Spartan RC – VisionLock

www.spartan-rc.com

Introduction to servos

Servos are closed-loop devices. This means that they are constantly comparing the commanded position from the receiver to their actual position which is acquired by the use of a potentiometer mechanically linked to the output shaft. If there is more than a small difference between the two, the servo's electronics will turn on the motor to eliminate the error. In addition to moving in response to changing input signals, this active error correction means that servos will resist mechanical forces that try to move them away from a commanded position. When the servo is not powered or not receiving positioning pulses, the output shaft can be easily rotated by hand. When the servo is powered and receiving signals, it won't budge from its position.

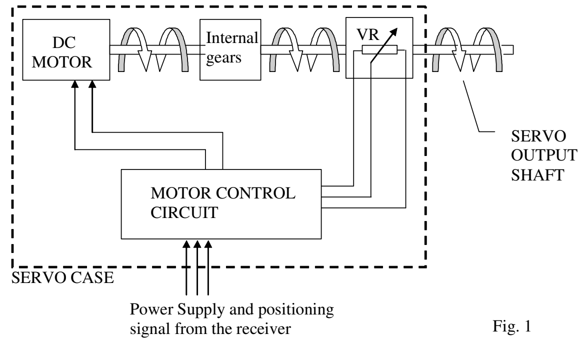


Fig. 1

Modified servos for aerial photography mounts

In aerial photography mounts it is common to see modified servos which allow the output shaft to perform full revolutions so it can later be geared down to provide higher torque and wider rotation. The usual method to do this is by cutting off the mechanical endpoints and unlinking the potentiometer from the servo shaft; thus effectively opening the control loop. This is simple to perform but has several drawbacks:

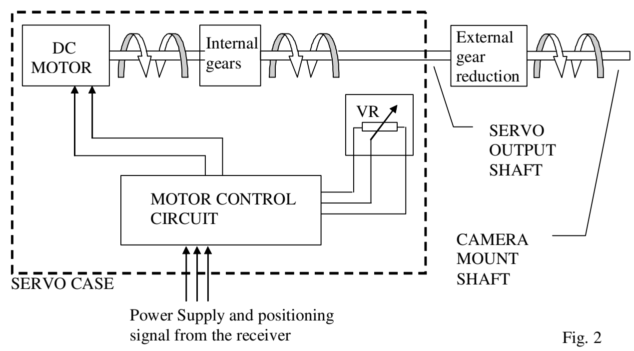


Fig. 2

- The camera mount does not have endpoints. It is possible to twist and damage cables.
- When the servo is not commanded to move the shaft can freely rotate with the weigh of a camera.
- There is poor proportional speed control of the camera mount.
- The servo will occasionally drift and require re-trimming or adjusting of the pot.

A different approach

All these issues can be corrected by using the servo in its intended closed loop mode. To do this we need to install a position feedback potentiometer after the external gear reduction. This will now allow the servo to operate like a normal unmodified servo with the benefit of extra torque but of course with the loss of speed. However, this system only has a 90 degree operating range like a normal servo which is probably not enough for camera mount. By adding two resistors on the outside pins of the potentiometer (shown as R on Fig.3) we can increase the rotation range of the servo. You may experiment with values in the range 1K to 1.5K. Larger resistance values usually make the servo unstable.

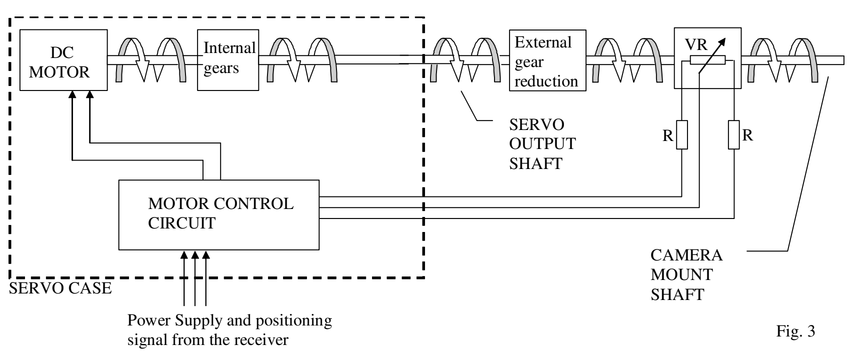


Fig. 3

The graph on the right shows how this everything fits together. The potentiometer is mechanically linked with the larger gear of the external gear reduction. A three way wire then connect the external potentiometer to the servo at the same contact points where the internal potentiometer used to be. If the servo rapidly moves in one direction on its own and reaches the endpoint it is possible that the two outside wires need reversing.

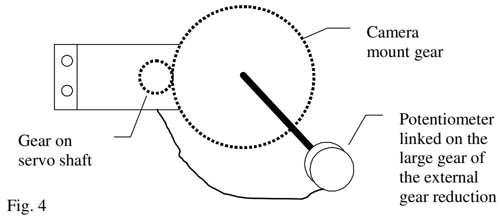


Fig. 4

Even more travel

It is possible to increase the rotation range of the mount even more by fitting a 3rd even larger gear for the potentiometer.

Finally, the Vision Lock is able to overdrive the servo by 20%. Most servos work perfectly fine with this. Using the system of Fig.4 with external resistors and a bit of overdrive it is possible to achieve rotations as large as 180 degrees.

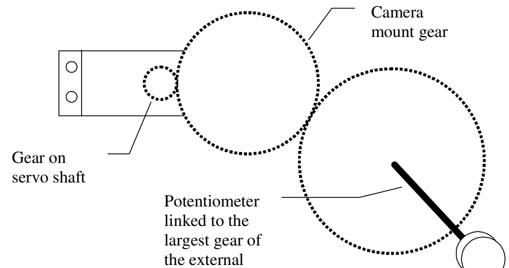
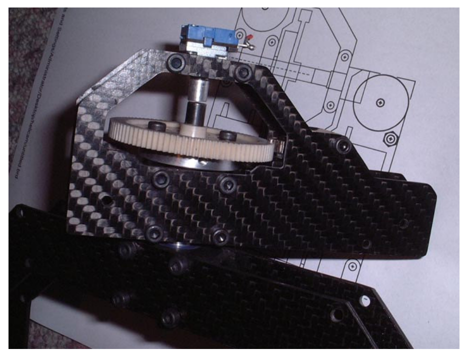


Fig. 5

The photo on the right shows how the potentiometer is linked o the pan axis of our camera mount.



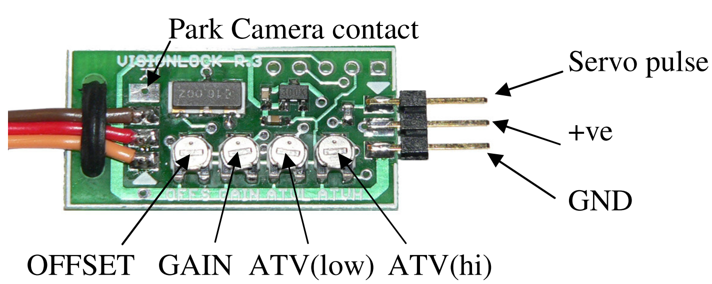
Proportional position to proportional rotation speed

However one problem still remains. The system shown in Fig. 3,4,5 operates like a normal servo. The mount position will be proportional to the joystick position which means that if the cameraman wants the mount to point a bit to the right he would have to constantly hold the joystick off centre. It is indeed not easy to control the camera heading this way. However, the VisionLock can help. The VisionLock can convert the proportional position demand from the transmitter to proportional rotation speed for the servo. This means that the camera mount will stay still when the joystick is in the centre. Then the more the joystick is moved off centre the faster the camera mount will rotate. Back to the centre and the mount will stop where it is.

VisionLock

The VisionLock offers two modes of operation. The Normal mode converts proportional position to proportional rotation speed as described above.

The Heading Hold mode offers the same behaviour to cameraman's inputs but it also allows the use of Heading Hold gyros to stabilise the camera heading.



Normal mode:

- This mode does not require gyros. To activate Normal mode rotate the GAIN potentiometer fully anticlockwise (GAIN=0). When the GAIN is greater than 0 the gyro mode is activated instead. The power must be cycled before the mode change takes effect.

- The travel of the camera mount is defined by the ATV potentiometers on the module. Keep your transmitters ATVs to 100%. Move the transmitter stick fully right and adjust the corresponding ATV potentiometer on the module. Repeat with fully left and adjust the other ATV potentiometer.
- In this mode the OFFSET potentiometer is used to adjust the maximum speed of the camera mount servo.
- When powering on the camera mount system, allow a couple of seconds for the module to learn the joystick neutral position. Do not move the joysticks during this time. When the system is ready the camera mount will move to the neutral position.

Heading Hold mode:

- This mode requires the use of a Heading Hold gyro. Futaba GY240 and GY401 work well for this task. The use of PCM receiver is recommended if a GY401 is used. This is because glitches on the gyro gain channel can be interpreted by the gyro as a command to recalibrate the neutral position (switch toggle 3 times within a second as described in the gyro manual). If this happens it results in the camera mount continuously moving in one direction and reaching the endpoint.
- The gyros must be installed in such manner so that they are affected only by the axis they control. Thus the pan gyro must be installed on the upside-down-U and the tilt gyro must be installed on the base plate of the camera mount.
- Set **the gyro ATV** (if available) to 100%. Set the **gyro gain** to 70%. The **transmitter ATVs** define the max rotation speed of the camera mount. Start at around 60% and adjust to get the desired max speed.
- Allow a few second for the gyros to learn the neutral position (as you do with your tail gyro). When the system is ready, the camera mount will make a small jump then the gyros will hold it in that position.
- Set the GAIN to max (fully clockwise). This should make the camera mount to oscillate violently. Now reduce the gain until the oscillation stops. If oscillations are present during flight reduce the GAIN a bit more. If the camera mount continuously moves to one direction the gyro may require reversing.
- Adjust the module ATVs as described for the Normal mode to get the desired camera mount travel.
- If you experience different stopping characteristics for left and right movements adjust the OFFSET potentiometer until the system behaves symmetrical.

Notes:

- VisionLock works only with servos which are not modified for continues rotation or camera mount systems where a potentiometer is available on the camera mount axis to provide position feedback to the servo.
- In Normal mode connect the VisionLock between the receiver and the servo. In Heading Hold mode connect the VisionLock between the gyro and the servo.
- In the interest of achieving increased travel range for the camera mount, the module is capable of driving the servos 20% further than their normal travel. Most servos are happy with this out of spec control however some may bind. This is not an issue of concern with externally geared servos, but always adjust the ATV potentiometers slowly and confirm that the servos operate correctly.

Camera parking:

Revision 2 and 3 modules have a camera park function. When activated it will move the camera smoothly to the centre (home) position. The movement time from the full extreme to the middle point is slowed down to around 2 seconds which is ideal for heavy cameras with a lot of inertia. The park function is activated when the “Park Camera” connection is shorted to the brown wire which can be remotely achieved using an e-Switch. More than one switches can be connected in parallel allowing both the cameraman as well as the pilot to quickly park the camera in an emergently and override the camera man’s controls. In such setups it is essential than an opto-isolated e-switch is used to eclectically isolate the helicopter electronics from the camera mount electronics. Our quad opto-isolated e-switch is ideal for such setups allowing control of 4 connections which typically are: zoom in, zoom out, trigger and park camera.
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