The Continuation of a UAV Based System for Detection and Sampling of Micro-Plastics and Particulates in the Atmosphere

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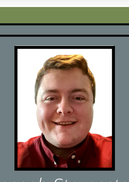

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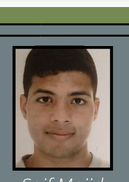

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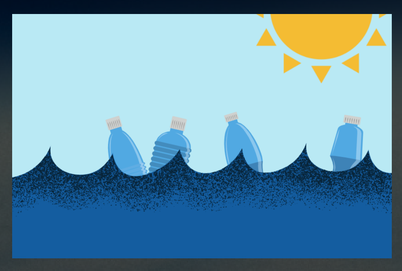
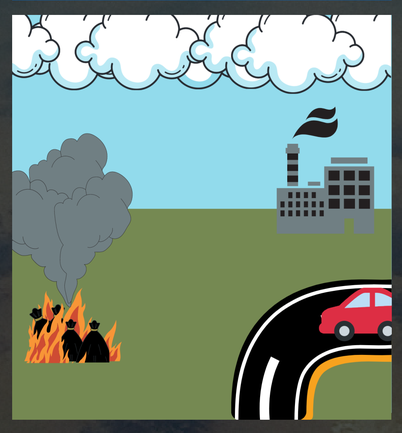
1. WHY?

Since the invention of plastic in 1907 humans have shamelessly distributed plastic wasted around the globe. This distribution has been aided by the natural cycles of our planet and can be seen today within our oceans.

Micro-Plastics are also being found within the North and South poles on the top level of snow. These Micro-plastics have been hypothesized to be deposited in these remote locations via natural airways.

The source of said Micro-Plastics could be due to fires, tire rubber and factories. To find the source of said Micro-Plastics a sustainable and cost-effective sampling and detection UAV was developed.





2. THE MISSION!

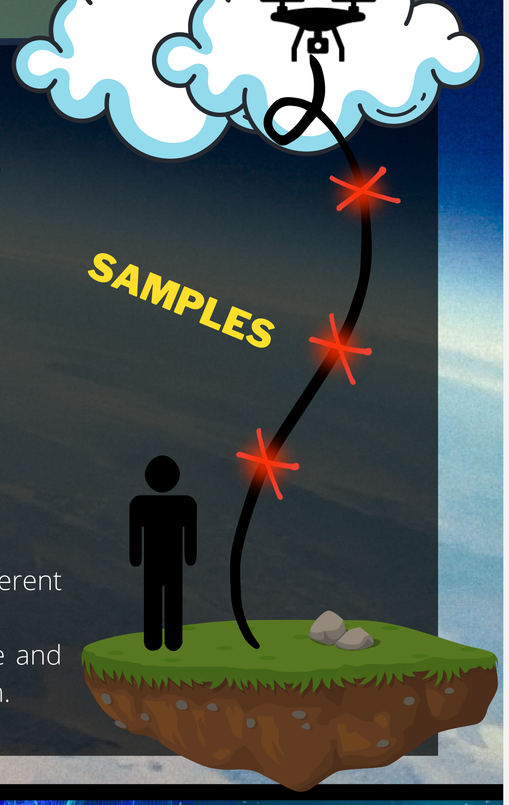
The mission is first to find the locations where high levels of MicroPlastics are be deposited. This will be done by first sampling vertically every 10 meters. Once this is complete the UAV will be utilized in multiple locations to map high-risk areas.

Objectives

- Sample the air at different altitudes.
- Be cost-effective when compared to alternative vertical mission techniques.
- Ensure the device does not contribute to the growing issue of Micro-Plastics.

How?

- Sample and detect simultaneously at different altitudes.
- Use sustainable materials when possible and recover and re-use the sampling platform.
- Recover Micro-Plastics for analysis.



3. EFFICIENT DETECTION AND SAMPLING

- Onboarded active and passive sensors.
- Custom-built filtration unit which allows for sampling at 10 different altitudes during a single mission!
- Efficient recycled propeller airflow into the passive filtration unit, Fig.1.
- Integrated SPS30 microplastics detection sensor, Fig.2.
- Detection size where number & mass concentration ranges from Pm1.0 to Pm10.0 and Nc0.5 to Nc10.0 respectively.
- Particle samples are then cross-referenced with SPS30 data to allow the user to evaluate possible high-risk areas.

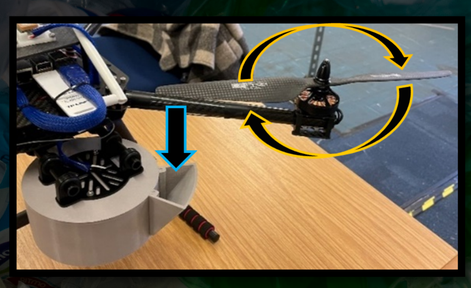


Fig.1 Mico-Plastics Filtration Unit.

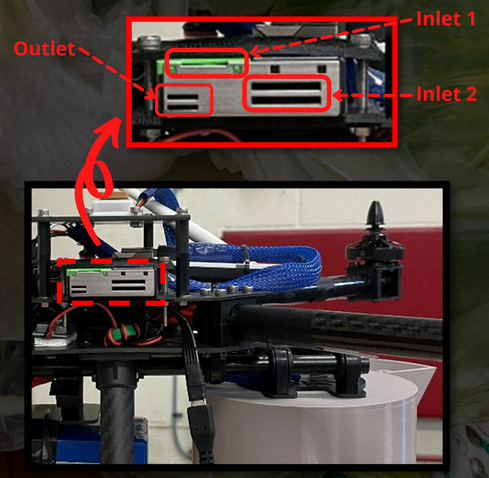


Fig.2 SPS30 Sensor.

4. RESULTS

A fully functioning UAV has been developed Fig.3. This UAV has undergone numerous failsafe, telemetry, vibration, GPS and magnetic field tests.

Indoor flights have also been conducted where the SPS30 and filtration unit function as intended. Data from the SPS30 for number and mass concentration can be seen in Fig.4.

Fig.3 Micro-Plastic UAV.

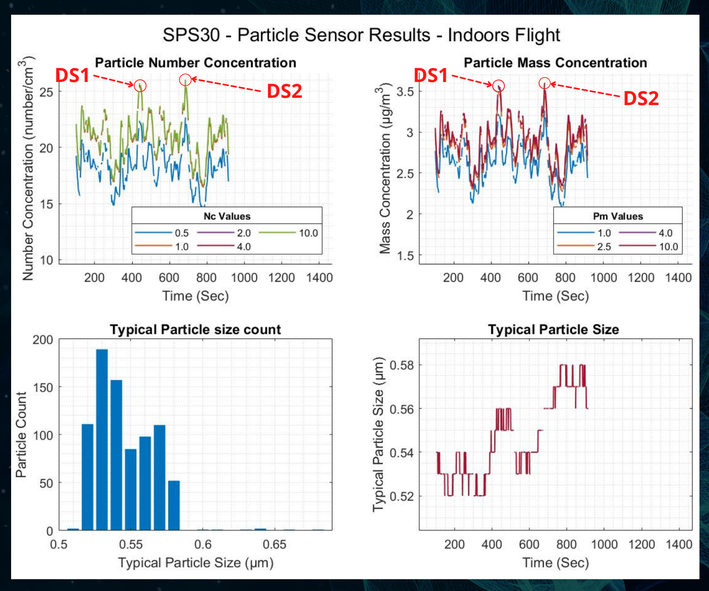


Fig.4 Indoor Detection and Sampling Flight.

Low levels of particles are being detected and streamed to the control station.

Two separate Dust Samples (DS) were also added into this environment during flight.

These dust samples were detected by the SPS30 and can be seen as two spikes within Fig.4.

This data combined with the physical sample collected from the filtration unit, Fig.5, can be used to detect the composition of said particles.

From this, an investigation can then commence and the root cause of the particles may be found. This knowledge allows future and present engineers to combative Micro-Plastic distribution, thus aiding the asperation of a fully sustainable future.

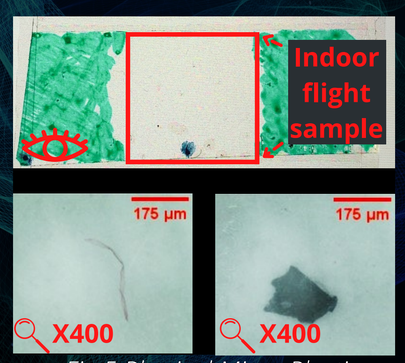


Fig.5 Physical Micro-Plastic Sample under Microscope.

5. FUTURE WORK

Within the coming months, the UAV will have flight approval from UWE's operational manager and outdoor sampling will commence.

Future and current work:

MBSE digital twining for future trade-off analysis with 2D lidars and obstacle avoidance Fig.6.

CFD to optimize the filtration unit inlet nozzle. This nozzle is currently a modular design and is under testing to increase the mass flow rate through the filtration unit.

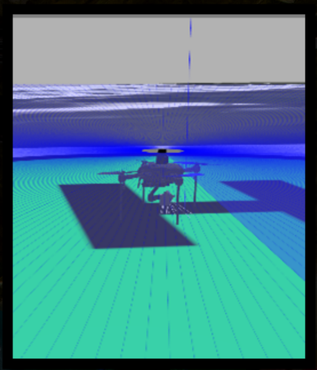


Fig.6 Digital Test Bed with Implemented Lidar.

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