Sensing by Proxy: Occupancy Detection Based on Indoor CO₂ Concentration

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Motivation and Background

Occupancy coupled with zonal control for energy savings

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 state1200ppm

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

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

Spatial temporal simulation

<table>
<thead>
<tr>
<th>Location</th>
<th>Cross-correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return-Supply</td>
<td>0.9592</td>
</tr>
<tr>
<td>Return-Blackbd</td>
<td>0.9882</td>
</tr>
<tr>
<td>Supply-Blackbd</td>
<td>0.9635</td>
</tr>
</tbody>
</table>

Conclusion and Future

- Reliable: RMSE 0.6 vs. 1.2 (frac. person)
- Misdetection with small magnitudes

Future work...

- Implementation in larger indoor area
- Application of Sensing by Proxy to indoor pollutants source identification