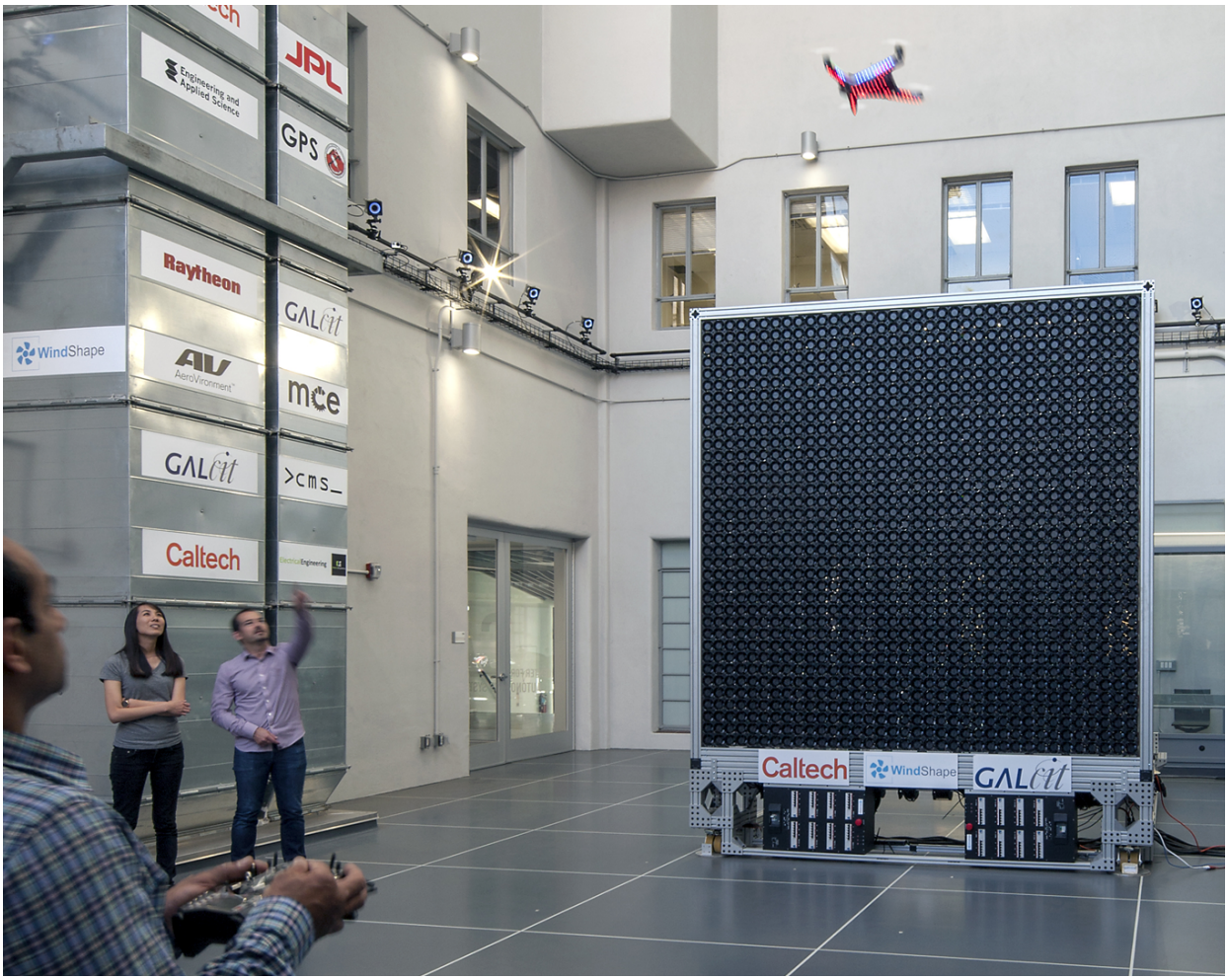
Custom Wind Facility Datasheet



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Introduction

This product is a fully customizable wind facility that provides endless possibilities for free flight testing. You have full control over the Windshaper (wind generator) size, shape and accessories. It is specifically designed to study the effects of different wind profiles on motors, propellers, ESCs, batteries, drones and any electric aircraft.

Description

The main piece of equipment in a wind facility is the Windshaper wall, custom-made to fit your needs. The Windshaper is composed of stackable modules that each have 9 wind pixel fan units (figure 1). Each wind pixel is equipped with 2 counter-rotating fans that can generate a flow speed up to 16 m/s (or greater with a convergent, page 7). By analogy with a TV screen, where more pixels yield a better image, Windshaper walls are composed of hundreds of wind-pixel fans that enable precise control over the airstream. The Windshaper is managed with software that allows you to precisely control wind settings with simple commands.

Applications

- Free flight testing
- Landing phase optimization
- Determine turbulence limits
- Optimize fixed wing profiles
- Study performance in various wind profiles
- VTOL transitions in flight
- Evaluate waterproofing
- Drone failure effects (loss of GPS, motor, sensor)

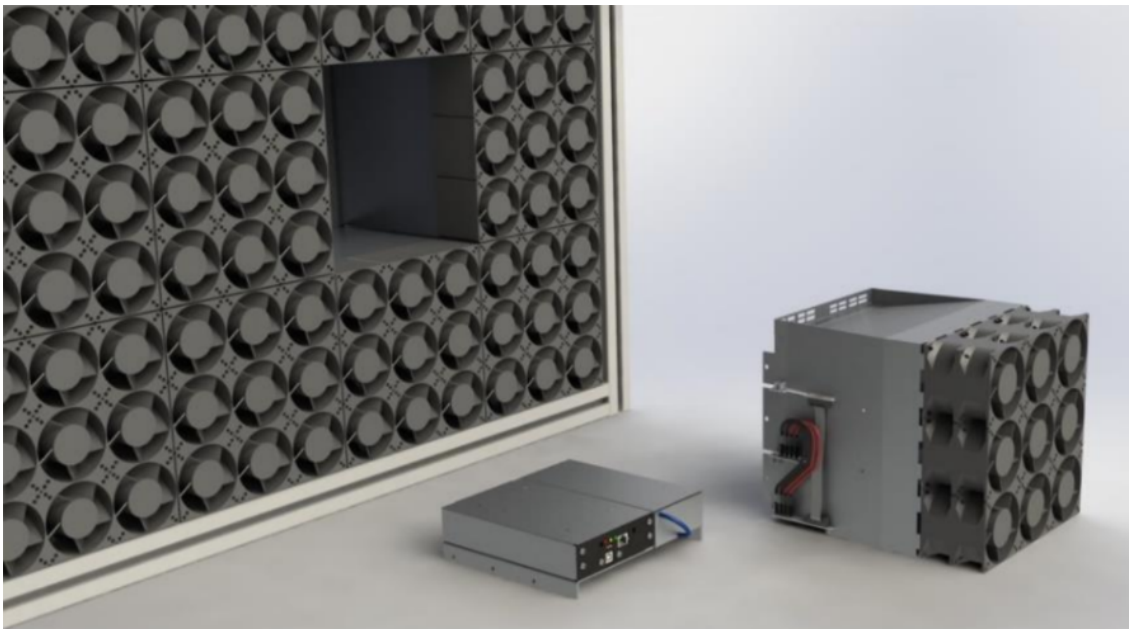

Fig. 1: Structure of a wind module

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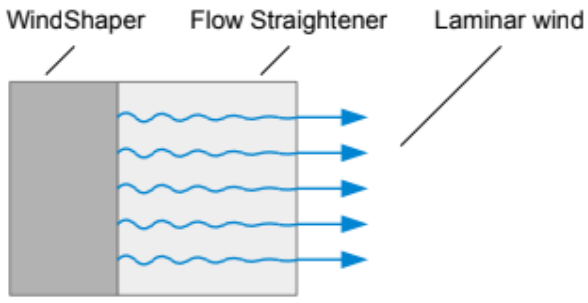
Wind Profiles

What makes Windshapers unique is their ability to create dynamic wind profiles. Traditional wind tunnels produce a uniform flow, whereas Windshapers use 3D input (u = ƒ(x, y, t)) to generate unique flow patterns such as wind shear, turbulence, and time-variable flows.

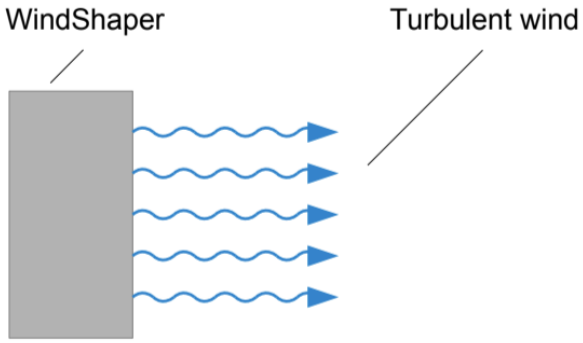
Uniform Laminar Flow

This setting can be used to simulate a drone flying at a given speed in still air. This is generated in the test area by setting the Windshaper's flow speed (in m/s) to the speed the drone would be traveling in still air, while the drone maintains its position. In this scenario, the relative wind speed, as seen by the drone, is equivalent to the speed the drone would be flying.



Turbulent Flow

Ideal for simulating the conditions a drone is likely to face in its work environment due to weather and topology. In the test setting, the level of simulated turbulence is controlled by the wind speed delivered by each wind pixel. This may be equal across pixels or different in each section of the test area.

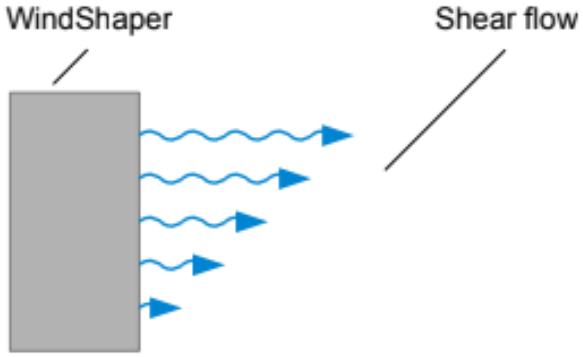


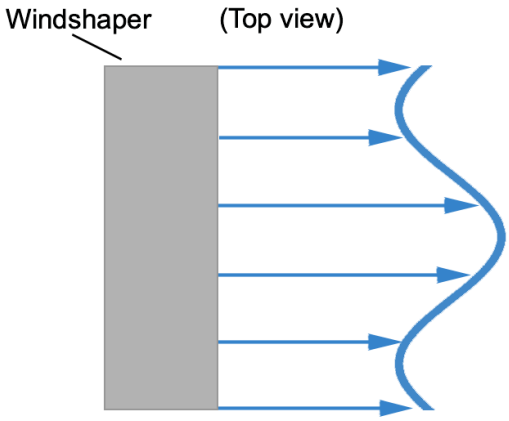
Shear Flow

The term 'shear flow' describes a wind profile where adjacent layers of fluids move parallel to each other at different speeds. This can lead to flow instabilities near walls, foliage or in regions with noticeable thermal effects. This can be simulated by setting wind pixels on one fan array to a slow wind speed and setting wind pixels on an adjacent fan array to a higher wind speed.

Time-variable Flow

With time variable flows you can create unique wind profiles by changing the wind speed of each wind pixel over time. A given wind pixel may begin at 2 m/s, increase to 10 m/s, then return to 2 m/s and so on. With this level of control you can create wind shapes like the sine wave shown below (top view).



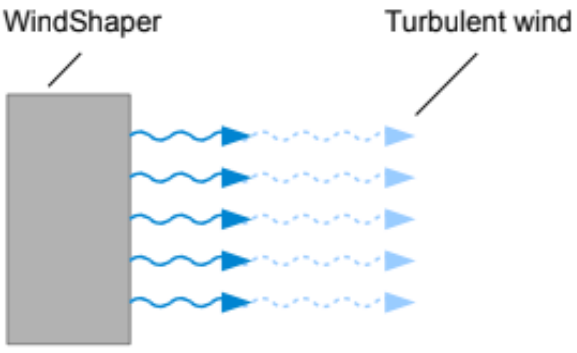


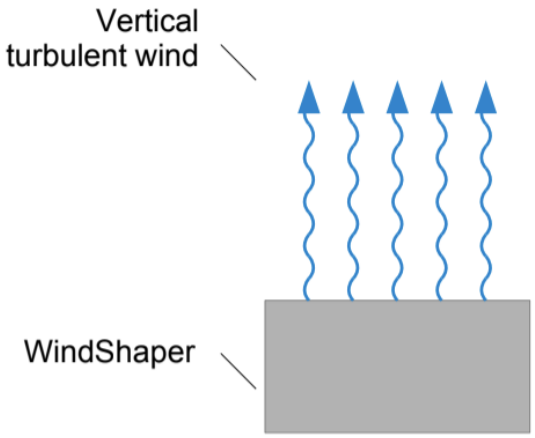
Wind Gust

Sudden changes in wind speed (gusts) can be challenging for a drone to navigate. Gusts can be simulated with rapid changes in wind speed coming from the wind pixels. This allows you to study drone displacement or resistance to gusts, and the responsivity of the flight controller.

Vertical Wind

While landing, drones experience a relative wind from below caused by their own turbulence (downwash), which leads to an unstable situation. To simulate this situation, the Windshaper is placed horizontally and generates a wind flow equivalent to the drone's downwash.





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Hardware

Structure (figure 2):

The facility's Windshaper consists of a wall of fans that generate both horizontal and vertical flows (1). Side walls (2) can also be installed to generate various cross wind profiles. The system is powered by two main distribution boxes (3) and a control network consisting of Ethernet switches, routers, and an onboard computer (4).

Fig 2. Windshaper components

Power and Control Unit

Each Windshaper module is connected to a Power and Control (P&C) unit. This unit contains two different systems: the module's control system and the module's power system. The power system can convert the input AC tension into 12VDC which is needed to power the fans. The control system is controlled with a microcontroller. It is connected to the Windshaper's Local Area Network (LAN) and communicates with the onboard computer through an Ethernet protocol. The integrated microcontroller interprets the signals received and pilots the fans accordingly. The status of the module (power status, health, fan status,...) is sent back to the main onboard computer.

Customizable Parameters (figure 3):

- Windshaper size
- Wind flow shape and direction
- Take-off and landing conditions
- Filters to reduce turbulence
- Convergent to increase max wind speed
- Tilting system from 0° to 90°

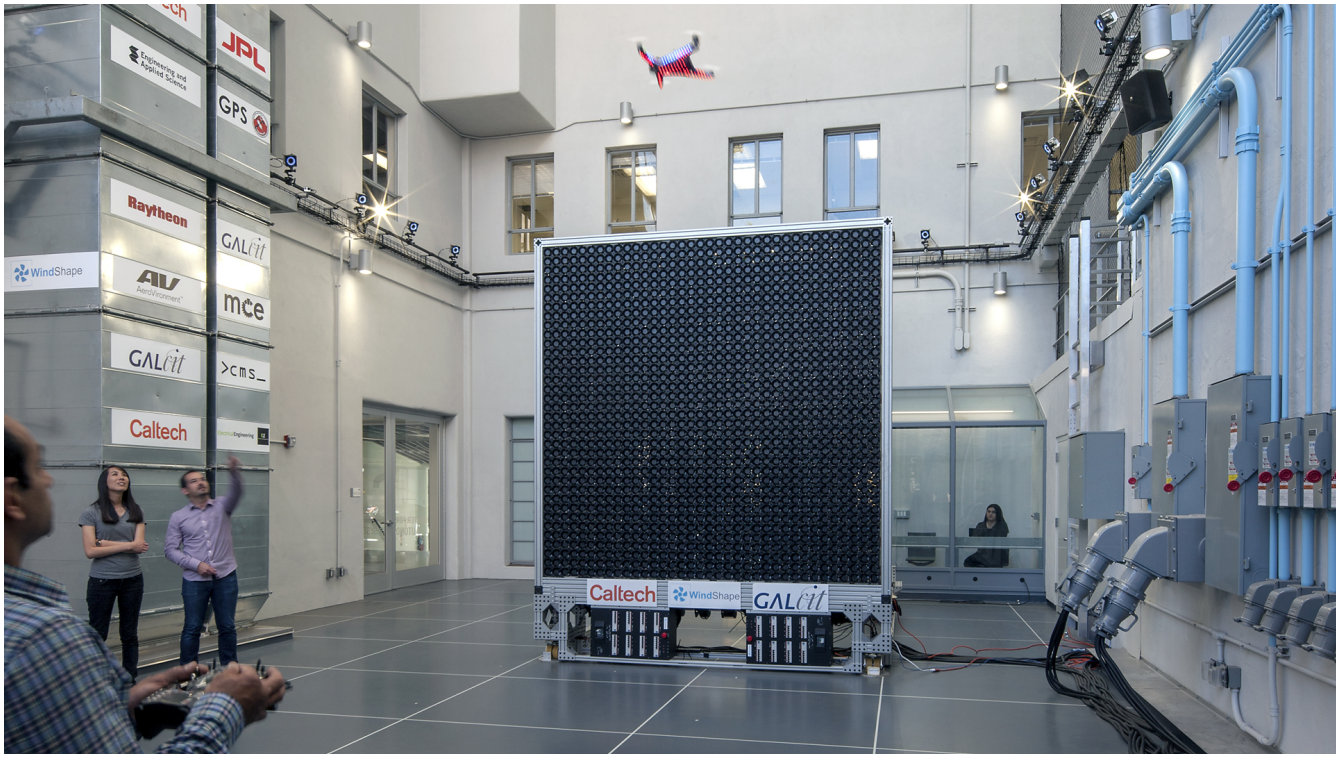

Fig. 3: A sample of possible Windshaper sizes and shapes

Customizable Features:

Filter:

The Windshaper can be equipped with a flow filter to reduce unwanted turbulence. This feature ensures an even flow of air and is a great option for studying ground effect and a multicopter's ability to fly in its own landing-phase turbulence.

Rainmaker:

The rainmaker feature allows for drone testing in conditions simulating rainfall. This is an excellent way to test the waterproofing of your drone or determine how performance is affected by changing weather conditions. Simulated fog is also available.

Tilt:

The Windshaper can be constructed with a tilting mechanism to allow for wind flow in any direction. With tilting capability up to 90°, an entire progression can be simulated from take-off to forward flight and back to landing.

Convergent:

A convergent device can be added to your Windshaper to increase the speed of the wind from 16 m/s up to 45 m/s, depending on the test section dimensions. Ask our sales team for more information about this add-on.

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Software

The Windshaper is managed with the WindControl software that allows you to fully and precisely control wind settings with simple commands. You can manually select the wind pixels that you wish to activate or you can input a mathematical function to reproduce any steady or time-variable wind profile. You can also control your Windshaper directly from a Python script using WindShape's Python 3.x control API.

- Dynamic control of the wind profile u = *f*(x, y, t)
- Smallest possible time step with dynamic control: 0.1s
- Ready swirl control for each wind pixel
- Improved WindControl Version 2.2 software
- Cross-platform portability (operating system)
- Network communication between user and Windshaper through Ethernet connexion
- Custom scripting interface using Python 3.x API
- Web-based graphical user interface

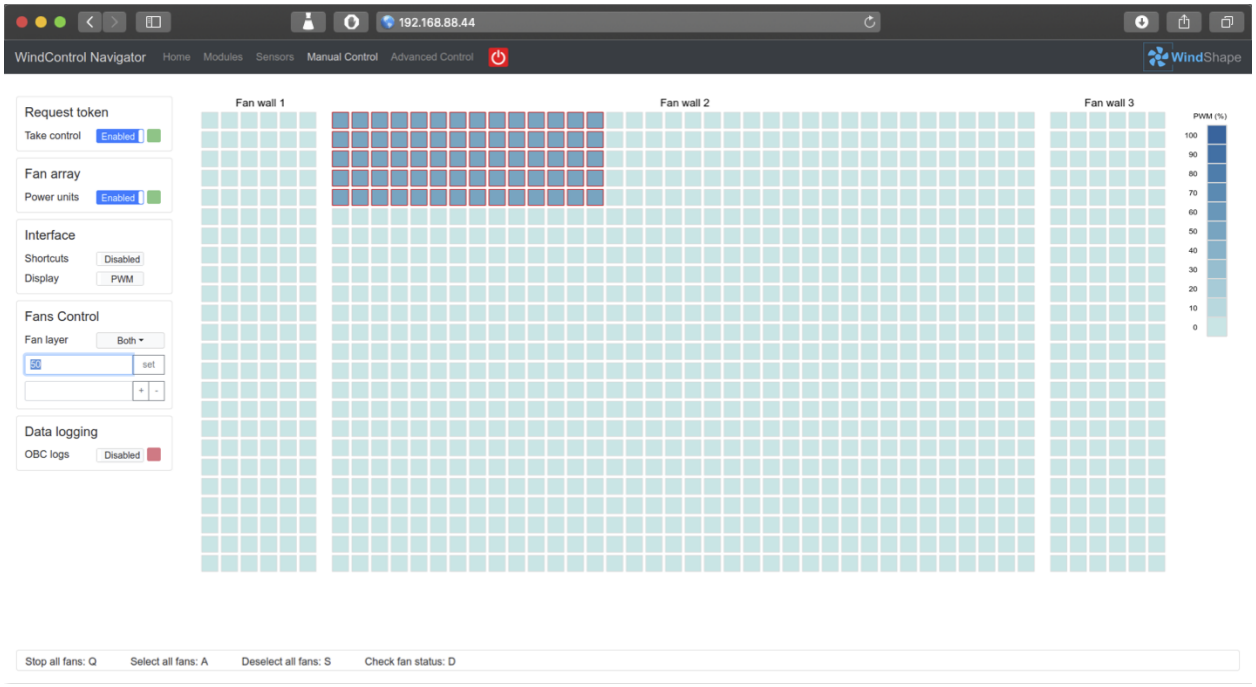

Fig. 4: WindControl GUI