Sovol SV01 – X axis leveling

Introduction

This is a my take on a problem that appears to affect some SV01s. It has no endorsement from Sovol, and I take no responsibility for any problems resulting from following it.

It is also written from looking at the printer – I have not taken a lot of it apart, or tried everything I suggest, so might well be wrong in some assumptions.

Read it and make your own minds up.

The problem

The SV01 has a dual Z driver arrangement – two stepper motors, one on each side of the gantry. This should reduce any wobble or oscillation in X gantry when compared to single stepper solutions like the Ender 3, on the side away from the stepper. All good so far.

But ...

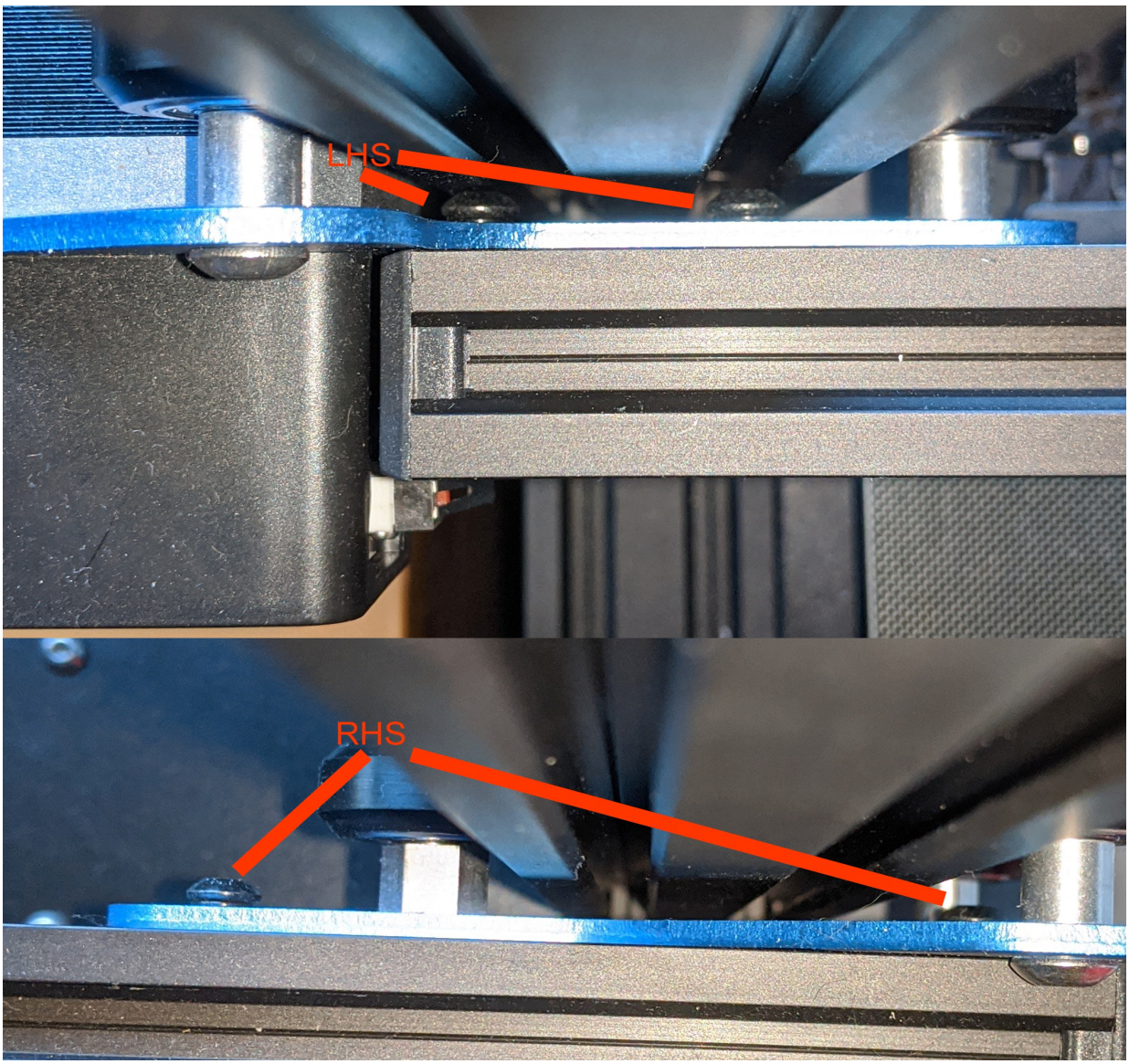
A lot of people have complained that there is a significant discrepancy in height from one side to the other (measured from the base frame to the X runner). The effect of this is that the bed springs will be squashed different amounts on each side, but more importantly, any tall object is going to have a lean (the Leaning Tower of Sovol).

Sovol have produced a video (https://www.youtube.com/watch?v=ZG2F08lWdWg) to correct this, but it does not appear to do much good unless the error is pretty small (Sovol themselves say that +/- 1mm is acceptable).

The Sovol video didn't help me, and the following are my thoughts on various ways of dealing with this.

How it happens

The X runner is secured to the blue brackets at each end by two cap head allen screws (M4x15 by the look of it). These screws screw from the back of the front part of the blue brackets into the X 20x40mm extrusion. Looking from the top/front, on the RHS one can be seen to the left of the eccentric nut wheel, and the other pretty much half way between the other two wheels. On the LHS they are closer together and the heads of both are hidden by the vertical gantry.



The X runner is firmly screwed to these brackets, it is not a hinge.

On each side there are three Z axis runner wheels between the two parts of the blue bracket, two on the outside, one on the inside. The outer two are fixed in place, the inner one is on an eccentric mount to allow rotating it to set the right amount of pressure on the runner – not so tight it binds, not so loose it can slop around.

Therefore, assuming the Z runners are truly vertical (they appear to be), any slope in the X axis is caused by the X runner being secured in a way that is not at right angles to the Z runner path.

How does this happen? Probably because in the manufacturing process they are not set truly level.

The Sovol video approach

The Sovol video appears just to suggest that one slackens off the eccentric nuts, rotates the two Z screws relative to one another to get the X axis level again, and then increases the wheel pressure using the eccentric nuts.

The problem with this, as far as I can see, is that if you do this while the Z motors are powered, there is probably plenty of detent to hold everything in place, but:

1. You've put stress on the Z runner wheels, and
2. It's used up torque in the Z motors – might cause a missed step, and
3. As soon as the motors are disabled / powered off, it springs back to where it was.

At least, maybe I have misunderstood, but it didn't help me.

Possible solutions

There are several of these:

Live with it

If it isn't far out, and you print low objects, why bother. That is largely what I have done so far.

In any case I use a BLTouch with unified bed leveling (UBL), so it copes with slight misalignment / slight changes print to print. I don't care about any small lean in the print.

Sovol sorts out their manufacturing QC

This seems to me a manufacturing defect. If Sovol made sure the X runners were level and tight in the first place, there would not be a problem.

Perhaps they have now – don't know, but it doesn't help those who already have out of level X axes.

The Sovol video

Works for some people it seems – just not me.

Adjust the Z screws on every print

Some people do this. Once the Z motors are powered they rotate the Z screws relative to one another until measurements show the axis is level.

The problem is:

1. You need to do it every time
2. The bed needs level checking every time (UBL or a complete level check with BLTouch does this)
3. It puts stress on the wheels, faster wear
4. It increases binding and thus uses up available Z motor torque, closer to missing a step

All that said, for small errors, seems to work OK for many.

Z screw linking belt

I saw this first on 'myfordboy' on youtube (https://www.youtube.com/watch?v=zkuoC4JXxmA). He basically disconnected one stepper, and put GT2 cogged wheels and a belt (2mm pitch cogged belt, 6mm wide) linking the two sides at the top.

So, once adjusted, in theory it will not move again, even when the motors are off.

But, it probably still has most of the downsides of adjusting the screws every print as above – except doing the per-print adjustments. It has one other disadvantage which is a small reduction – but most likely insignificant to most people – to the Z range.

Also bear in mind he used 60T wheels. I think those wheels need a slight machine down to make them clear the Z runner. There are plenty of smaller toothed wheels around though – 40T etc, just pick the right belt.

Fit a mainboard with dual independent Z drivers / endstops

This seems to be gaining ground with some people. This requires a mainboard with independent Z drives (on the SV01, both drives are synchronised, in fact, I think one driver). You also need two Z endstops.

Marlin can apparently deal with this and at start up it will independently drive each side to the end stops, so if the Z endstops are set right, the X axis will be level.

But, again, it has the same problems as before, stressing the X runner and Z wheels, except you do not need to manually do anything. Added to which, I think – could be wrong, that this means you cannot use BLTouch / UBL or equivalent, which, to me anyway, is a 'must have' for consistent first layers.

I can envisage an mechanism whereby Marlin could manage two Z stops and a BLTouch all at the same time, but I don't know if it does.

Re-level the X axis

To me, this is the real answer. If it isn't level, rebuild it so it is.

Unfortunately it is not as simple as it might be. In theory all you need to do is slacken the two screws each side, make sure it is level, and do them up again.

The problem is, on the LHS, you cannot get at the screw heads because they are hidden by the gantry.

The following therefore is what I would do, and may at sometime get around to actually doing. As I say, I have not disassembled the printer, or done this, so my assumptions and approach might be quite wrong.

Change the LHS screws

If the screws on the LHS had slim ordinary hexagonal heads, one could slip in a thin open ended spanner. The gap from the blue bracket to the runner is only 3.5-4.0mm, so not sure if a shakeproof washer would fit as well, but it probably isn't that important. Needs some careful measuring before you start.

(If it is important to you, and washers won't fit then it should be possible to spacer out the front blue bracket by adding some padding to the runner wheel bolts – only about 0.5mm or so would be needed so a 4mm washer might do on each bolt. Or, machine down / file down the hexagonal heads).

I got some stainless M4x16 screws for this from modelfixings.co.uk. They have very slim heads (less than 2.9mm). I also have some slim open end spanners (7mm) with two different possible angles at each end, so at first sight I think this looks possible. No need to change the RHS ones because the heads can be got at, although one could.

The aim of the following to get the LHS front blue bracket far enough away from the Z runner that you can get an allen key in there to remove the X runner securing screws, then replace them with the new hexagonal head ones.

This is my possible approach to doing it – E&OE. Since I have not done this it might well require rethinking as one hits problems. I also suspect two people would help (one to hold, one to do):

- Put the carriage roughly in the middle and an inch or two off the bed. Cover the bed with something soft (don't want to drop anything on it and crack it). Support the X runner so it cannot suddenly drop. Might also be wise to disconnect any unpluggable cables.
- Slacken off or remove the X axis belt tensioner on the RHS.
- Remove the 'eccentric nut' securing nut on the RHS (the bolt head is captive behind the runner, but the allen head is accessible), and remove the two fixed RHS wheels.
- Do the same on the LHS.
- The X runner will now be very sloppy indeed, but the Z screws aren't going to let it go far.
- It looks to me that it should now be possible to 'move' the X runner and front blue brackets slightly forward, maybe 2-3cm (the eccentric nuts / wheels / spacers will fall off at this point).
- On the LHS, one by one replace the two X runner securing bolts with the hexagonal head ones).
- Reverse the above process.

The result of all this work is simply that you have two hexagonal head screws on the LHS, instead of allen head.

Leveling the runner

This is now much simpler.

- Slacken the two runner screws each side (use open ended 7mm spanner on the LHS) – not loose, nipped just so the runner can be moved slightly relative to the brackets.
- On each side, adjust the eccentric nut wheels for correct Z runner pressure.
- Put a spacer between the base frame and X runner on each side, about 100mm long (must be equal lengths).
- Let the X runner rest on the spacer on each side.
- Tighten up the four screws.

- Re-level the bed.

And that is it. Wouldn't it have been much easier if you could have got at the LHS screw heads in the first place?

Z screw linking belt

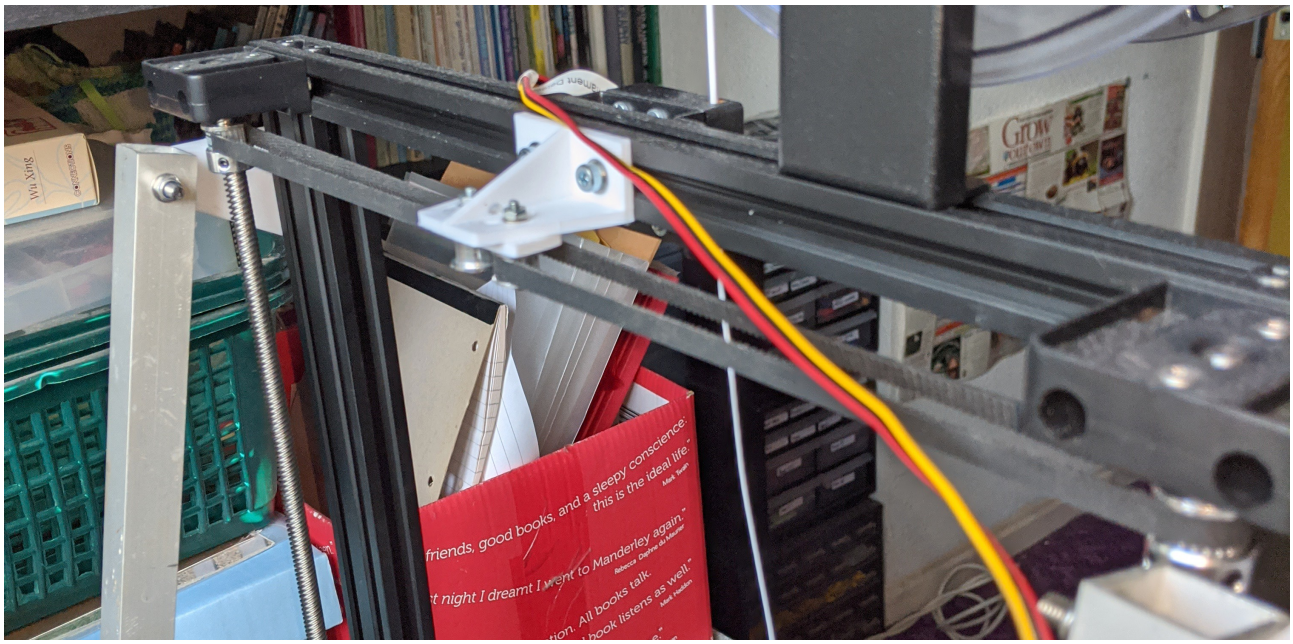
The above should be sufficient.

However, there is no denying that with the Z motors off a knock could move the sides relative to each other. They might spring back to exactly the same place, but there again, they might not.

When the motors are powered, there is plenty of torque and detent to stop relative movement.

It seems to me therefore that a Z belt is not a bad idea, and I cribbed this largely from 'myfordboy' (thanks) – but unlike the 'myfordboy' approach, to still use both motors.

So far, I have done this bit at least.



The above picture shows it. There are 20T GT2 cogged wheels (2mm pitch, 6mm wide, 8mm shaft), linked with a 760mm belt. There is a tensioner of my own (FreeCAD) design in the middle, using a couple of 6m wide belt idlers, 3mm shaft diameter.

It would actually be better to use 40T wheels and an 800mm belt (more teeth gripping the belt), but at the time I couldn't find an 800m belt (I have now). In that case, the tensioner would need a slightly longer bracket.

All parts were from Ebay and Amazon. In total, you need:

- 2x M4x10 bolts and T slot nuts
- 2x M3x15 bolts and nuts
- 4x M3 flat washers
- 2x 20T GT2 cogged wheels, 2mm pitch, for 6mm belt, 8mm bore (or – 40T)

- 1x 760mm 2mm pitch belt, 6mm wide (or – 800mm)
- One bracket to do the tensioning

You do lose a small amount of Z range – it doesn't bother me.

The Z screw bearings at the top are floating so the Z screws do not bind, and of course the belt puts tension on this.

However I do not feel it is an issue because the belt tension is very low indeed – just enough to stop teeth being skipped. There is no drive going through the belt – the steppers drive their own screws – the belt is simply there to keep both sides in sync when the motors are off / disabled.

Conclusion

That is it really. Those are some solutions.

It would be easier all round if the Sovol manufacturing process built them level in the first place, but failing that, these are ways of addressing it. Obviously I think mine is best because it gets to the root of the problem.

But – it is a lot of work, completely unproven, and would undoubtably destroy your warranty.

So, in summary, treat this as just my thoughts, and go your own way.