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Case study #1: Drone Tali H500

The following document is the first of a series about the most popular drones on the market. Data and ratings have been provided by Mauro Pompetti, CEng, inventor and builder of the DronesBench and related testing tools able to provide technical data on drones during operation.

Mr Pompetti and his team co-authored four international scientific publications, presented the result of their studies at the IEEE Torino 2017 conference and is contributing to the implementation of the new EASA legislation.

The Tali H500 is an elegant hexacopter equipped with GPS, a nice remote control DEVO F12E with built-in monitor, a bottom camera and a retractable trolley to allow, in flight, any shooting angle. Its full battery and camera weight is 2420 grams.

The drone was provided by a drone repair workshop so it made several flights and a crash before repair. The test was carried out by applying the drone to the DronesBench instrument, a test bench capable of providing technical information on the flying drone.

The main measurements provided by the instrument are listed below, for more information, see:
http://www.dronesbench.com/.

Below is a photo of the drone before the test.

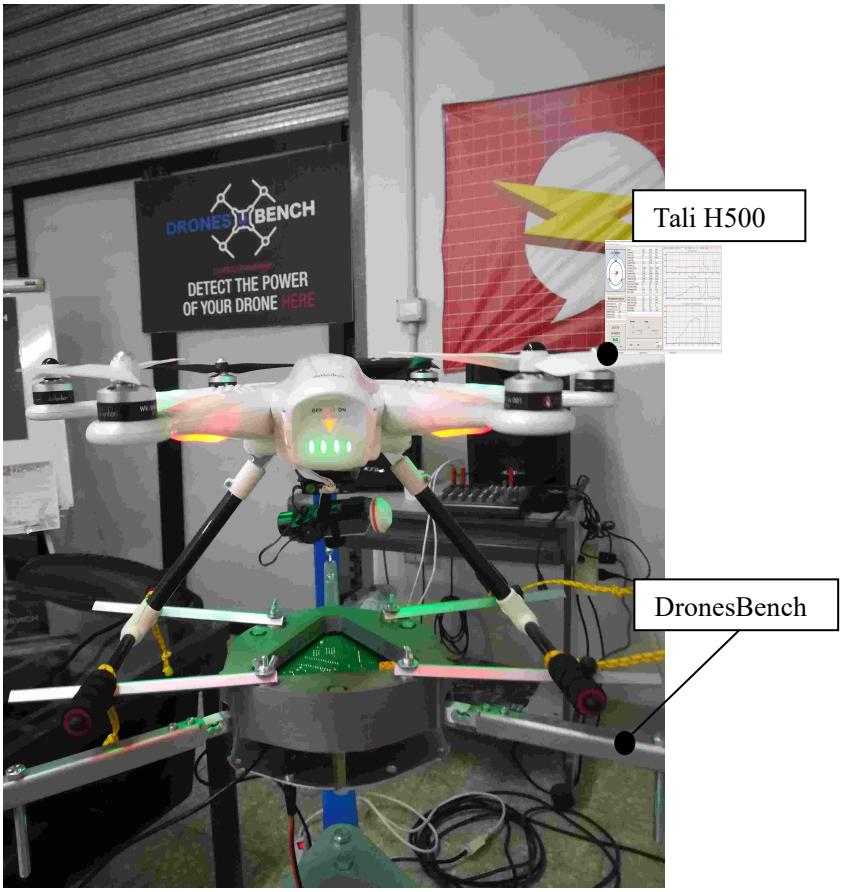

Figure 1: Fixing the drone to the DronesBench before the test

Figure 2 and Figure 3 below show the HMI interface developed to analyze the data from the measuring instrument.

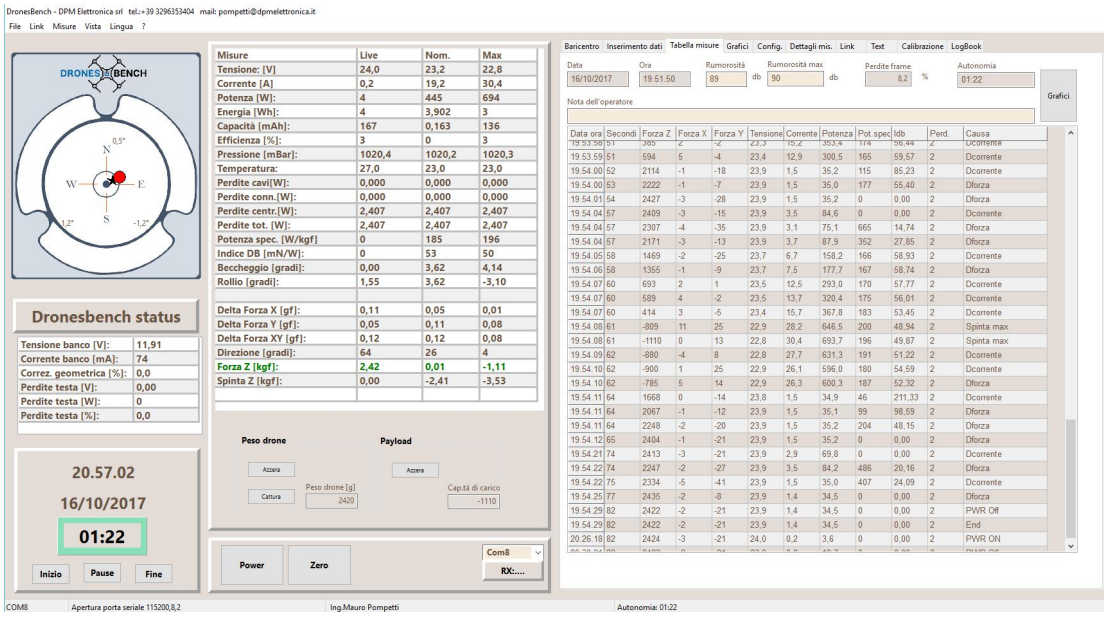

Figure 2: HMI Interface with Measuring Tables

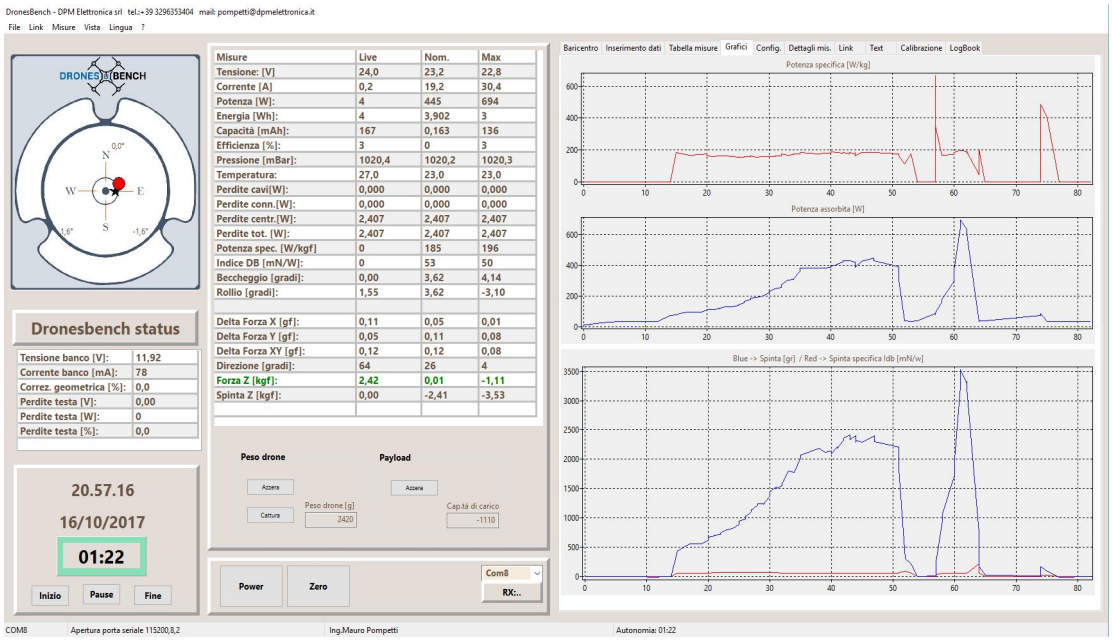

Figure 3: Graphical HMI Interface

In the first instance, there was a technical problem on the battery: during a preliminary test, as soon as the drone arrived at maximum power, the voltage dropped abruptly and the drone switched off instantly.

Even though the battery signaled the highest charge, the information was not truthful. If the test had been done in the air, the drone would have fallen on the ground. The reported data refers to tests with a battery just removed from the packaging, apparently virgin, with obvious signs of swelling.

A measurement of the actual battery capacity shows a value of 3250 mAh versus the 5400 mAh on the plate. This battery is used for the the drone test on the DronesBench test bench.

The good operation of the entire electro-mechanical drone unit can be synthesized through an index called "DronesBench Index" which represents the ratio between the drone thrust and the power absorbed by it to generate that thrust in the space. The DronesBench Index, DBI, is a parameter that physically matches a more general Factor of Merit (FoM) evaluated for

the drone as a whole. The FoM of the entire drone is an efficiency index that takes into account all the components of the drone, from the battery to the propellers, and its decrease compared to its nominal value unambiguously demonstrates a defect of the drone.

The H500 has a DBI at take-off of 52 mN/W, this value drops at peak moment up to 49 mN/W. This value is much lower than the values found in other drones, and this lets you think of two possibilities:
1) The drone has some defect that could occur during the flight.
2) It may be appropriate to review some aspects of design by the manufacturer to improve efficiency.

A sure answer could be obtained by comparing the measurements made on a new, perfectly functioning Tali 500. Below is a table showing some of the principal quantities measured during the test.

Parameter	Motors stopped	Take off	Max power
Voltage [volt]	23.8	22.4	21.6
Current [ampere]	1..1.5	20.0	27.4
Power [watt]	28 medi	447	592
Thrust [gramms]	0	2420	3130
Idb (fom) [milli newton/watt]		52	49
Specific power [watt / kgf]		192	204

Table 1: Tali H500 Measures

You can notice the 2.2 volt difference between minimum and maximum voltage, which can also be attributed to the low internal battery strength. The Tali H500 Battery C parameter is not declared, it can be presumed that it is insufficient if the battery is working properly, otherwise it is working with a naturally defective battery.

There is a significant problem of extraction of the swollen batteries from the drone, due to the fact that the cross ribs of the battery counteract within the drone. This defect prevents the user from replacing the battery with a non-swollen one and forces him to contact a workshop.

The maximum thrust value is analyzed: -0.61 kg more than the drone weight, this is the theoretical maximum payload of the drone. By reading the horizontal forces, one can find that they are not significant during vertical flight, in particular we have measured 170 grams in hovering and 160 at maximum power.

Remote control trimmers needed a rebalancing of ESCs, which was done directly on the bench in total safety.

The audiometric test made at 1 meter distance and 45 degrees below the drone, under a propeller, provides a measure of 89 db at takeoff and 90 db at maximum power. Subtle note: other than the intensity, the noise produced by the propellers has a 'metallic' connotation that is not soft. I learned that this feature denotes a lower efficiency of the coupled helix-motor.

Of the 340 seconds of the entire test, the drone remained on for a total of about 200 seconds. It is noteworthy that the tests that have been carried out here were all with unreliable batteries, so that the test was repeated using 24 volt external power supplies. In that demonstrating the incorrect operation of the battery, the external power supply makes the drone generate a maximum payload of 1.1 kg.

Improvement is also highlighted by a slightly higher DBI.

We summarize the most significant data in the following table:

Parameter	Motors stopped	Take off	Max power
Voltage [volt]	23.9	23.2	22.8
Current [ampere]	1..1.5	19.2	30.4
Power [watt]	28 medi	445	694
Thrust [gramms]	0	2420	3530
Idb (fom) [milli newton/watt]		53	50
Specific power [watt / kgf]		185	196

Table 2: Drone measurements performed by external power supply

The losses on the connecting cables are 9 watt, the current measurement error does not exceed 2%.

A DronesBench Index so low would imply a hidden defect, so the tests have been run out to the fatigue limit in order to break any semi-broken part. During the fatigue test, in fact, the DBI falls progressively until the visual manifestation of the failure. This did not happen, though, even after 10 minutes of work. In fact, the motors remained cold and this implies that the DBI we measured is just the characteristic of the drone.

In conclusion, our Tali H500 has been tested extensively and all its relevant parameters measured. It can certainly fly with a new battery. That said, through the analyses we carried out, we have offered great opportunities for improvement.

We contacted Walkera for a comment and they stated that it is one year the designer is not working with them any more and, as a consequence, the Tali H500 was put out of production.

MORE PHOTOS FROM THE TEST