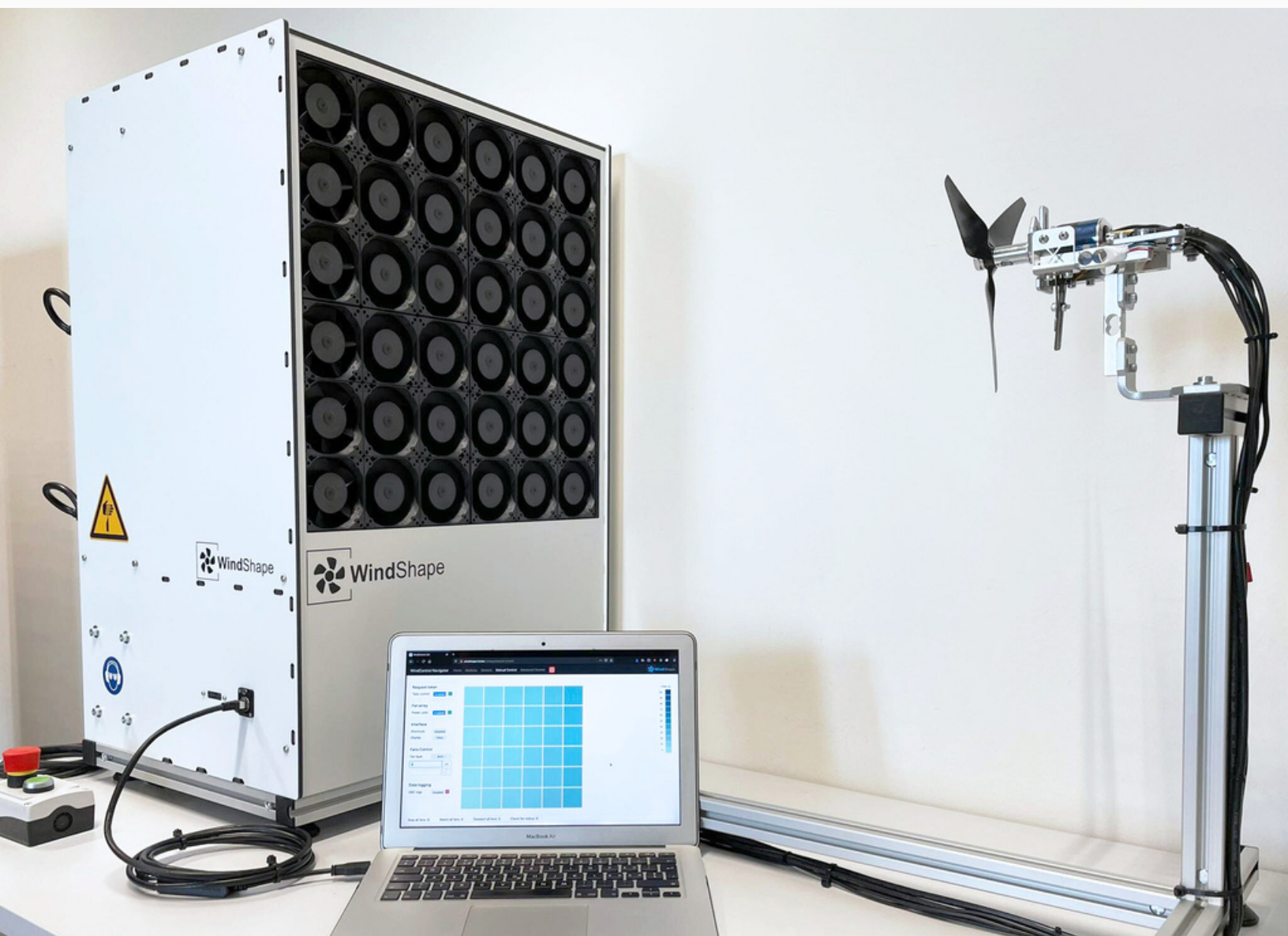# TYTO ROBOTICS

Prop Testing Station

Complete setup for propeller testing

Introduction

This testing set-up is designed to study the effects of different wind profiles on propellers, motors, ESCs and batteries. It includes a 2x2 Windshaper and a Series 1585 thrust stand.

Users will collect key information on performance, efficiency, consumed power and more.

How it Works

Windshapers are a wind tunnel alternative that offer extra flexibility and customization. The 2x2 Windshaper is composed of 4 stackable modules that each have 9 'wind pixels'. 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, see page 5).

The Series 1585 thrust stand allows you to characterize motor and propeller performance, including the efficiency of each individual component and the overall system efficiency.
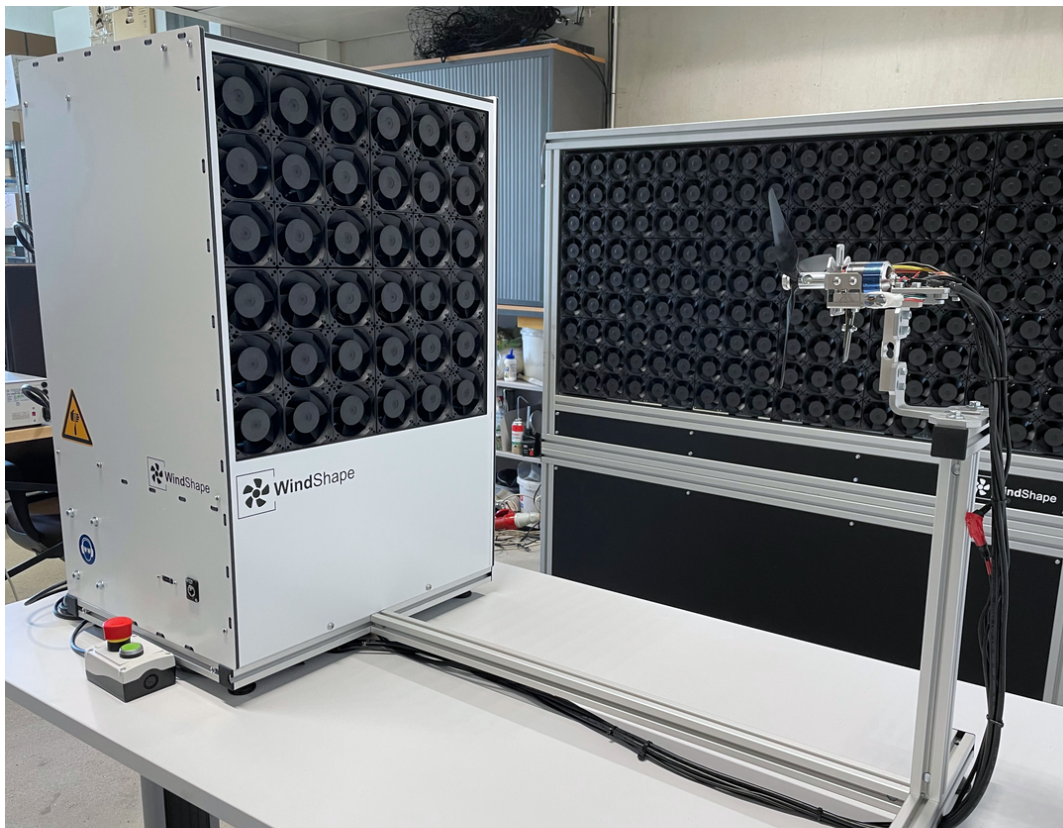
Hardware and Electronics

The Prop Testing Station has two main components: the 2x2 module Windshaper, and the Series 1585 thrust stand.

2x2 Windshaper

The 2x2 Windshaper is a 50 x 50 cm open wind generator. The wind generator is composed of 4 modules, each with 9 wind pixel fan units. Each wind pixel is equipped with 2 counter-rotating fans that generate a flow speed up to 16 m/s. The Windshaper is managed with the WindControl software that allows you to precisely control wind settings with simple commands.

Series 1585 Thrust Stand

The Series 1585 thrust stand measures thrust, torque, RPM, current and voltage. Power and efficiency values are automatically calculated after the test is completed. Additional sensors can be added to measure temperature and airspeed. The stand is controlled with the RCbenchmark Software that allows you to control your ECS's throttle directly from the GUI and view your recorded data live.

Technical Specifications - Windshaper

	Specification	Units	Value
Fan module specifications	# of wind pixels per wind module	n/a	9
	# of fans per wind pixel	n/a	2
	Total # of fans per wind module	n/a	18
	Single wind module width/height	meters	0.243
	Single wind module surface area	meters	5.905
Flow specifications	Minimum flow speed	m/s	2
	Maximum flow speed (without convergent)	m/s	16
	Maximum flow speed (with convergent)	m/s	Depends on size - ask our sales team for more information
	Ramp-up flow acceleration (hot wire at 1 m from the fans)	m / s2	4
	Ramp-down flow deceleration (hot wire at 1 m from the fans)	m / s2	3.6

Technical Specifications - Series 1585 Thrust Stand

Specification	Min	Max	Tolerance	Unit
Thrust	-5	5	0.5% ± 0.005	kgf
Torque	-2	**2**	0.5% ± 0.005	Nm
Voltage	0	50	0.5% ± 0.05	V
Current	0	55	1% ± 0.1	A
Angular speed*	0	190k	1	eRPM
Coil resistance	0.003	240	0.5%	Ohm
Digital Scale	0	3	0.5% ± 0.1	kgf

*Electrical RPM, divide by the # of motor poles to obtain true mechanical RPM

Optional Features

Flow Filter

A flow filter is added to the front of the fan surface and reduces unwanted turbulence.
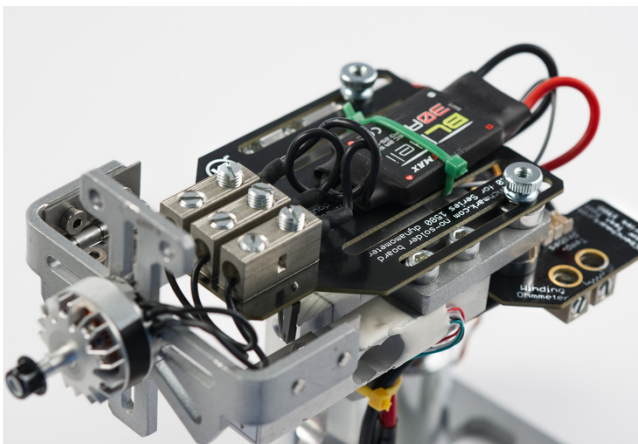

Flow Convergent

Can increase the wind speed up to 45 m/s, depending on the size of the test section.
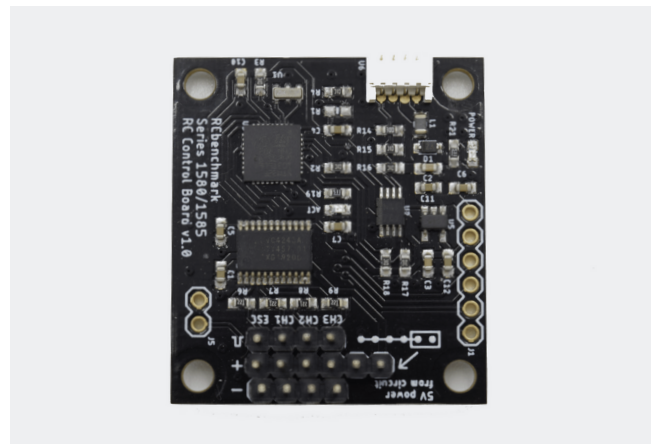

No-Solder Board

Allows the installation of various types of ESCs and motors without any soldering.

RC Control Board

Supports multiple ESC protocols (DShot, OneShot, MultiShot, Standard PWM, etc.)

Applications

- Study propulsion system performance in diverse wind conditions
- Power / battery consumption analysis
- Efficiency characterization at different pitches
- Flight replay testing
- Dynamic tests
- Testing different combinations of motors and propellers
- Comparing different propeller designs
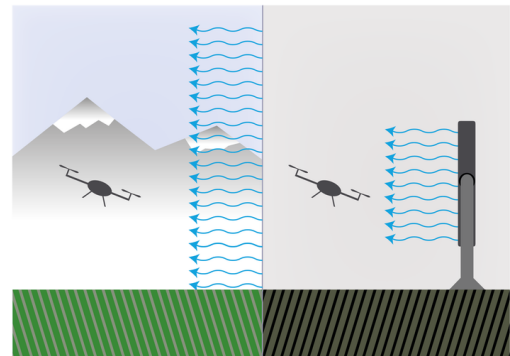
Wind Profiles

What makes Windshapers unique is their ability to create dynamic wind flows.

Traditional wind tunnels produce a uniform flow, whereas Windshapers use 3D input $(u = f(x, y, t))$ to generate diverse patterns such as these:
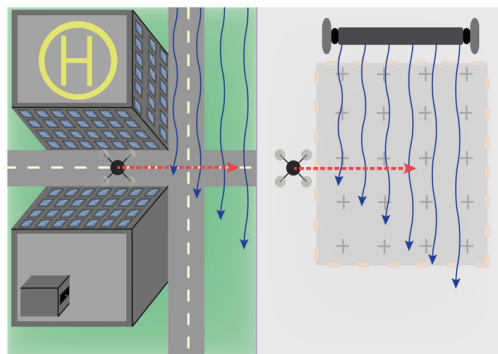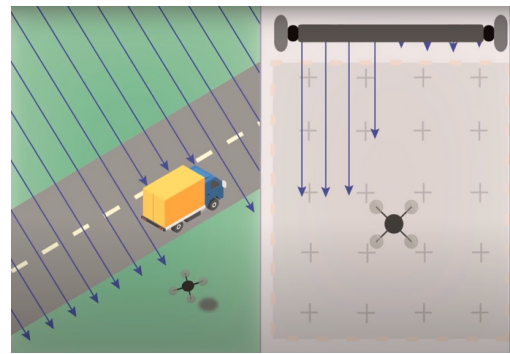
Uniform Laminar Flow
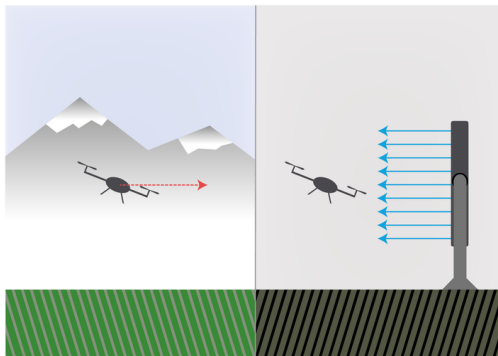
Turbulent Flow

**Shear Flow**

Time Variable Flow

Software - Windshaper

Your Windshaper is managed with the WindControl software that allows you to fully and precisely control the 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 produce a steady wind profile or a time-variable wind profile. You can also control your Windshaper directly from a Python script using the Python control API.

Features:

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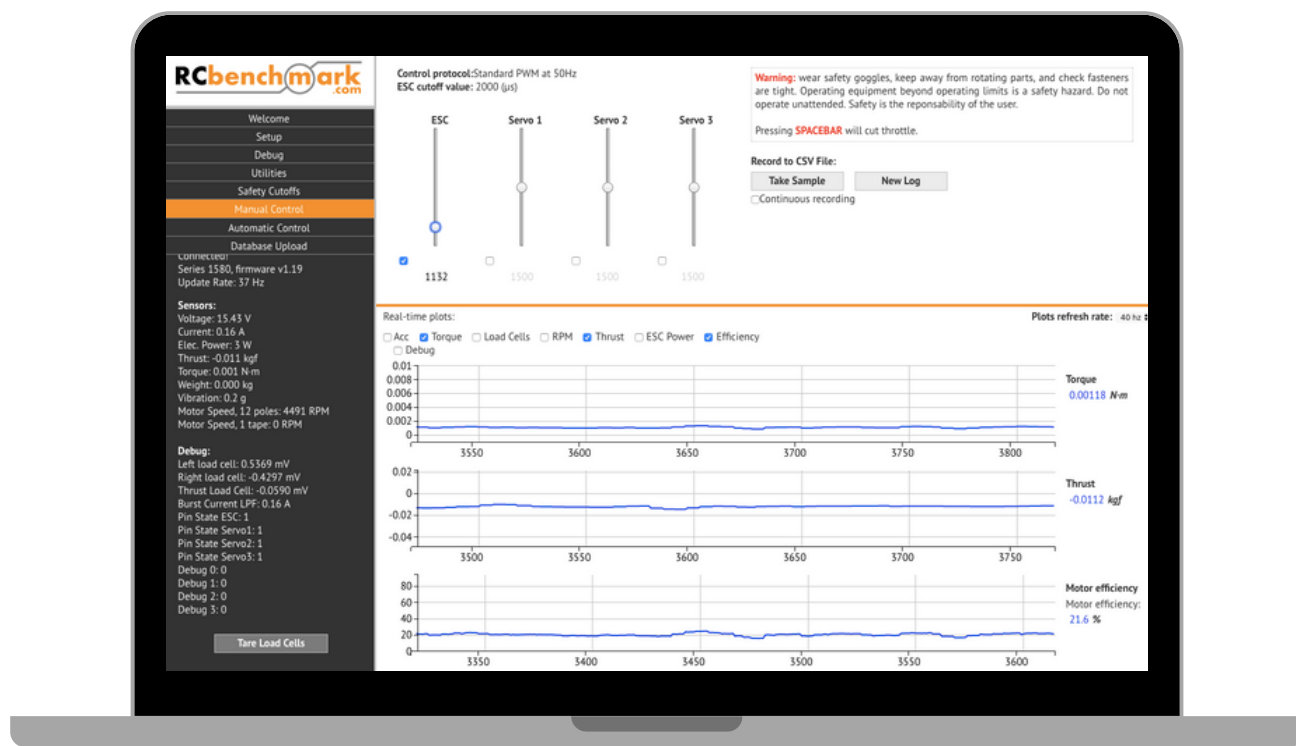- Web-based graphical user interface
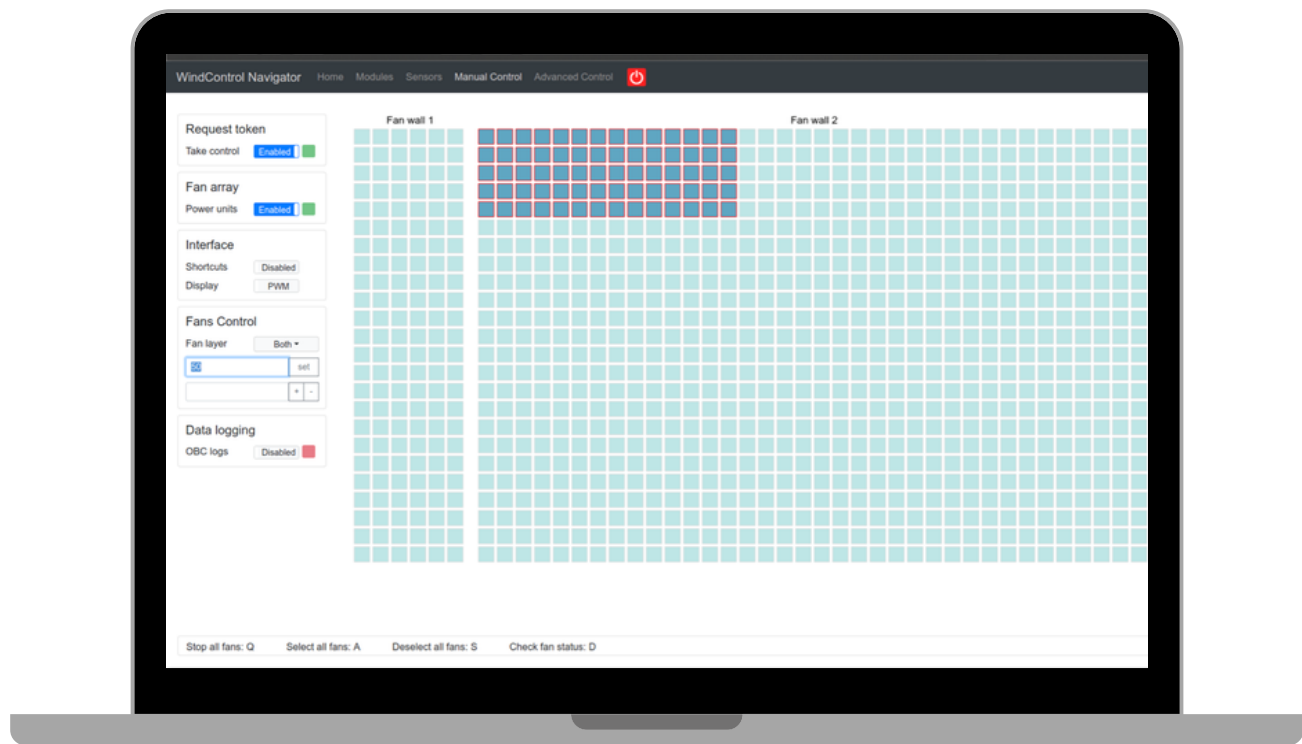
Software - Thrust Stand

The RCbenchmark software is included with your kit and allows you to control your thrust stand and record data. The thrust stand can be controlled manually or automatically with Windows, Linux, Mac and Chrome OS. The interface displays sensor information in textual and graphical form, which can be recorded as single data points or continuous data.

We provide pre-written test scripts for you to edit or you can write your own custom scripts. Once the data is recorded, you can easily export it to a .CSV file.

Features:

- Real time graphs
- Manual motor control
- Manual servo control (three channels)
- Calibration wizard
- Safety cutoffs based on any measured data
- CSV export

- Automated test
  - Ramps
  - Steps
  - Measure Kv
  - Measure number of poles
- User scripts with documentation

Technical Drawings

FRONT VIEW – 2x2 modules

SIDE VIEW

USB data acquisition board

ESC mounting surface

Pivot mount for torque measurement

Height: 124mm

Universal motor mounting plate

Mounts to table using bolts or clamps (not included)