HiTec HS-422 Servo Modification

Step 1. Disassemble the servo as illustrated above. Be sure to keep the small parts in a safe place, away from small children.

Step 2. Remove the mechanical stop from the gear as shown in Figure 2.

Caution, wear eye protection for this step. Use a wood backing as illustrated in Figure 3 and Figure 4. A 1/2 wide, square, exacto blade (#18) works well. First make a short (vertical) cut, then make the long (horizontal) cut.

A file or fine tooth saw may also be used, as shown in Figure 5 and Figure 6. Use whatever method you are most comfortable with to remove the plastic stop from the gear.

Step 3. Next we need to bring the potentiometer outside of the housing. This allows the precise adjustment of the servo stop value. I use a pair of needle-nose pliers to remove a small section of the case to allow the wires to exit. Just give the pliers a twist and the plastic will come out easily. Figure 7 illustrates the procedure.

Step 4. A nice feature of the HiTec servo modification is the ability to reverse the wires to the motor. The motor is the large round object with the brown and orange wires going to it as shown in Figure 8. When done to one of the servos the relationship of left and right servos are the same. For example an increase in pulse length on both sides will result in forward motion. Reverse the motor leads on one of the servos and mark it as the "M" servo.

http://www.lynxmotion.com/images/html/sm0d2.htm

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here. Give it a yank and Voila!, you have a continuous rotation servo.

Note that, before reassembly, you will want to plug the servo in and turn on the transmitter and get the pot positioned so that the servo doesn't rotate. Or you could do what I did; forget about it, reasonable everything, plug it in and find that you have a true continuous rotation servo since it will not stop!

Yaaaah! Minolta GS50 digital

From the point of view of modifying the servo to Continuous Rotation, at this point you'll be done. This servo will rotate through 360 degrees with no problem. In my pan design, I want to mount a small gear on this output shaft. To do this, I need to thread the output gear to a 4-40 thread so I can attach a shoulder bolt (from Small Parts Inc.) on which will go the small gear. Since I have this servo apart already, I might as well thread the thing.

Preparing to Tap the Output Gear To thread this gear I am going to use a 4-40 tap. As you can see by where the screwdriver is actually laid in the photo, this will require drilling a hole using a #3 drill bit. You aren't going to find this bit in your drill bit set from Target; it is one of a sequence of precisely-sized bits I buy mine one at a time, as needed, from the hardware store. You can see the packaging for it lying in the photo. The black metal thing is useful for checking threads on fasteners you are unsure of and also has the clearance and tap bit sizes I neglected to lay the tap down in this artistic tableau. Minolta GS500 digital

Carefully Position the Workpiece The hole to tap into needs to be precisely positioned. This isn't too hard with the drill press, here the gear is clamped in the drill press vice, the drill press table has been locked, the vise lightly tightened down and I am moving the vice the last few inches, slowly to position the gear. The hammer, gently employed, helps greatly in making these final positioning moves. Note that my drill press, seen vaguely in the background here, is pretty burly. I owned this long before I tried KAP. If you don't own a drill press already, I'd recommend it, but if it's mostly for light work like this I'd buy a smaller, cheaper benchtop model. Minolta GS500 digital

Drilling the Hole to tap out With the workpiece positioned and clamped in place, you can drill the hole. The drill press is set to its slowest speed (450 rpm in my case) for drilling metal. You can also set the depth so it will only drill to a certain depth, and I have done that here. In this photo the drilling is actually occurring. Minolta GS500 digital

Cleaning Things Up It's a good idea to keep things tidy. Here I vacuum up the mess while things are still clamped down. When working around small parts it's good to be careful with the vac. While I have never sucked up, say, all the output gears for a servo or a bunch of 4-40 hardware, I did inadvertently vacuum up a screwdriver which became lodged in the first bend of the vacuum pipe. I had to saw off several inches of vacuum hose to get it out, hence the stubby hose-end here. Be Clean but Be Careful. Minolta GS500 digital

Tapping the Output Gear I clamped the output gear in the vice, mounted the tap in the tap handle and tapped out the gear, cutting a set of 4-40 threads in the gear. There are threads in these output gears already, but good luck finding what they are. The local hobby shop thought they might be 2.6mm metric threads but apparently it's all very ill-documented. You probably aren't going to find these fasteners and hardware anywhere. The 4-40 thread, by contrast, is bigger and gives me some options. Minolta GS500 digital

The Shoulder Bolt The option I went with was a 4-40 shoulder bolt from Small Parts, Inc. Early on, when I was first acquiring parts for the very first rig, the one I didn't actually complete, I ordered a bunch of interesting hardware from Small Parts Inc. Included in the order were these shoulder bolts. The shoulder happens to match well with some aluminum gears available from hobby stores and it is these that I have chosen for my pan mechanism. Minolta GS500 digital
Step 9
A: Place the main shaft back in place.
B: Place the intermediate gear back in place.
C: Place the nylon bushing on the shaft.
D: Replace the servo top.
E: Reattach the 4 rear screws.
Step 7

The hole under the main shaft must be rounded and enlarged. This is what comes in contact with the potentiometer.

Use a 9/64" drill bit held with your hand or pliers and insert it into the hole and ream out the slots. Once you have rounded the hole use a 5/32" bit to enlarge the hole.

Warning: Do not use a drill. You will not be able to hold the shaft in place and will cause damage if you try.

Tip

If you insert the drill bit into a drill (no power) it makes it easier to turn the bit.

Step 8

Insert the shaft into the top of the servo case as shown and test that you can rotate the shaft completely.

Tip

Assemble the servo without the intermediate gear and rotate the main shaft by hand. It should rotate freely with out catching. Also examine the potentiometer shaft and make sure it did not move.
Modifying a Servo

Project Background Info:

I was in need to modify four expensive JR-D86721 Ultra Digital servos to rotate 360° instead of the standard 180° or something. The need was required so they could be used with a 360° turntable. The inherent one-way rotary motion equipment is reversed underneath the Epping on a special drilled aluminum cage and is radio controlled (RC). I chose a digital 18-channel radio transmitter merely for the modulated channels and reliability of JR products.

The project was handed to me by our local "Land Resources" department, for my extensive experience with all sorts of radio control systems and products.

Since modifying the digital servos was not going to work, I opted for four cheaping existing servos, Hobbyco C600 (made by Hitec). The little jet inside the servo is 5K and so has to be replaced with a 2.5K resistor each. Since 2.5K is not standard stock, I crapped for 2.4K resistors. Worked out fine. (I thought maybe publishing my findings would possibly assist in helping someone else obtain the same gear). Check the pictures at the bottom of the page for the modification sequence. I sacrificed a couple days later two small ceramic capacitors (0.01µF) over the servo motor power connections to eliminate "serve-snap" on a frame servo. Worked fine. (See pictures 14-16 above).

Also, remove the switch (or starter) from the gear with the bearing. Snip it off with a cutting plier and then use an exacto knife to clean up the rear.

Underneath this thing is a system with 2 infrared cameras which takes a variety of pictures from the soil at different locations. The different colors of the soil in the pictures are then analyzed in regards to soil loamness, clay, (brown), type, etc. The system which houses these cameras had to be currently sold. The 2 cameras alone are expensive at a cost of $25K each and weight almost 4 pounds each plus the battery packs and I.C. equipment and weight of the aluminum frame (cage) itself. Total weight to be carried by the thing, at one time, was about 15 pounds (40). Cameras can be switched with infra-red cameras or night vision, etc.

http://www.austrin.ca/~tonto/gadgets/servos/servomod.html

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I say generally because I found that the range can be anywhere from 2ms to 3ms depending on the servo manufacture and model. Again generally when the pulse width is 1.5ms the servo will reach the half way point in its swing.

There is a small potentiometer inside the servo that rotates with the main shaft. This is what tells the electronics in the servo where it is at any given time. When we convert a servo to free running mode we disconnect the potentiometer from the shaft and set it at its center position. We also remove any mechanical stops that may keep the servo from turning completely around.

Once the servo can rotate freely we can find the center spot by slowly adjusting the pulse width. I call this the neutral position. Now by adjusting the pulse width greater than the neutral position we can move the shaft in one direction. By adjusting the pulse width less than the neutral position we can move the shaft in the opposite direction.

Most servos were designed so that when it gets closer to its allocated position it slows down. This will allow us to adjust the speed of the shaft by varying the amount that deviates from the neutral position.

Modifying the Servo

Note that the following modifications will void your servo warranty.

There are two ways to convert this servo. You can open up the servo and disconnect and remove the potentiometer. You then must solder two 2.2 resistors in place. Even after all that you need to take the potentiometer apart and remove some detents. I feel this is too much work and can be very error prone.
In the following steps we will work only on the main shaft. You never have to open up the guts of the servo. Also by purchasing a new gear set you can restore the servo back to normal operation if you decide to do so later.

Step 1

Remove the 4 screws on the back of the servo.

Note that it is not necessary to remove the back of the servo.

Remove any servo wheels or arms that may be attached to the main shaft.

Step 2

Remove the top of the servo by lifting.

Note that the two pins shown may stay attached to the top of the servo. If they do remove them and insert into position as shown.

Step 3

A: Remove the intermediate gear by just lifting.

B: Remove the main shaft by lifting.

The main shaft also has a nylon bushing. Remove it from the main shaft.
Step 4

With your fingers or some small pliers place the potentiometer shaft into the center position.

The position shown seems to be the center pos on all the servos that I have converted. Just rotate it to the left detent and right detent to make sure.

Place a very small amount of super glue around the potentiometer shaft where the shaft comes in contact with the mounting screw.

Be very careful not to get any glue on the other gears as this will ruin them. Let the glue dry.

Step 5

There is a small stop that must be removed from the main shaft. I found that using small wire cutters and then cleaning up with and exact knife works the best.
The Shoulder Bolt with Pan Gear: Here the small pan gear is in place. It slides onto the shoulder and a small set screw tightens against the shaft and locks it in place. In my pan mechanism, this small, continuously-rotating gear will "craw" around a larger gear attached to the suspension bolt (and Picavet Cross) of the rig. Minolta GS50 digital

Putting It Back Together: Here I am reassembling the servo. You can see the inside of the front cover with the ball bearing insert in it. I like this on a servo that is going to be in constant use or which has to bear weight. On this digital rig, I used the same servo model for the tilt servo (unnamed, of course). On the Contax G1 rig, where the camera is much heavier, I used a better Hitec HS-225MG with two bearings, metal gears and more torque. Minolta GS50 digital

The Modified Servo: All Done: Here the servo is all reassembled and I have marked it with a "C" for Continuous Rotation. The output shaft is threaded (although I have removed my shoulder bolt and gear) and ready for mounting on my pan structure. But that's a different project, one of many little time-consuming involved in a KAP rig and is covered in a separate page (which can be found on my Pan Mechanism Page). Minolta GS50 digital

I didn't time this procedure, but the Continuous Rotation modification is actually pretty quick. Once you figure out that all you have to do is rip out that plastic sleeve, this goes really fast. The threading of the gear takes some more time and involves the extra runs to the hardware store if you don't already own the drill bit, tap or tap handle.

by Matthew Cole, Saint Paul, Minnesota email me
Modifying the HS-322HD Servo for Continuous Rotation

Acroname Ideas
Modifying the HS-322HD Servo

Related Products

The following instructions will show how to modify the HS-HC-322HD servo for continuous rotation.

Step 1

1. Locate the tiny black knob attached to the potentiometer. It’s made of plastic and rotates easily through 360 degrees. With the tiny hand saw (or scissors or a small hacksaw) cut off the knob. It is very important to make a clean cut as close as possible to the servo case.

2. You’ll need a controller (we use a Brutus2.0, GP1) that outputs a 5V square wave signal to the servo. Plug in the servo. The motor will probably be spinning. Adjust the potentiometer (where knob Is just removed) with a small screwdriver until it stops rotating. As an optional next step, you can put a tiny bit of glue on the pot to hold it in this centered position.

3. The biggest gear, the one with the output shaft and spline, has a small plastic stop on it. Using diagonal cutters, a tiny saw, or some other tool, remove this plastic stop to allow this gear to rotate continuously.

4. Lock the bottom of the big gear. You’ll see the rectangular hole that fits over the potentiometer bush. Use the drill and 1/16" bit to widen that hole and make it a little bit deeper. It needs to be rounded out so no part of it will catch the screwdriver, but not too much material since that will weaken the output shaft. Test the fit of the big gear and make sure it spins freely when moved over the potentiometer. It should not move the potentiometer. If it does, drill the hole a little deeper.

5. If you have a servo ball bearing, you can replace the plastic dented bearing on the output shaft with it. The ball bearings don’t have a top or bottom and can be installed either way. The fit is tight so it may take a bit of persistence to get the bearing to seat down on the gear. Once you get it aligned, it will typically snap down in place.

6. Make sure the gears are aligned properly and re-install the top of the servo and the 4 long screws to hold the servo together.

7. The servo is done! Test it out to make sure it spins freely and can be used in both directions. If there are problems, try verifying the input to the servo with another servo before taking it apart again. You may want to re-install the white round servo horn depending on your intended use.

Tools you will need:

- Small Phillips screwdriver
- Small flathead screwdriver
- Small diagonal cutters
- Tiny hand saw or other plastic cutting device
- Drill and 1/16" bit

Below are the steps we take to modify the HS-HC-322HD servos. The square boxes allow you to print this article and check off each step as you proceed from start to finish.

Step 1

1. Remove the tiny black knob holding the round white servo horn. Make sure you get a good grip on both the horn and servo case when removing the screw. The screw can be pretty tight in a new servo. Once the screw is removed, pull the servo horns off. It may also have a long bit in it so it may take some force to remove it after the screw has been taken out. Sometimes rocking the servo horns a bit can help.

Step 2

2. Remove the four screws from the bottom of the servo. These screws are quite long reaching the entire height of the servo. Take care as these screws can get stripped easily.

Step 3

3. Now, carefully remove the cover of the servo. The gear train will be exposed and don’t be surprised if some of the gears fall out. There may be a lot of gear teeth. Be very careful to avoid getting them on your hands and neck as you’ll still be in the middle of the servo and you can rock the post in and out back and forth slightly while pushing to remove both the post and the gear.

Step 4

http://www.acroname.com/robotics/info/ideas/mod322hd/mod322hd.html

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http://www.acroname.com/robotics/info/ideas/mod322hd/mod322hd.html

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