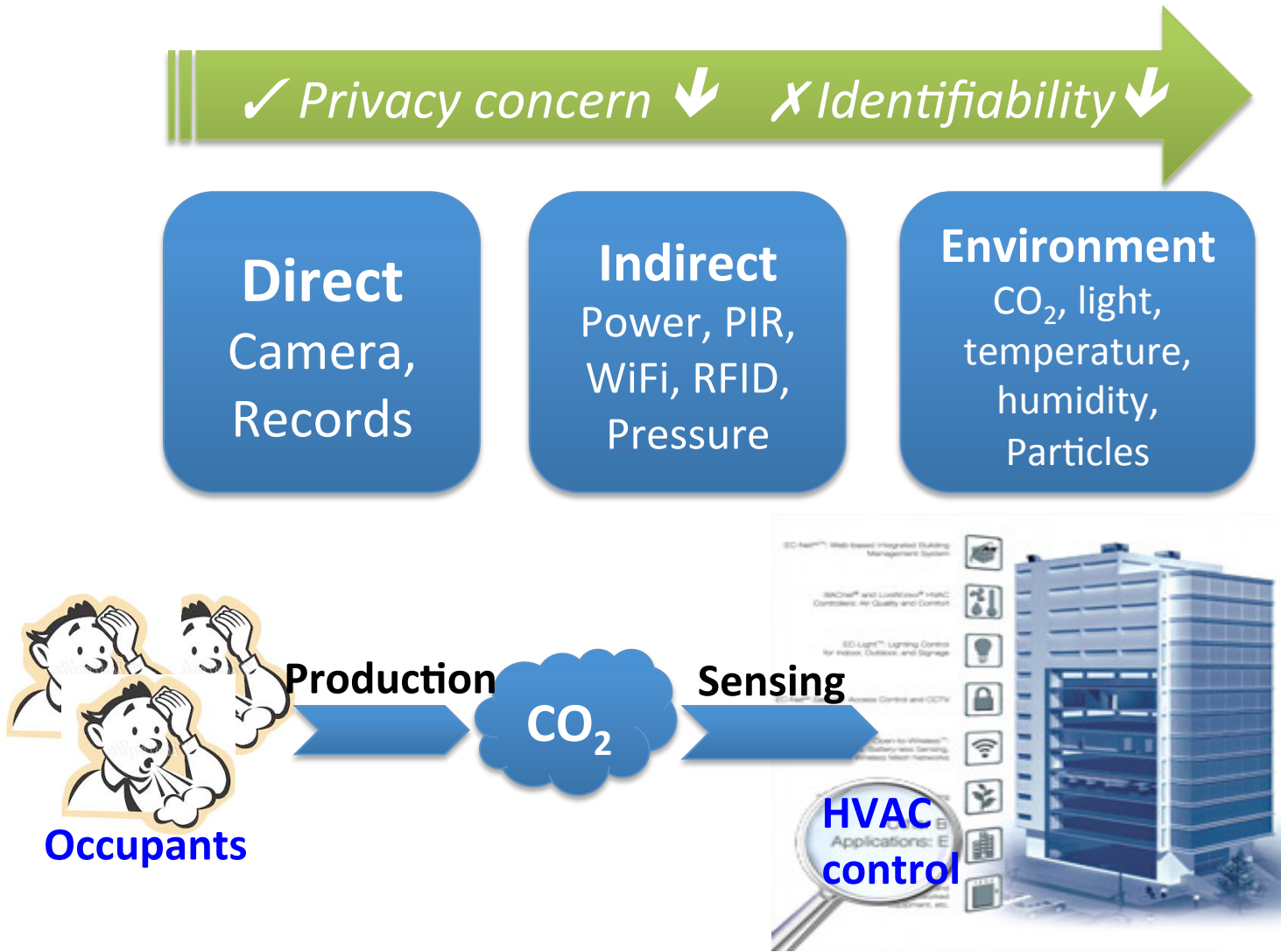
Motivation and Background



Proxy Design and Modeling

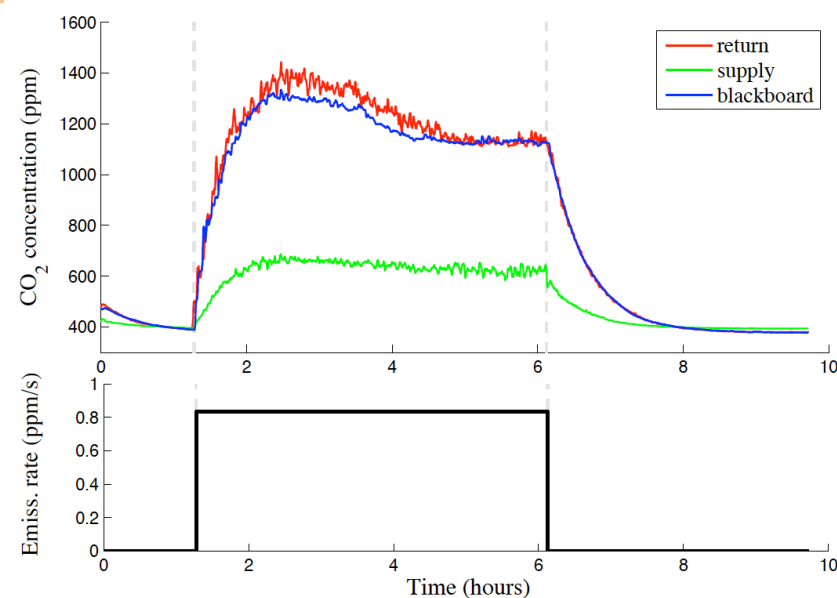


Proxy Inference



CO₂ Pump and Occupants Experiments

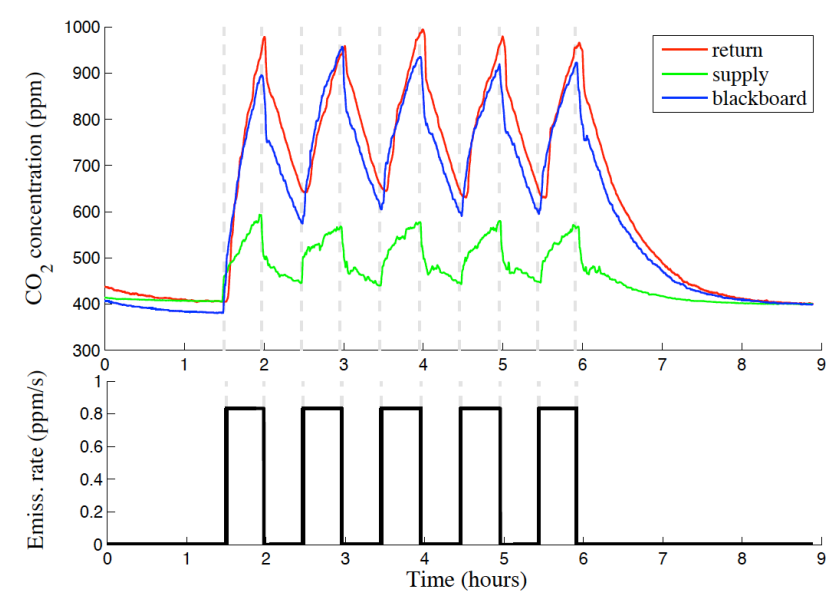
Hypothesis 1: when CO₂ is injected for a long time, system reaches **steady state**.



- ❖ Steady state: balance of mixing rates
- ❖ Takes ~ 3h to reach the state 1200ppm

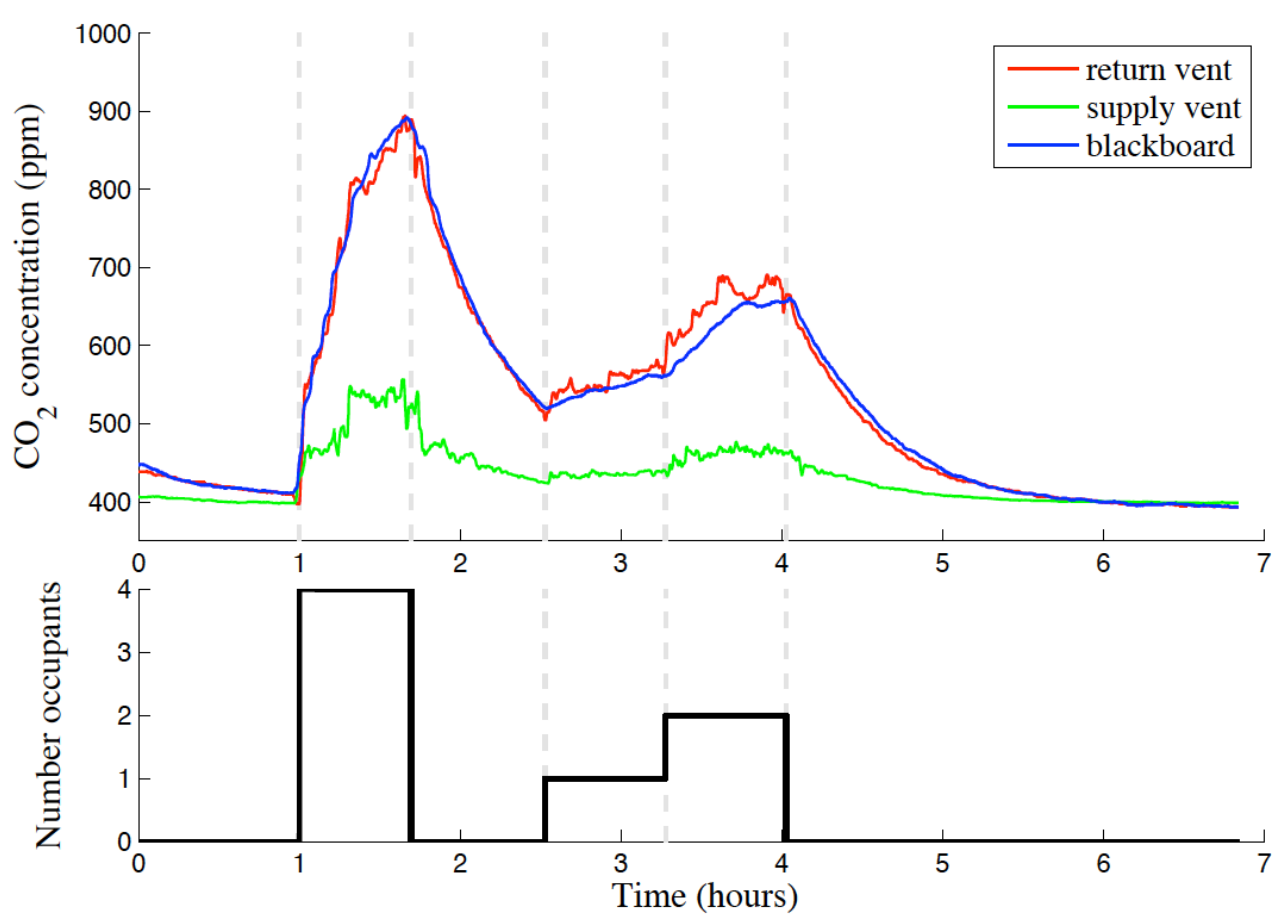
Hypothesis 2a: measurements exhibit **periodic patterns** if CO₂ injected periodically.

Hypothesis 2b: CO₂ from **different** points in the room **react similarly**.

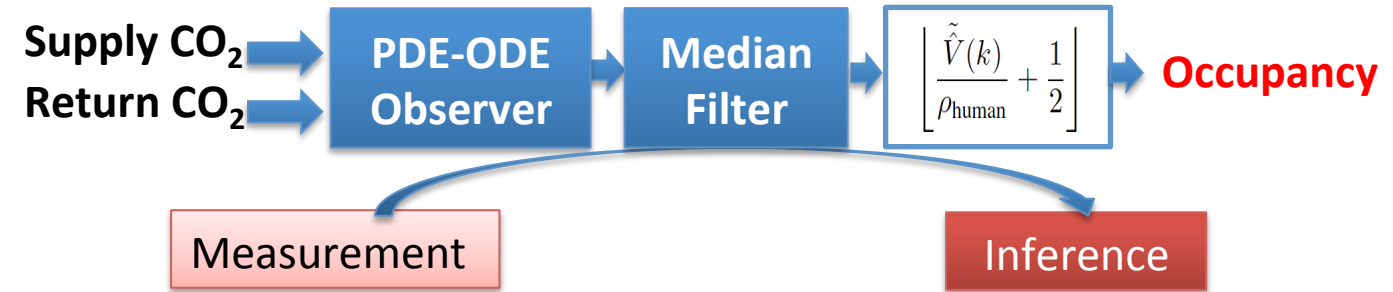
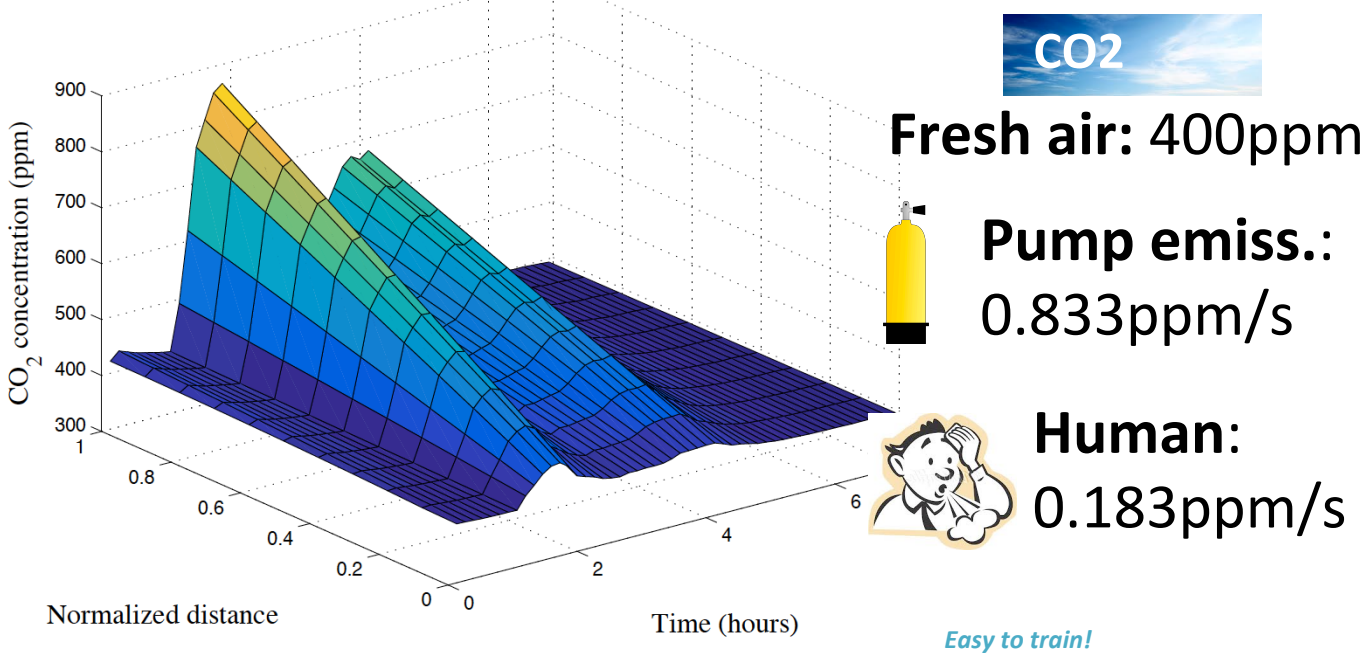


Location	Cross-correlation
Return-Supply	.9592
Return-Blackbd	.9882
Supply-Blackbd	.9635

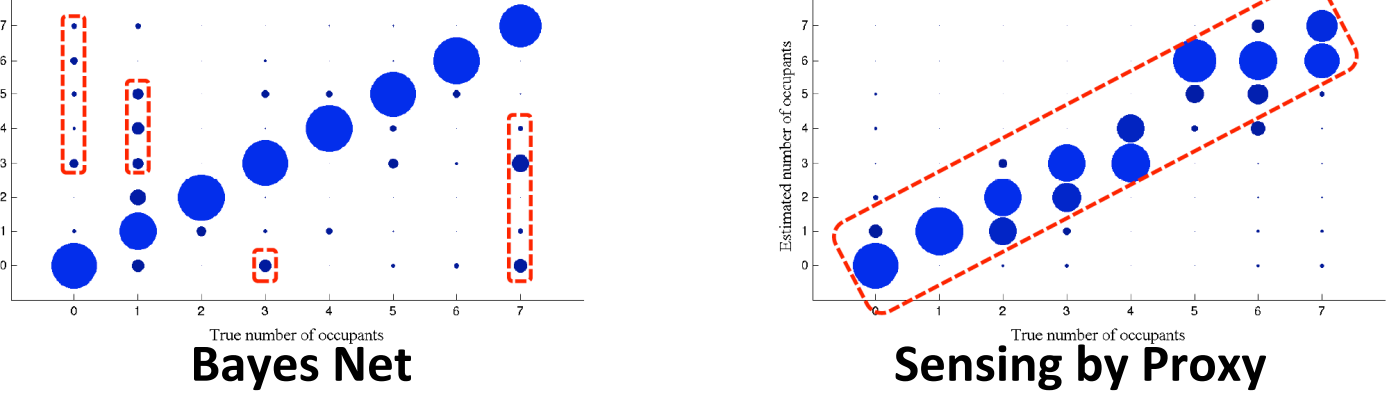
Field Experiment



Spatial temporal simulation



	Naïve Bayes	Bayes Net	Logistic Regress.	Multi-Layer Perceptron	Ada-Boost	Sensing by Proxy
RMSE	1.356	1.21	1.47	1.23	2.39	0.63



Conclusion and Future

- ❖ Reliable: RMSE 0.6 vs. 1.2 (frac. person)
- ❖ Misdetction with small magnitudes
- Future work...**
- ❖ Implementation in larger indoor area
- ❖ Application of Sensing by Proxy to indoor pollutants source identification

Publication: Sensing by proxy: Occupancy detection based on indoor CO₂ concentration, 9th International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies, 2015