

Data Acquisition System for Understanding the Behavior of Resuspended Particles



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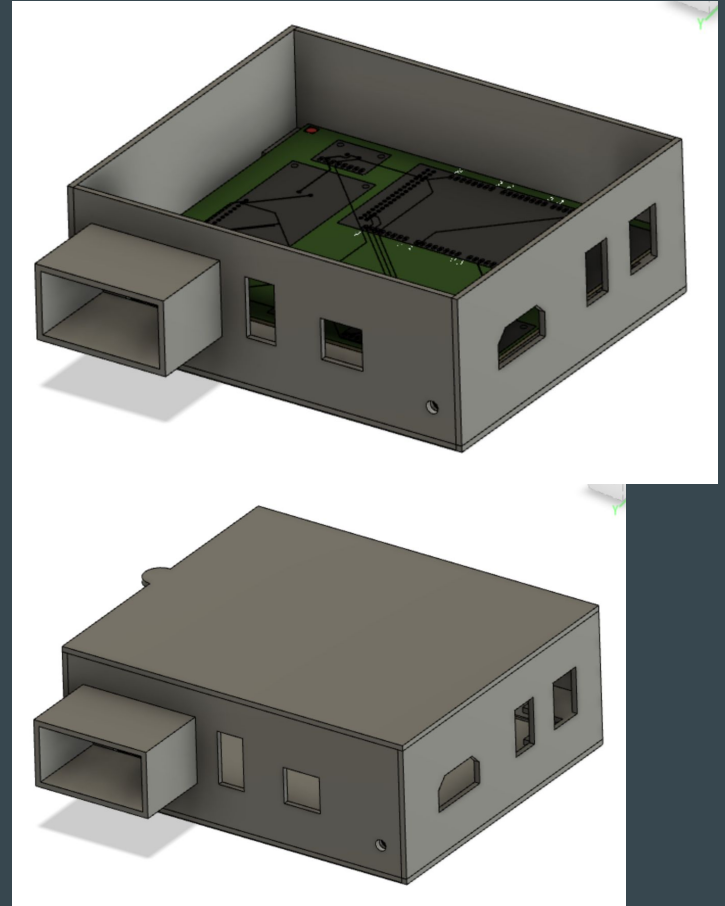
March 9, 2023

Overview

Explaining the setup and raising questions

Housing Reasonings

- Plantower only needs to face one way
- Plantower extruded
- Lid easily movable to view LCD before data taking
- Holes for components that need to see outside



Experimental Procedures - Updates

- We must ensure that confounding factors do not affect our measurements
- This requires careful attention to the setup and startup of our systems
- The procedure is as follows:
 - Sweep the floor and surrounding areas
 - Perform control trials to gain a baseline for the testing area and the number of particles already in the air
 - This includes taking a baseline with no pedestrian, and taking a baseline with a person walking, but with no seeded particles
 - Finally, seed the floor with particles, wait for the resuspension due to seeding to settle
 - Start the plantower, being careful not to walk on the seeded particles
 - Wait two minutes after starting the plantower, then perform the walk by

Initial Data Acquisition

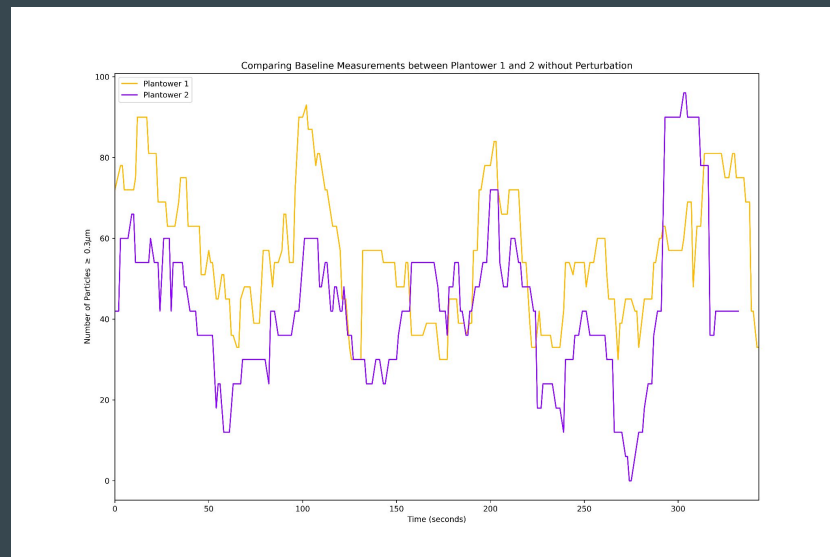
- Trials began in the basement of loomis
- We decided several controls were needed before we could proceed with test runs
- Trials were taken with two plantowers, one at 4ft, one at 5ft.
- The tests run were (two runs each):
 - Control: No pedestrian, no particles
 - Control: Pedestrian, no particles
 - Test runs: Particles (Sawdust), Pedestrian
- Focus of initial data was on controls and determining whether certain variables made a difference in the data, such as height.
- There was more focus on controls because we do not have our standard particles

Test Data

Interpreting the data

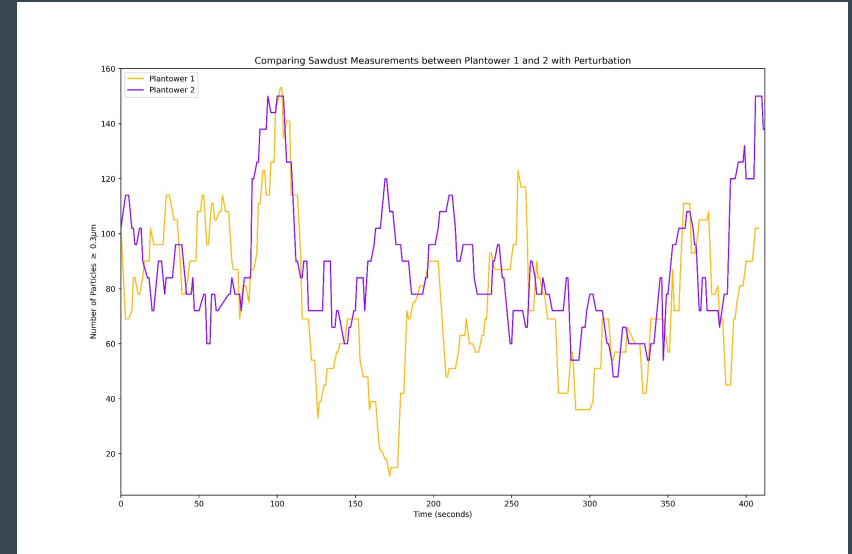
Control Run

- “Clean” air already has plenty of suspended particles
- Unavoidable statistical noise
- Plantowers do not measure the exact same value - but they follow a tendency
- It is essential to have a baseline measurement in order to compare our test data



Test Run

- Floor seeded with sawdust
- Mechanical perturbation (walking) was present
- Plantowers at different heights:
 - Plantower 1: 5 ft
 - Plantower 2: 4 ft
- Mechanical perturbation after about 100 seconds
- Plantower 2 measures more particles, on average, as it is at a lower height

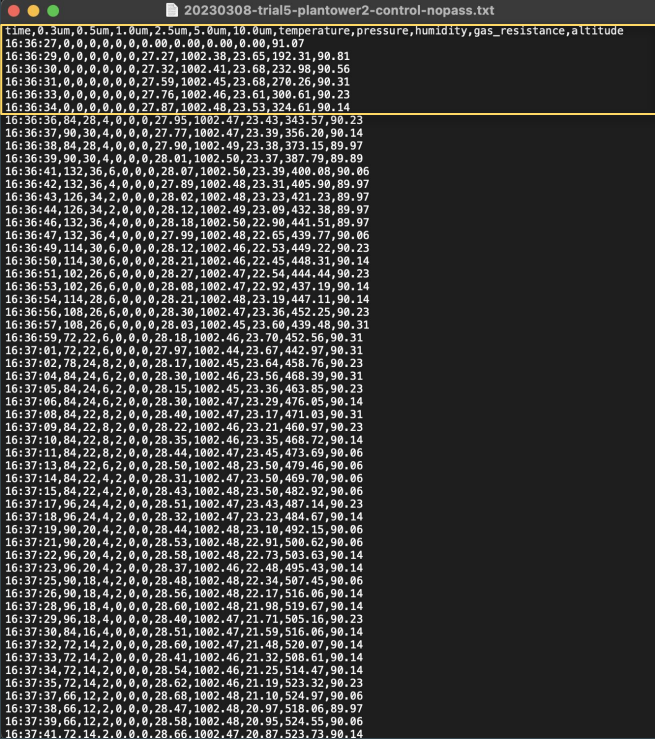


Data Analysis

Standard and techniques

File Format

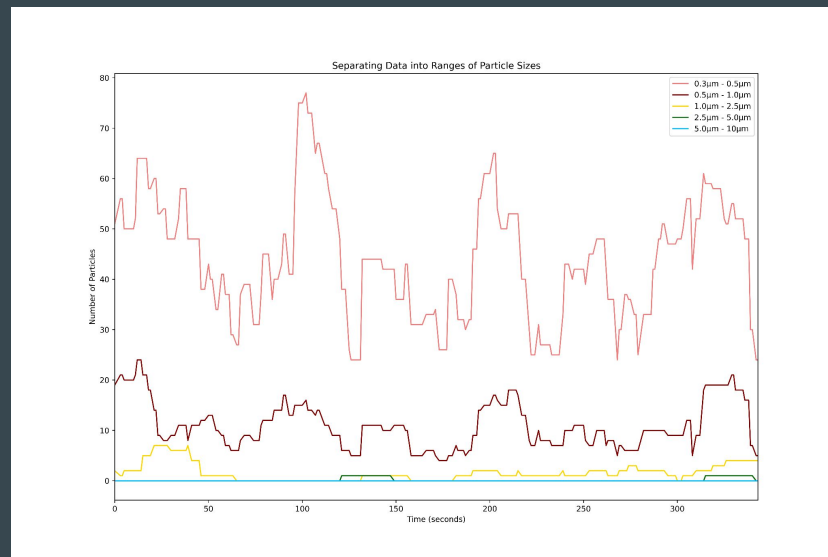
- Standardized file format
 - RTC: Time
 - Plantower: Particle Sizes
 - BME: Temperature, pressure, humidity, gas resistance, altitude
- Always ignore first and last data points
 - Plantower takes a while to “warm up”
 - Movement close to the Plantower near the end might slant data
- Descriptive filenames
 - Note taking is essential
 - Filenames relate data with observations



```
time,0.3um,0.5um,1.0um,2.5um,5.0um,10.0um,temperature,pressure,humidity,gas_resistance,altitude
16:36:27,0,0,0,0,0,0,0.00,0.00,0.00,0.00,91.07
16:36:29,0,0,0,0,0,0,27.27,1002.39,23.65,102.31,90.81
16:36:30,0,0,0,0,0,0,27.32,1002.41,23.68,232.98,90.56
16:36:31,0,0,0,0,0,0,27.59,1002.45,23.68,270.26,90.31
16:36:33,0,0,0,0,0,0,27.76,1002.46,23.61,300.61,90.23
16:36:34,0,0,0,0,0,0,27.87,1002.48,23.53,324.61,90.14
16:36:36,84,28,4,0,0,0,27.95,1002.47,23.43,343.57,90.23
16:36:37,90,30,4,0,0,0,27.77,1002.47,23.39,356.20,90.14
16:36:38,84,28,4,0,0,0,27.90,1002.49,23.38,373.15,89.97
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16:37:41,72,14,2,0,0,0,28.66,1002.47,20.87,523.73,90.14
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Data Analysis Techniques

- Separate data into ranges of particle sizes
 - 0.3 μm - 0.5 μm
 - 0.5 μm - 1.0 μm
 - 1.0 μm - 2.5 μm
 - 2.5 μm - 5.0 μm
 - 5.0 μm - 10 μm
- Subtract baseline from final dataset to reduce the amount of noise
- Plot vs. Scatter
 - Markers



Next Steps

Data taking and analysis with final setup

Variables

- The variables we find most interesting are:
 - Height
 - Particle size
 - Number of passes
 - Pedestrian Weight
 - Floor type
- This will require a very large number of trials if we attempt to measure all combinations of these variables

Test Matrix and Trials

- Even disregarding humidity, temperature and shoe type, the number of trials required for this experiment becomes incredibly large
- As the test matrix above shows, we would have to perform 288 runs to get all combinations of these few variables, which would take approximately 34 hours of straight data gathering, without accounting for setup for time between runs.
- This may be not be feasible, thus we need to prioritize and eliminate parameters early on

Variables	height 4'2", 5'6"	particle size (control, 3um, 5um	number of passes (1,3,5)	Pedestrian weight	Floor type (linoleum, concrete)	Total Combinations	Time Required (mins, hours)
Variable Number	2	4	3	2	2	96	
Runs per Variable	3	3	3	3	3	288	2016
Total Runs per Variable	6	12	9	6	6		33.6

Priorities: Controlling Variables to Reduce Trials

- One option is to rule out a difference in resuspension between 4 and 6 ft high, which is a hypothesis we currently have. If hypothesis turns out to be correct, this would reduce the number of trials by a factor of two.
- In addition to this, we do not need to perform a control with respect to each variable, it is unnecessary and redundant. A control at the beginning of the testing session to test the baseline particles should be sufficient
- Focus on the most important variables first – for our first runs, we will primarily use one height and one pedestrian weight, then explore other options given sufficient time.

New Test Matrix

- As this shows, this would reduce our trial number to 54
- With continuing data analysis we can then decide which combinations are most important to pursue, and add those once we have our base data set

Variables	height 5'6"	particle size (3um, 5um, 10um)	number of passes (1,3,5)	Pedestrian weight	Floor type (linoleum, concrete)	Total Combinations	Time Required (mins, hours)
Variable Number	1	3	3	1	2	18	
Runs per Variable	3	3	3	3	3	54	378
Total Runs per Variable	3	9	9	3	6		6.3

Thank you for listening!