Simon’s Conclusion:

Motor properties were analyzed using open-loop and closed-loop control systems. The open loop systems had an advantage in the sense that they are functionally more simple and easier to implement, however, the closed-loop systems provided superior control. The closed-loop response was able to maintain a set motor rotational velocity to a better degree than the open loop system.

In general the proportional response was the fastest, but had a high error. The integral response had a lower error the proportional, but was the slowest of all three methods. Neither proportional nor integral response compared to the low error level of the proportional-integral control, and the proportional-integral response was faster than the integral response alone.

Regarding the calculated parameters, the calculated values, excluding the damping coefficient are all within the spec range of the motor – generally very close to the middle of the range. Incidentally, this (although not statistically significant in sample size) suggests that the motor company specifies their motors such that the entire standard deviation range they produce will fit within spec, rather than creating a tighter specification that only a few motors reach. This makes sense from a manufacturer’s point of view – to simply make the spec large enough to cover the deviation of their production is cheaper than changing manufacturing.

Major errors in this study were caused by excessive friction and motor age. A newer motor is recommended for applications where a tighter conformance to spec is required. An interesting experiment would be to replace the bearings on the motor to see whether or not the bearings were the major cause of friction, or if the difference in performance comes from motor brush wear or another unknown variable.