



Fig. 1 UAV Gimbal with maxon motors.

## Selecting DC servo motors for a high precision camera gimbal application.

Aerial photography and surveying can be beneficial for many businesses and industries. For example; mining companies doing aerial-surveying of mine sites, oil & gas companies conducting aerial-inspections of their offshore platforms, electricity Companies inspecting high voltage transmission lines or a real estate agent taking high resolution aerial images of properties for marketing.

A common problem faced in these often harsh operating environments is keeping the camera or the surveying equipment steady against wind, turbulence and the vibration from the aircraft it is mounted to. This is where a high precision stabilisation camera gimbal comes into action. These gimbals provide users with a firm and level platform that allows them to capture high quality images and data without being effected by destabilising elements.

maxon motor Australia received an enquiry from Photo Higher in Sept 2011, they were looking for a small brushless DC servo motor and gearhead combination for a high end camera gimbal that they were designing. Photo Higher is located in Wellington New Zealand; they specialise in the design, development and manufacture of precision camera gimbal systems for Vertical Takeoff and Landing (VTOL) Rotary Wing Unmanned Aircraft Systems. The Photo Higher gimbals are designed to be light weight, smooth and very stable. Their gimbals are all 100% designed and manufactured in New Zealand. With the innovative design and carbon fibre manufacturing capabilities, Photo higher are considered to be one of the industry leaders in the commercial precision camera gimbal industry.

The initial requirement was to have a DC servo motor combination with zero backlash, 40rpm and 2Nm output torque. The total weight of the motor combination needed to be less than 100 grams and the overall length needed to be less than 50mm. This required speed and torque was achievable however the weight and length were proving to be an issue. To achieve 2Nm at 40rpm continuous with low backlash, the combined weight of the motor and gearhead was around 370grams which far exceeds the weight requirement by the customer. maxon engineers worked through all available options with standard backlash figures, having

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the intention of using a standard brushless DC servo combination first and then to work on customising a DC servo gearhead to achieve the low backlash specification afterwards. maxon were able to come very close to the weight, speed and torque target but the overall length for the proposed brushless DC servo combinations was too long for the client.

### **Why a brushless DC servo motor with such high power density?**

With most unmanned aerial vehicles (UAV) applications, the power consumption is important. With higher power density and higher efficiency, maxon brushless DC servo motors will consume less power compared with other motors, allowing the UAV to stay airborne for longer.

So the search continues.....

A right angle drive option was then considered but it was too heavy for the application. We finally settled on a flat brushless DC servo motor with a harmonic gearhead. This Harmonic flat brushless DC servo combination delivers the required speed and torque in a flat compact form; most importantly this combination has an output with zero backlash which makes it ideal for a gimbal application.

After the brushless DC servo motor selection for the large Photo Higher gimbal was completed, maxon started work on three smaller Photo Higher gimbal designs. The smaller gimbals were more price sensitive, therefore the harmonic brushless DC servo combination could not be considered. maxon engineers then proposed several different small flat DC servos with low back lash gearheads, but either the price or performance made them unsuitable. After some discussion and with some smart carbon fibre structure designs by Photo Higher, we were able to use a flat DC servo motor to direct drive the gimbal. With the new gimbal design irrespective of the camera brand or model used, the end user can always adjust the gimbal mount and balance the centre mass of the overall system. With a balanced centre of mass fast acceleration and quick response can be achieved with minimum effort from the DC servo motors.

Besides providing the customer with brushless DC servo solutions for their various types of gimbals, maxon also provided the customer with a customised brushless DC servo motor controller. The customisations included the PCB shape, control parameters, gain and connectors; all have been tailored specifically to cater for the special requirements of the application.

The AV and Halo series of gimbals by Photo Higher are products designed for the most demanding applications. Combined with an unmanned aircraft it provides users with an easy and cost effective way to collect and capture high definition aerial imagery and geospatial data. Besides UAV the gimbals can also be mounted on various types of platforms, such as helicopters, airships, cranes, boats etc.

Photo Higher chose maxons' brushless flat DC servo motors because of their compact, high torque density, long service life and attractive price vs. performance ratio. These features combined with maxon motors ability and willingness to customise the motor and controller to meet the customers' application needs, made maxon motor the ideal choice for the application.

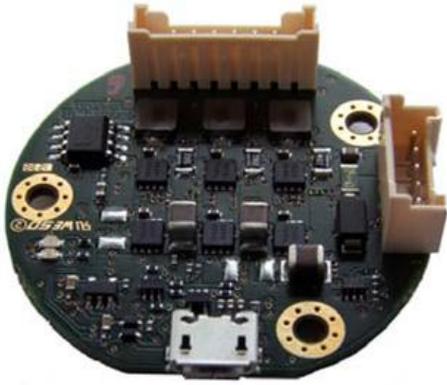


Fig. 2: Custom Brushless Motor Controller



Fig. 3:Photohigher Halo 3000 gimbal



Fig. 4: Octocopter with brushless DC motors

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