GETTING THE MOST FROM YOUR STEPPER SYSTEM

In previous chapters we have looked at different types of motors and how the current is controlled through the coils. Here we will look at how to optimize the performance of your system; it is recommended that you read all the other chapters first before reading this one as you will need an understanding of the way things work.

Stepper motors move in discrete steps, the most common is 200 steps per revolution. To improve the resolution manufacturers started microstepping the motors, what this means is that in instead of moving at 1.8 deg per step they made the motor move half that.

So this is great, we can use these high voltages and control the current but how will we know when enough is enough? “When we make smoke!” See the section on Overdriving your stepper motor and Current control.

“What is smoke?”

Good question, many of us have seen it but what really makes it? The simple answer is heat, the coils and laminations are covered in a varnish for insulation, when this varnish is heated it will begin to smoke (age restrictions don’t apply here!), if you are unfortunate the motor will stop working, if you are lucky you might not be out of pocket to the tune of one motor.

What happens when a motor fails or rather how will we identify a motor that has failed? For this discussion we will exclude mechanical failures as it is likely that they will be evident from visual inspection, i.e. seized bearing or broken shaft. There are three electrical failure modes that are common, all of them caused by overheating:

1. The least common and the one that you might never know actually happened is when the insulation between the wires of two adjacent windings breaks down and a shorted turn will develop between two adjacent wires, this probably happens to some but you might never know it.

2. The motor will definitely have failed if instead of a short between two adjacent windings the coil wire fuses and opens. This is most likely to happen deep within a winding where the cooling is least and it is unlikely that you will be able to spot it. This is the most common failure

3. The third is when the insulation (usually varnish) breaks down between the laminations of the windings and allows eddy currents to flow, this inefficiency will make the motor heat up faster in use and you won’t be able to understand why.

If these failures are caused by overheating, what causes the overheating? Overheating happens when the motor cannot dissipate the wasted energy (heat) faster than it produces it. The heat generated is equal to the winding resistance multiplied by the

square of the current passing through the coil. There are other losses but they are negligible compared to this. Stepper motors are actually rated to run quite hot; there is a common assumption that if you can still touch it without burning your fingers you are not driving it hard enough! This is partially true, but common sense usually prevails and we don't drive a motor to this extreme.

To get higher speeds from our motors we overdrive them by between 10 and 20 times the nameplate voltage. We determine the current requirements from the torque that we need to drive our system reliably. Read the following sections on tuning your stepper motor system and microstepping your stepper motor, these will help you understand a topic that seems at first easy but is actually not so trivial.

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