

Using information fusion across stationary, mobile, and wearable consumer-grade sensors to confidently estimate bedroom ventilation rates

One of these days I will come up with a succinct title

Main Idea: Calculate ventilation rates in UTx000 participants' bedrooms using steady-state and decay methods. While this process is not novel, the *more* interesting part comes from the data fusion component. I showcase the methods I use to confidently determine when bedrooms are occupied:

1. **Cross-referencing GPS and Fitbit-detected sleep events:** GPS confirms that participants are home and Fitbit confirms when participants are asleep i.e. in their bedrooms (assuming people don't pass out on the couch)
2. **Occupancy Detection:** Using the dataset from (1) and a dataset that cross-references GPS data when participants are *not* home with IAQ data, I can label my IAQ data as either being from *occupied* or *unoccupied* periods. Then I train a model (MLP seems to work best) per participant on the CO2 and TVOC parameters and can predict, with 90% or more confidence, occupied bedroom periods that we don't get from (1) because GPS is down or participants didn't wear their Fitbit to bed. This process helps augment the dataset from (1) and in some cases provides 4000+ extra IAQ data points (at a 10-minute resolution).

I can also separate out the ventilation rates estimated from (1) vs (2) which could indicate the utility of the occupancy-detection-based dataset.

Main Contribution: I would say this study highlights the ability of consumer-grade sensors to provide powerful/useful information to curate *accurate* datasets for other analyses. So the main idea might be less about calculating ventilation rates and more about the method, but not sure how best to frame that.

Analysis Required

This work is a combination of the work I have done for ASHRAE and Indoor Air in combination with some of the lesser work for the WCWH Showcase and GAIN events. Thus most of the work is done. I would need to calculate ventilation rates using data from (2) which will require a bit of processing to get (2) into a good form. Once processed, I would just need to run (2) through the script I already developed to calculate ventilation rates.