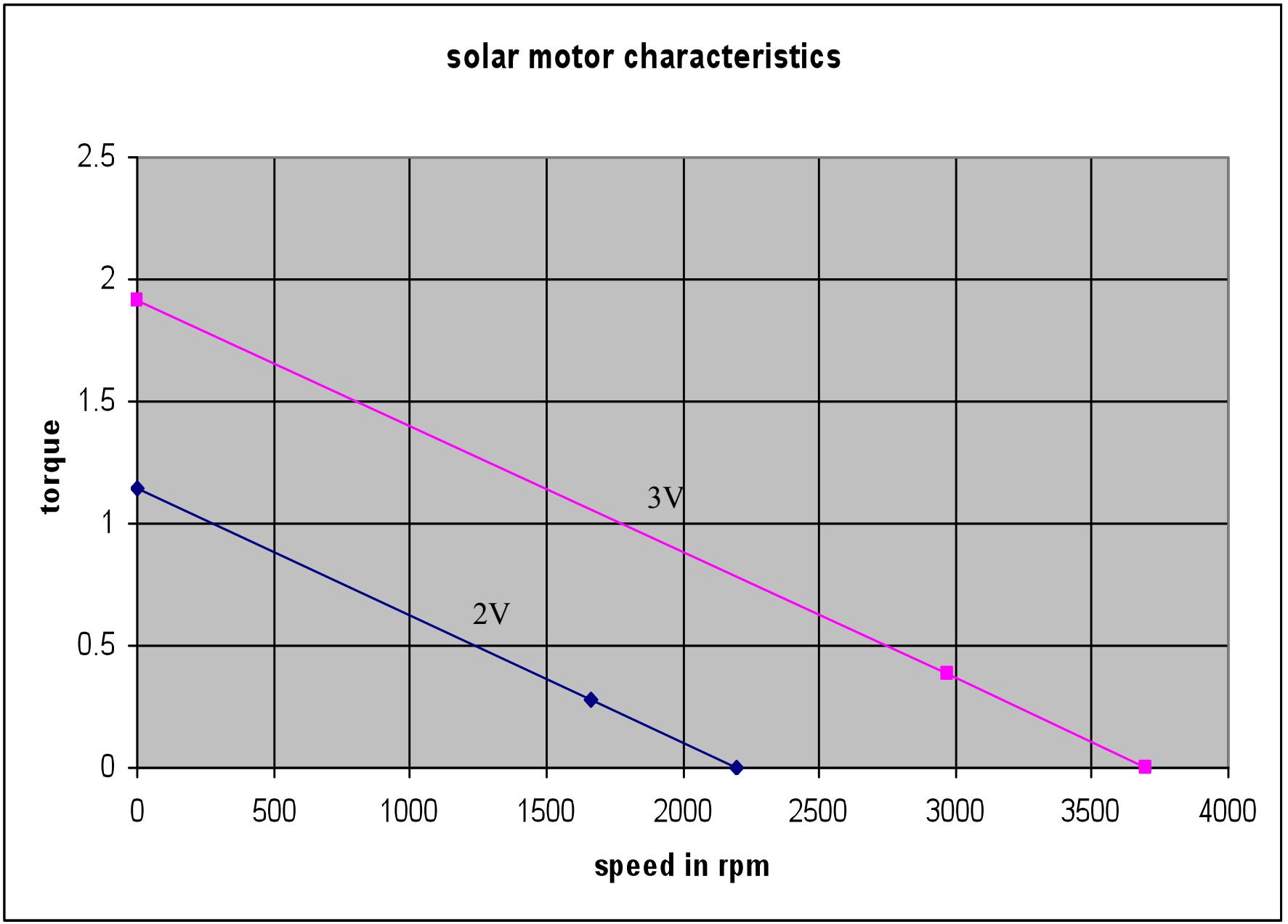
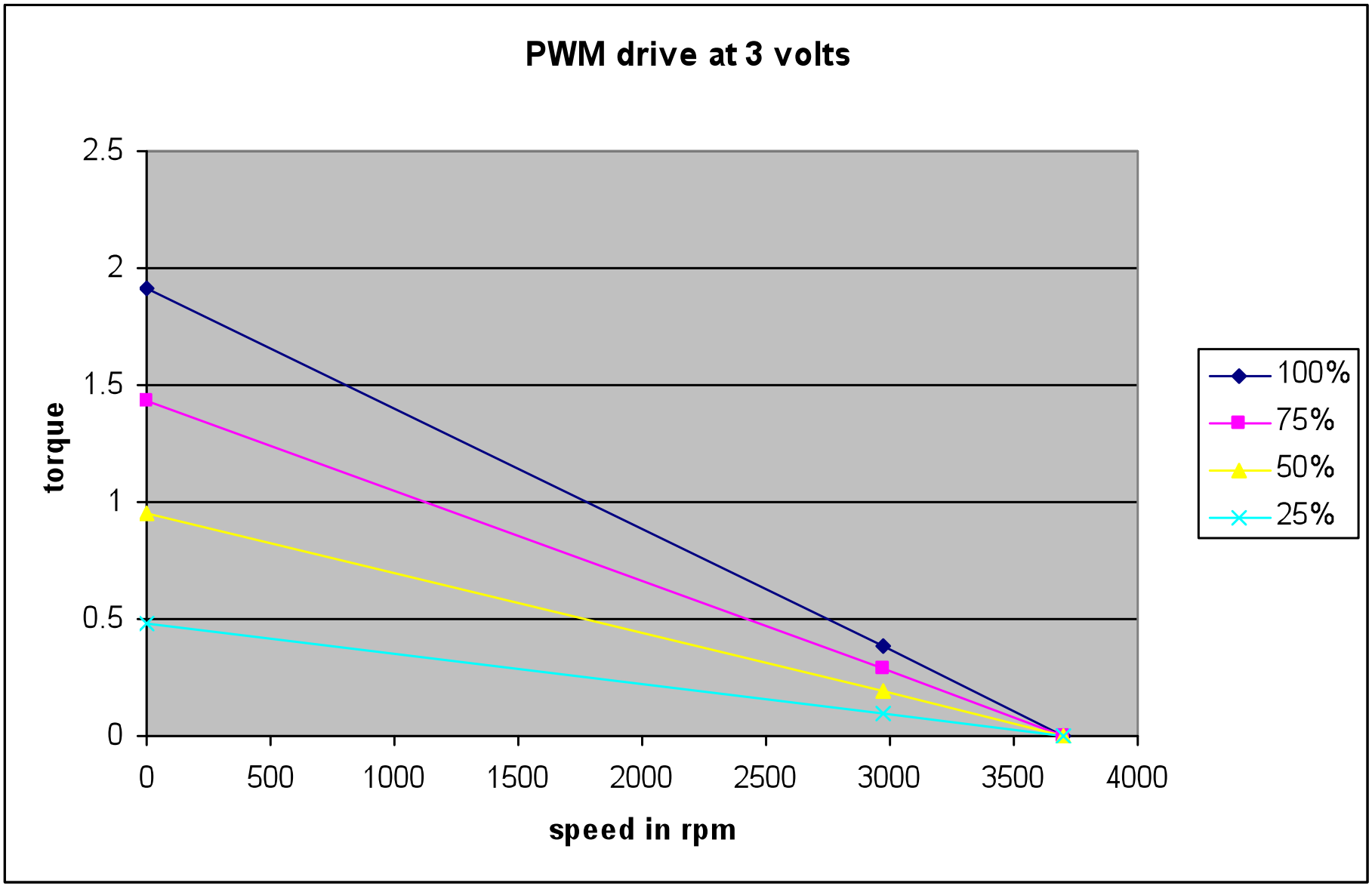
“Weightless odometry”?

An attempt to get rid of the encoder and associated software overhead.

Duncan Louttit MINOS 2010


solar motor characteristics
torque
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
3000
3500
4000
speed in rpm
3V
2V

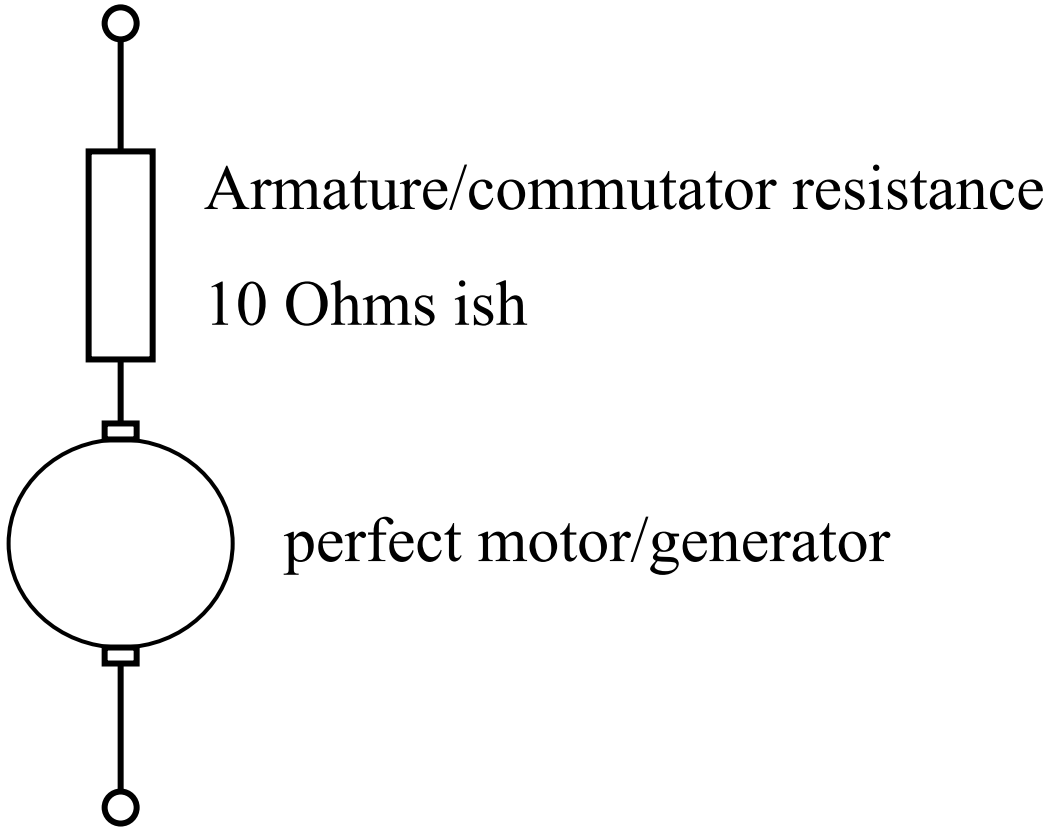

PWM drive at 3 volts
torque
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
3000
3500
4000
speed in rpm
100%
75%
50%
25%

Note that the shallower the slope the more the speed changes with load.

The slope for DC drive is related to the armature resistance (including the commutator etc.)

PWM makes the slope shallower. That's why it is so "fussy".

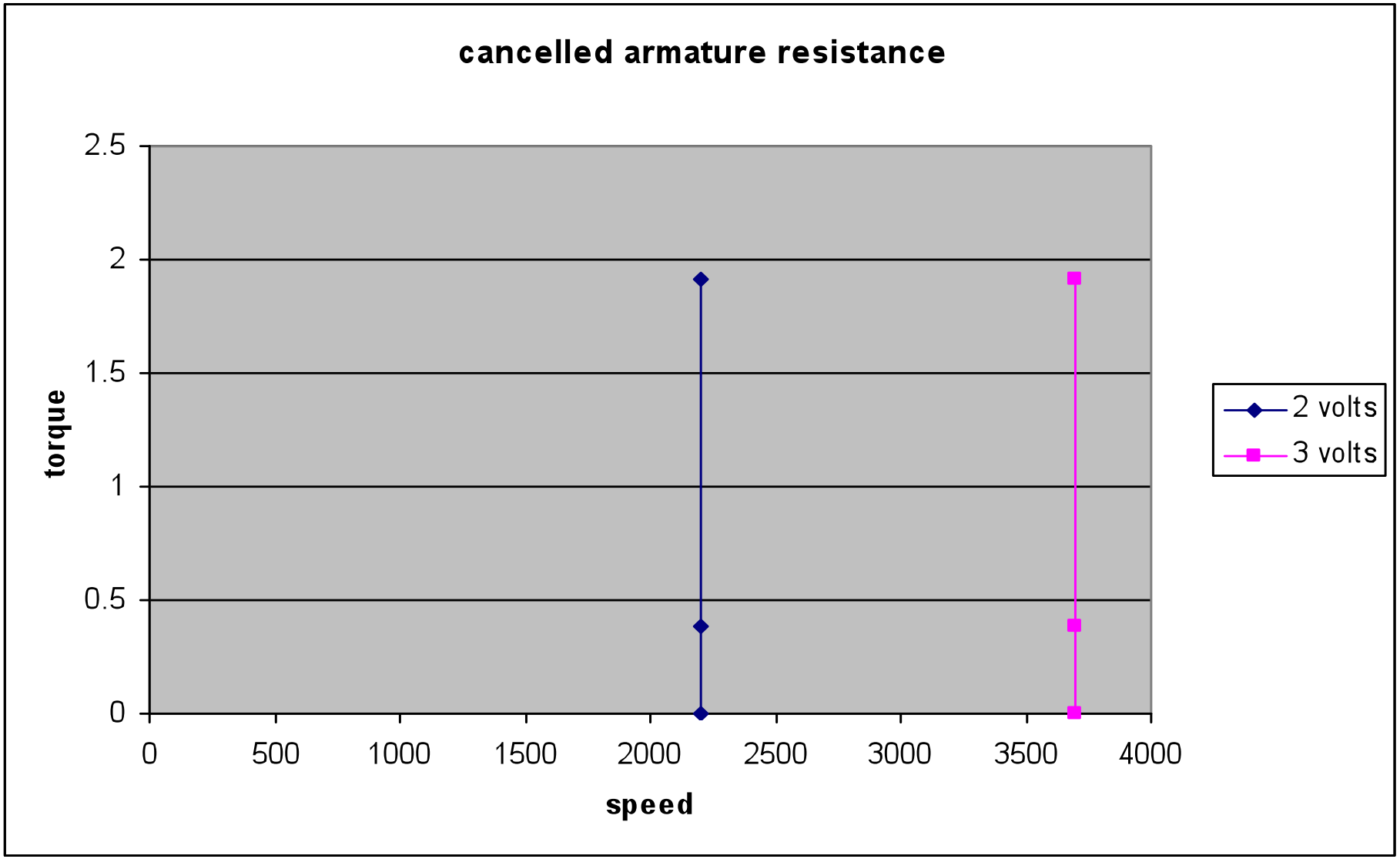
Is it possible to make the slope steeper?



Simple motor equivalent circuit.

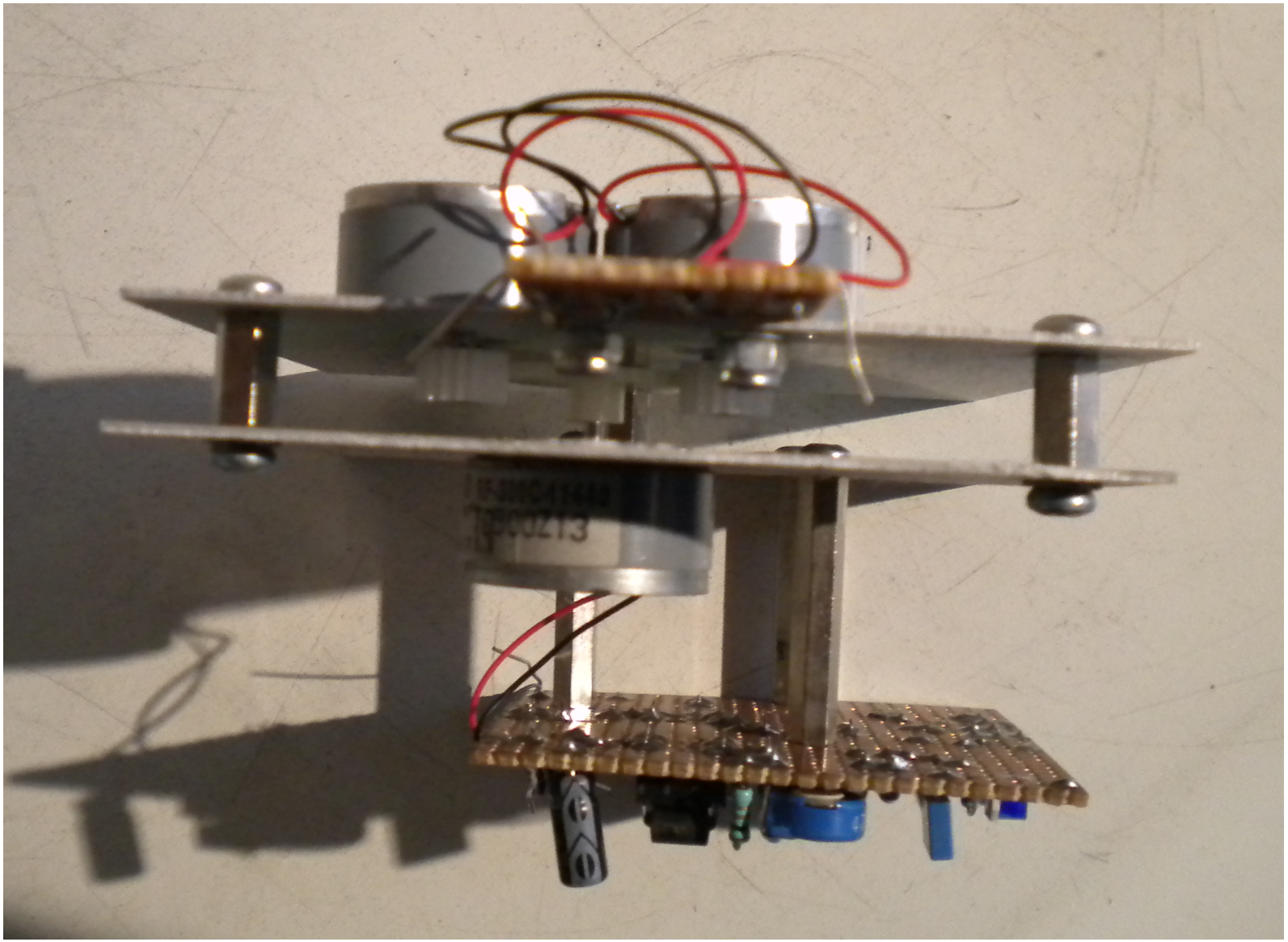
Motor can be made “perfect” by putting a negative resistance in series!

I couldn’t buy an adjustable –20 ohm resistor so I had to make one. Details later.



Speed is now independent of load. Apply the appropriate voltage and that's the speed you get.

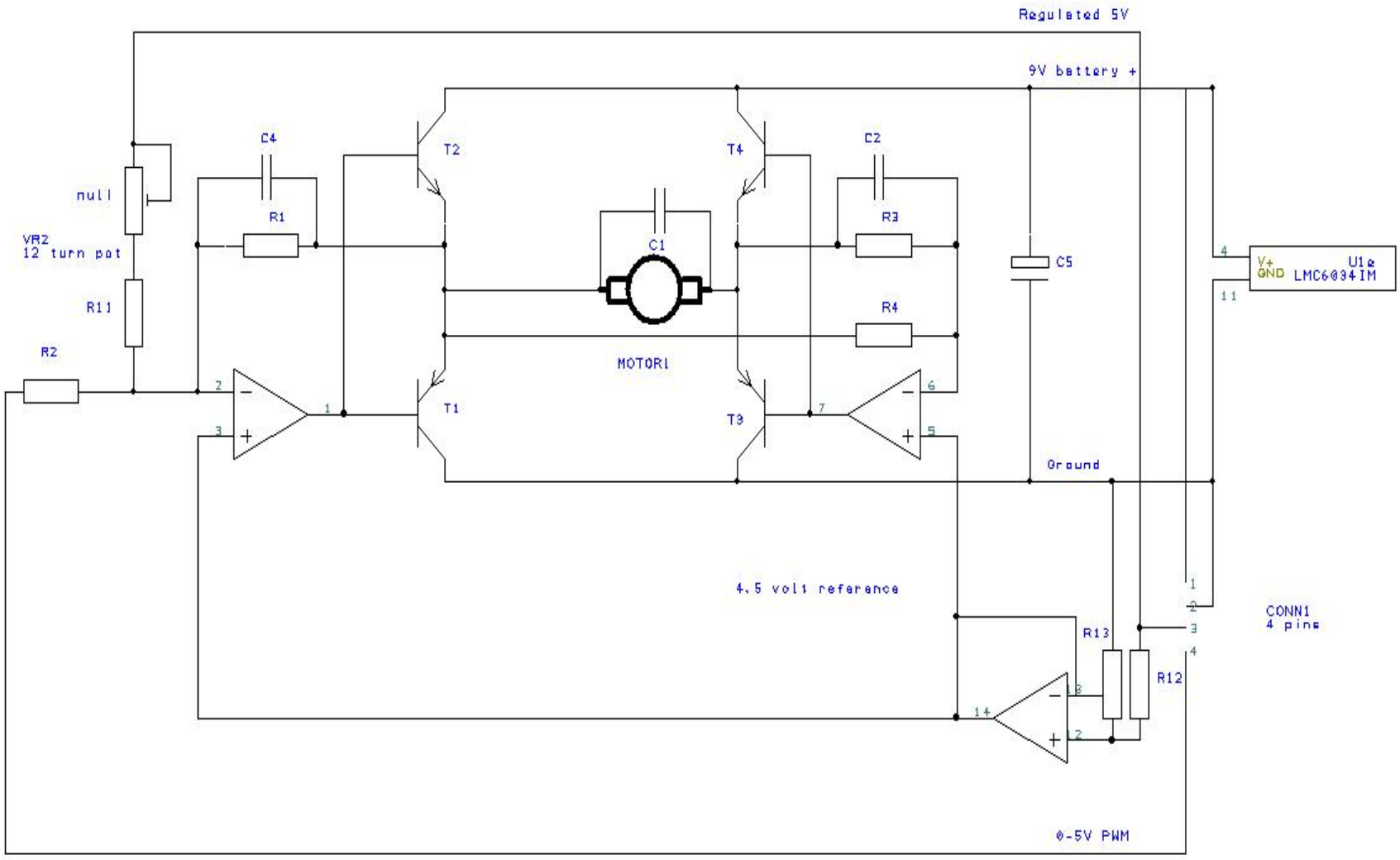
I built a test set-up. Three motors coupled together.



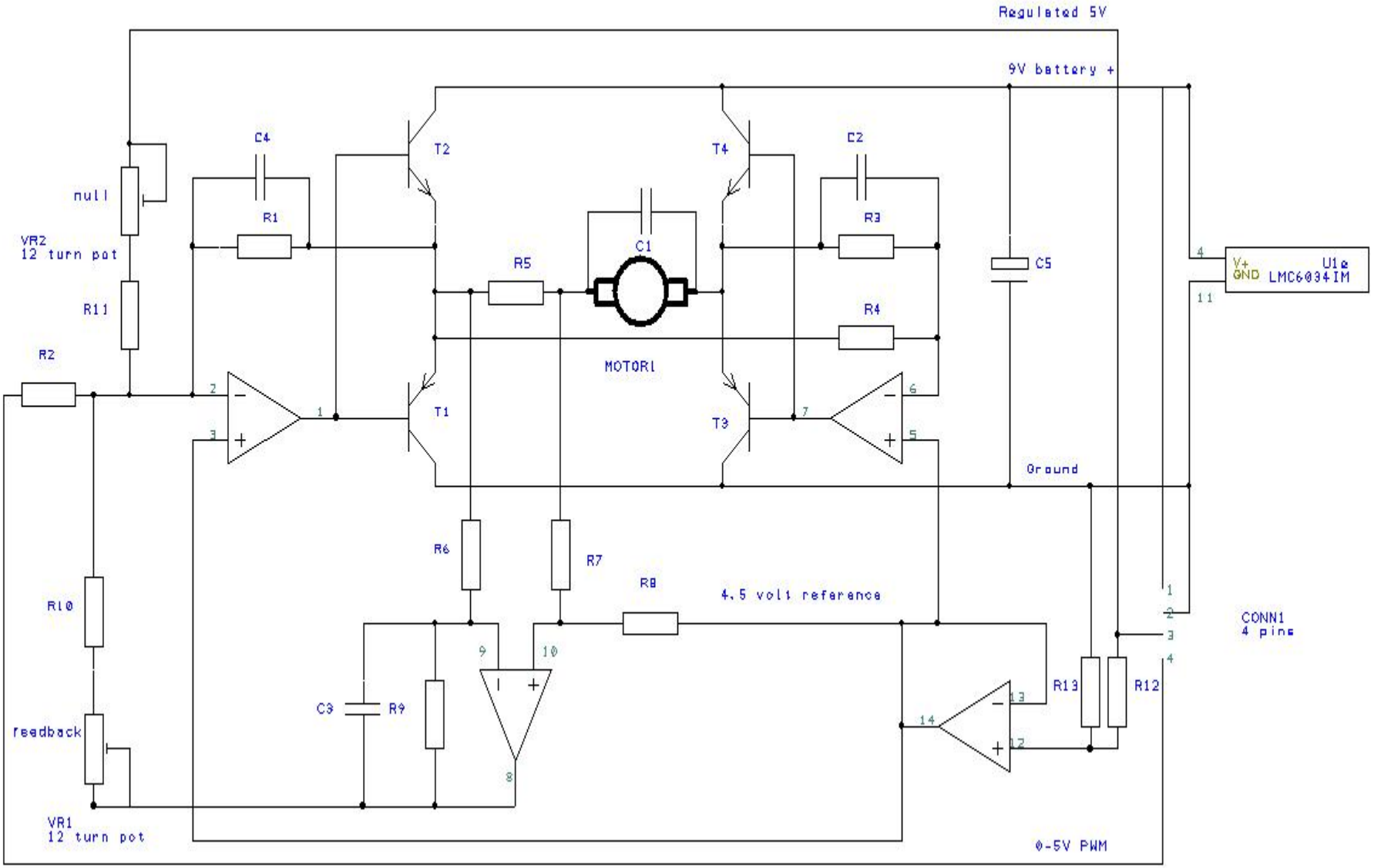
One is the test unit

One is tachometer.

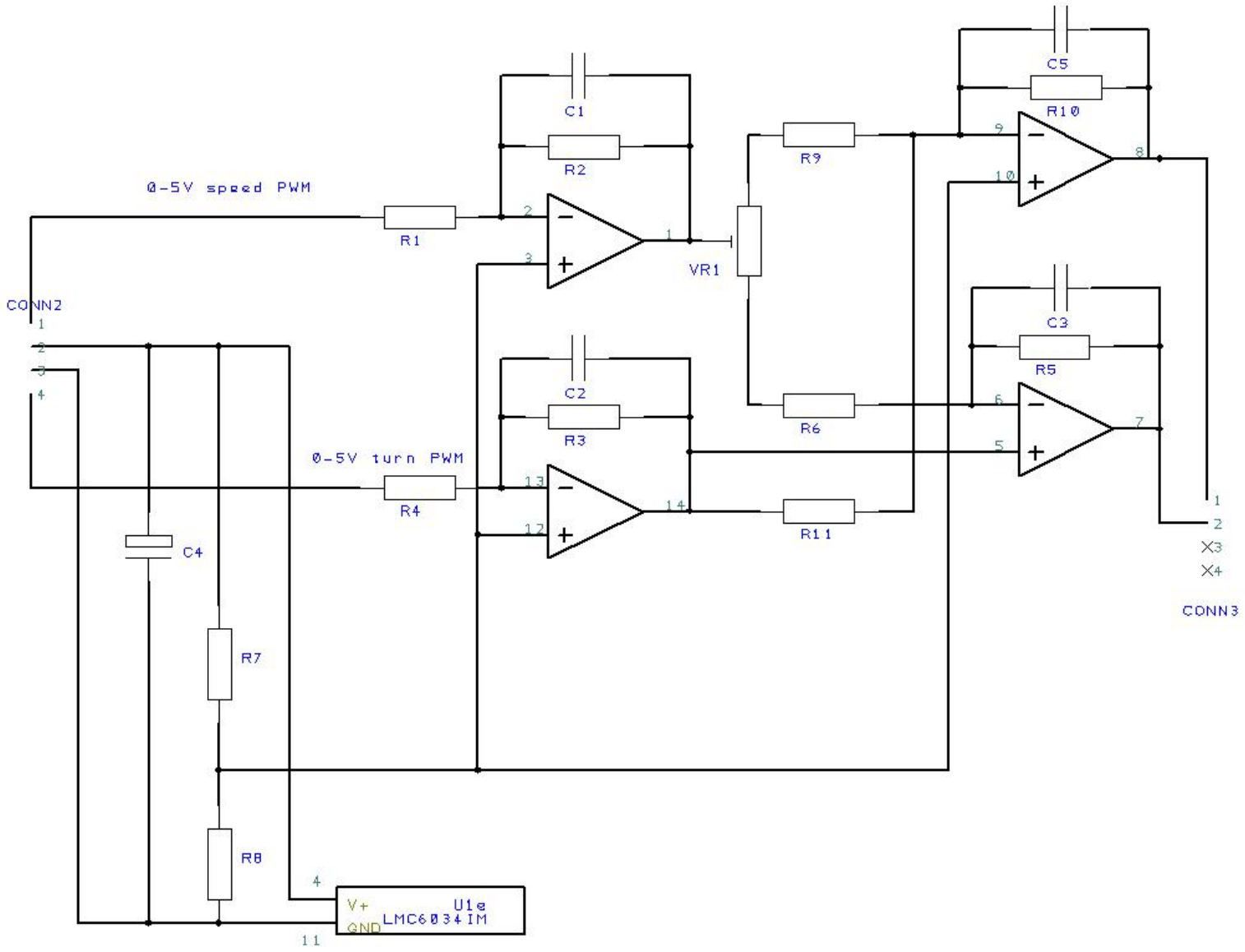
One is used to apply a load.



Bidirectional DC motor driver



Positive feedback to balance armature resistance.

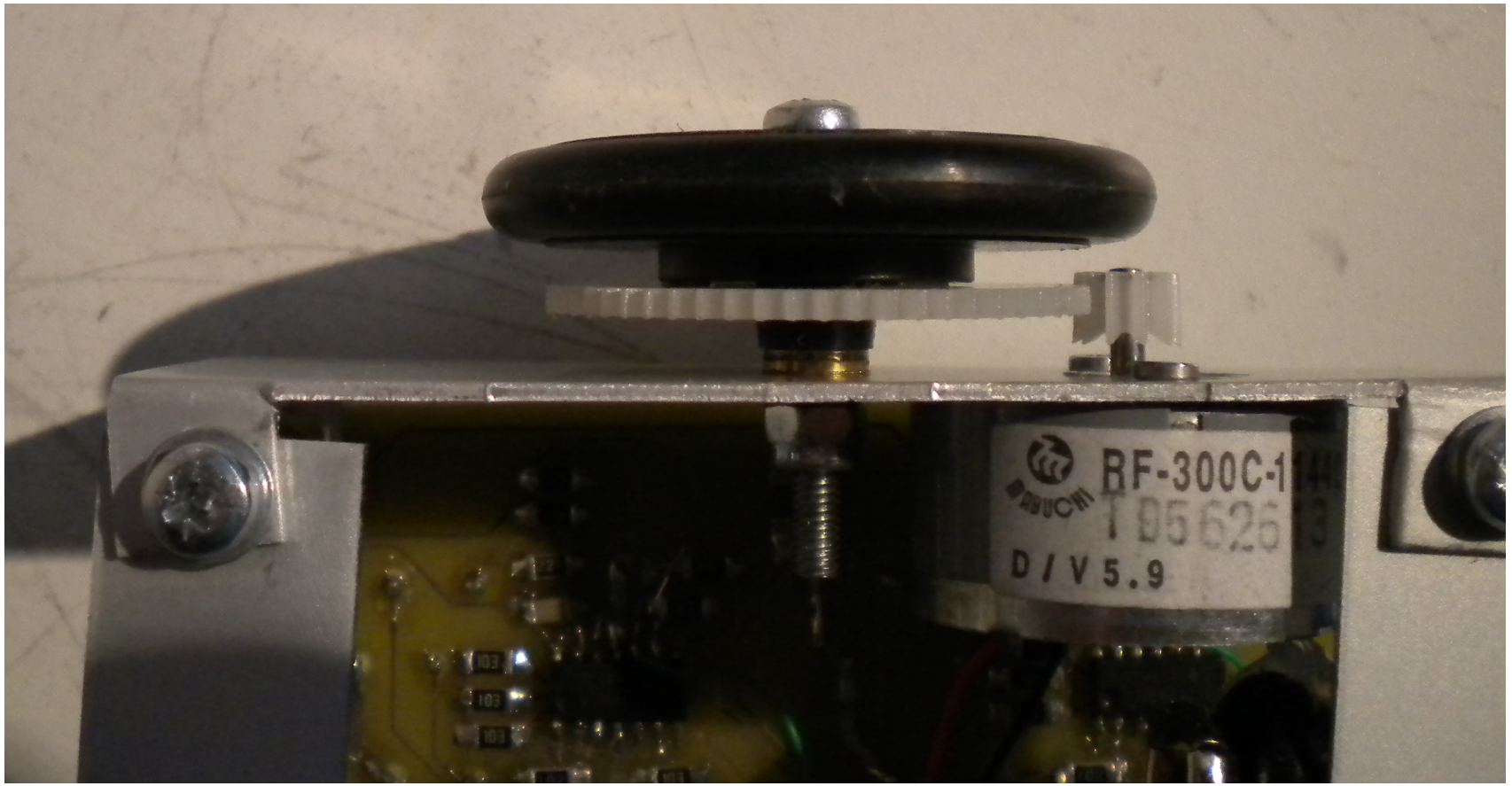


PWM to DC for straight & turn control.

The software currently adjusts PWM slowly to control acceleration. Intervention every 2-3 ms.

In principle, adjusting the time constant of the smoothing filter can reduce this arbitrarily. In the limit, the software sets the o/p to 1 and the slew rate of the filter controls the acceleration. After a suitable time the controller tri-states the output and lets the mouse coast at that speed. Then the o/p is set to 0 for the same time to decelrate to rest.

The software overhead should be almost negligible.



Look, no encoder!

Video?

So, Does it work?

YES!!

Problems?

YES!!

DC drift. The system is very sensitive to offsets. The motor will “creep” at1 rpm or so if the offset is not spot on.

Need acceleration profile carefully controlled to avoid saturation.

Development continues.