

Average Motor Efficiency of UAV

Offers the results of researching on the efficiency of electric motors taking into account the mass with aerodynamic diagnostics system for UAVs.

Introduction

Unmanned Aerial Vehicles (UAVs), commonly known as drones, have become essential in various sectors, including military, commercial, and recreational use. UAVs rely on efficient propulsion systems to maximize flight duration, operational range, and payload capacity. Motor efficiency is a critical factor in the overall performance of UAVs, influencing how effectively they convert electrical energy into mechanical thrust.

Aerodynamic diagnostics system

The use of composite materials is due to their high strength, stiffness and low weight compared to metal materials, energy losses are reduced. Therefore, the efficiency of using such engines increases substantially. However, a serious disadvantage of polymer composites is that they can contain deformations due to various influences that can cause accidents during the operation of aircraft.

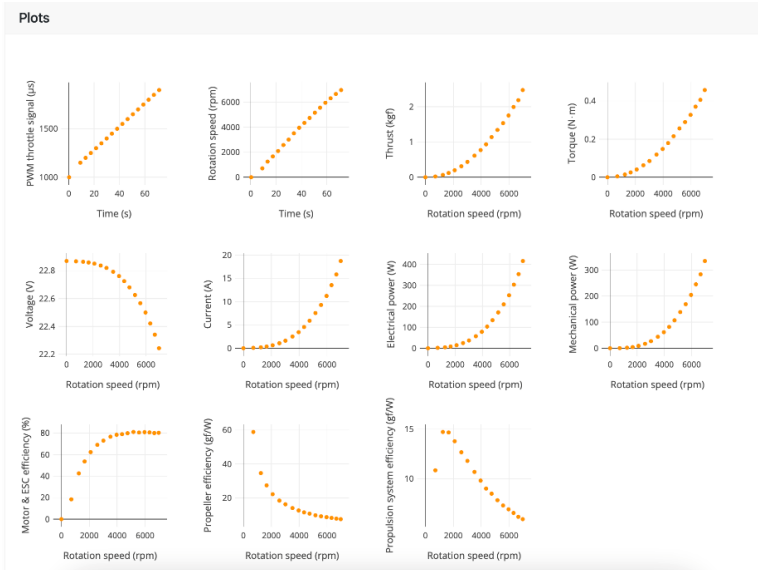


Fig. 1. Results for a standard motor/propeller propulsion test

First, let's look at the motor efficiency data for the group as a whole. The average maximum efficiency percent for all 48 electric motors included in the study is 78.62%. This is not bad, given that the data was not collected for maximum efficiency purposes. This would-be good estimate of typical electric motor efficiency.

The highest efficiency observed was 96.59% and the lowest was 54.81%. The graph below shows the distribution of maximum efficiencies:

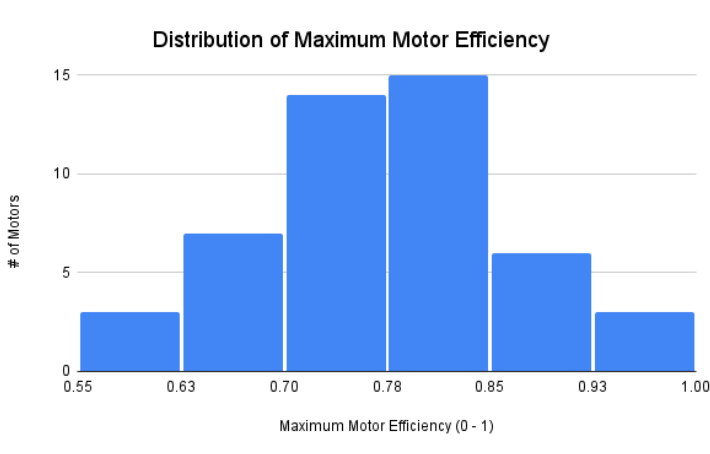


Fig. 2. Histogram showing maximum motor efficiency distribution

When we break it down further into groups based on weight, this is what we observe:
 Weight Category (g) with Average Maximum Efficiency: (3.9 - 30.2) 70.179%, (30.2 - 37.2) 66.65%, (36.2 - 70.2) 78.97%, (70.2 - 158.0) 82.67%, (159.2 - 255.0) 83.52%, (1092.2 - 5120.0) 86.85%.

As you can see, there is an overall trend of increasing efficiency as motor weight increases. When all data points are included individually, the trend is similar, albeit more dispersed:

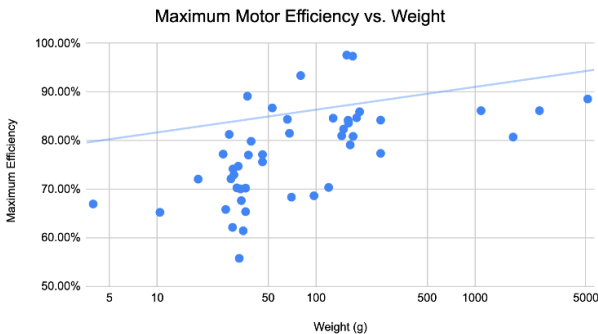


Fig. 3. Maximum Motor Efficiency vs. Weight for all individual data points

From these graphs it can be expected that, in general, the larger the motor size, the higher the maximum efficiency. This is consistent with current industry practice.

Also, there is a wide range of efficiency for the same size motors, especially the 30-50g and 4-30g motors surprisingly

For most UAVs, replacing the bottom motor with a top motor can add several minutes to the flight time. And in general, it will increase the effectiveness of UAVs by several percent

Conclusions

In conclusion, according to this observational study. On average, the larger the motor, the higher the efficiency. There is a large range in efficiency for motors of the same size. The efficiency figures are highly dependent on the case used and the choice of propeller. Motor efficiency plays a vital role in the operational performance and cost-effectiveness of UAVs. Advances in motor technology, energy management, and system optimization continue to push the limits of UAV motor efficiency, making them more capable and sustainable.

References

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