Chasing vibrations in a RC helicopter.

By Bones and Gonzo

A smooth vibration free helicopter is a joy to fly. On the other hand an RC helicopter with a lot of vibration can be a handful.

Vibrations can be broken down into two categories in an helicopter: A high frequency vibration and a low frequency vibration.

1) High frequency vibration.

High frequency vibration is generated from the tail rotor. You can feel it but spooling up the helicopter on the bench and holding onto the tail boom. You can feel this vibration as a buzz. You can also see this vibration while the tail rotor shaft buzz. The tail rotor shaft will look like a wave rather than a straight shaft when it buzzes. When you are flying you can see the vertical and/or horizontal tail fin tips buzz in a blur.

To get rid of the high frequency vibration you need to get the tail rotor assembly balanced.

First you need to make sure the tail rotor output shaft is absolutely straight, to check it just roll it over a glass surface. The stock tail rotor shaft is very soft. You can bend it just by hitting the tail rotor blade on the ground. The optional hardened tail shaft is a lot better option. Another alternative is to buy some 3 mm hardened drill blanks or 3mm piano wire, cut to length and grind two flats on the shaft with a Dremel tool. The next area is to balance the tail blades. Generally the tail blades are pretty well balanced. However the screws that attach the blade grips may be off just a little bit to create an imbalance situation. To balance the tail rotor blades first you determine the weight of the tail blades. You can use the tail shaft or similar if you hold it between two glasses you will see which one is heavier. Alternately you can put the blades on a gram scale and see which one is lighter. Now cut a piece of masking tape and put it on the lighter blade. Spool the helicopter up without the main blades while holding onto the tail boom. You will find a situation where the right amount of masking tape on the light blade will give you minimum buzz. Now use some finger nail polish and paint to substitute the masking tape on the blade around the middle of the span.

Once you have a well-balanced tail rotor you will find that you gyro works a lot better.

2) Low frequency vibration.

This is the hard one because there are so many places that could induce a low frequency vibration. Most of the low frequency vibrations come from the main rotor head.

The symptoms of the low frequency vibration include:

Tail boom bobbing up and down and shaking like a waveform
Antenna tube shaking
Canopy shaking
Servo wire shaking
Landing skids shaking

To get rid of the low frequency vibration you have to be very patient. So let's start from the top.

There are four metal shafts that will contribute to the vibration: The feathering spindle, the main rotor shaft, the flybar and the tail rotor transmission shaft. The stock ones are always very soft. The main shaft and feathering spindle has a hardened version. The feathering spindle is the first one to get bent. Sometimes a minor hard landing will cause a bent spindle. The main shaft will bend from a tip over to a crash. The flybar will bend from a crash. The transmission shaft is always the last to bend but check it when you have a tail boom strike or the tail rotor hit the ground. To check any bends in any shaft just roll it on a glass surface as I said before.
The tightness of the feathering spindle will cause a vibration. When you tightened the nuts on the feathering spindle make sure the main rotor blade grips will rotate freely. If you feel any grittiness the nuts are tightened too much. This applies to both the stock nylon lock nuts and the special T nuts with the thrust bearing kit.
The flybar is the next area to look. The flybar needs to be balanced. That does not mean the flybar is exactly the same distance on both sides physically. The flybar paddles can have a difference in weight so the flybar may be shifted by ½ to 1 ½ mm to one side to get the perfect balance. Statically balancing the flybar may not help totally. The best way to balance flybar is also by trial and error. To start, make sure that the flybar is equal distance on both sides of the rotor head. Spool up the rotor head without blades and see if you can feel any low frequency vibration. If you do, mark the flybar with some indelible marker and start shifting the flybar from one side a little at a time. You will find the perfect spot where the rotor head will spool up very smooth. Another area to look at the flybar is the straightness. The flybar bend pretty easy because it is so long. Look from one flybar paddle over the rotor head toward the next flybar paddle. Check if you can detect any creakiness in the flybar. A bent flybar may be balance but will still induce a lot of vibration.
The next area to check is the main shaft. The best way to check the shaft is to roll it on a perfectly smooth piece of glass. You can also chuck it up on a lathe or drill press and spin it up. You need to chuck it up both ends to check. A bent main shaft will induce a lot of low frequency vibration.
The main blades will need to be CG'd and balanced to achieve a smooth flying helicopter. Check the article on balancing main blades for the proper procedure. One blade off by 1/100th of a gram will induce a low frequency vibration. Adding trim-tape or paint arbitrarily will not smooth out the helicopter. You need to add weight precisely at the CG of the blade to achieve smoothness.
Blade tracking is also a main induction of low frequency vibration. You need to put two different color tape exactly the same size on the tips of the blades. Put the

helicopter into a stable hover and have someone watch the tips of the blade. The two colors need to be in perfect alignment. If one color seems higher than the other does then you need to adjust the pushrod between the swash-plate and the mixer on the main blade grip to change the pitch of the main blade.
The flybar seesaw on both the plastic stock head and the aluminum upgrade head can be a cause of vibration when they are not balanced. The plastic one can be harder to check because of the drag on the pivot point. The aluminum one will hang lower on one side if it is out of balance.
The flybar control arm pushrods can contribute to low frequency vibration. Make sure the pushrods are the same length and have the same bend to them.
The top main shaft bearing holder and bearing can also induce vibration. The stock plastic bearing holder will wear out after a while. Especially after numerous crashes. If you cannot get rid of a low frequency vibration this is the area to check. The top bearing has to fit snuggly in the holder. If you can feel any play between the bearing and the holder you need to change the holder. The top bearing can also get damaged from a crash. This is another area to fix when you have a stubborn low frequency vibration. Changing to the upgraded aluminum top-bearing holder is a good fix.
The last item to check is the tail transmission shaft. If the shaft is bent from a crash you will see a low frequency vibration. That also holds true if you tightened down the plastic pulley too much and distorted the shape. Bottom line is if you see the pulley wobble you helicopter is wobbling.

If all else fails, tear down the whole helicopter and rebuild it.