Adjusting the PID for Engine Dyno (low inertia systems)

Test System Setup

- **Electric Motor**, max 4000 rpm at 50V
- **Water cooled eddy current brake**, 25 ohm, max 8A, slow response
- **Gear Ratio: 20T:56T, ratio = 2.8**
- **Gear Tooth:** 60 Teeth
- **PWS3.3** tested in 3 modes: PID, L-R, open loop

Test is performed at 500 RPM (in the brake) (1400 RPM at motor), which generates 500 pulses per second.

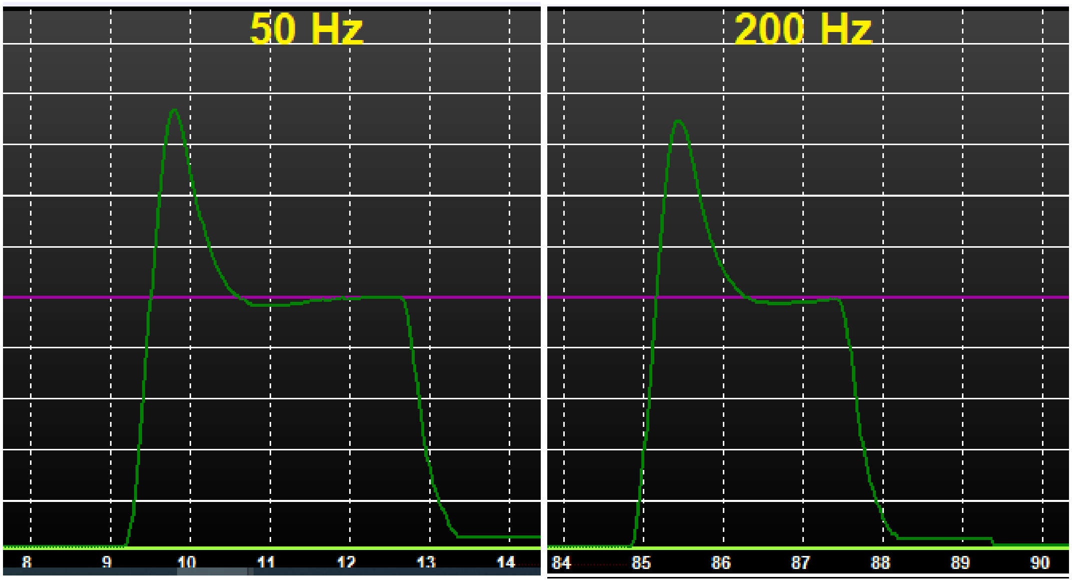
- PID at 50 hz = 10 pulses are received each cycle
- PID at 200 Hz = 2.5 pulses are received each cycle

The algorithm calculates only the acceleration and PID output each cycle. When including the acceleration filter that generates a delay of max 200 ms at 50 Hz and 10 ms at 200 Hz, but it is not noticeable in the PID Cycles experiment

Accel Filter: use always “1”. 0 filter provides dirtier control, and filters of 2 or more also add delays.

PID Cycles (50 Hz vs 200 Hz)

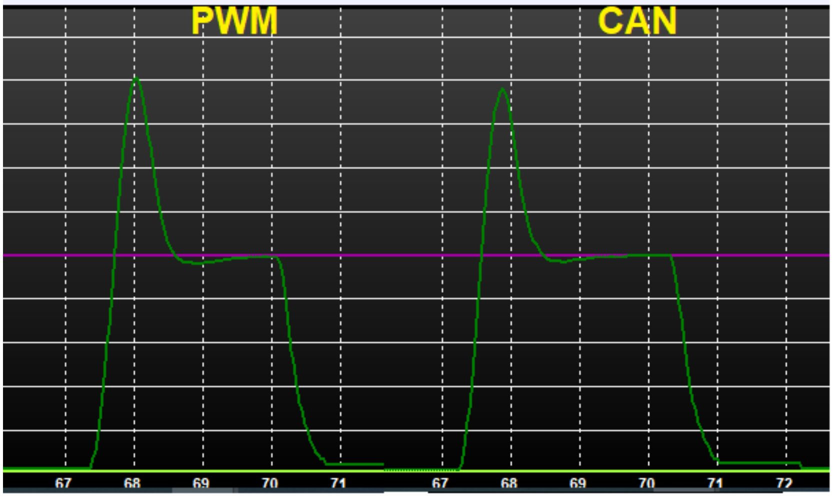
There are **no** significative differences



PWM / CAN

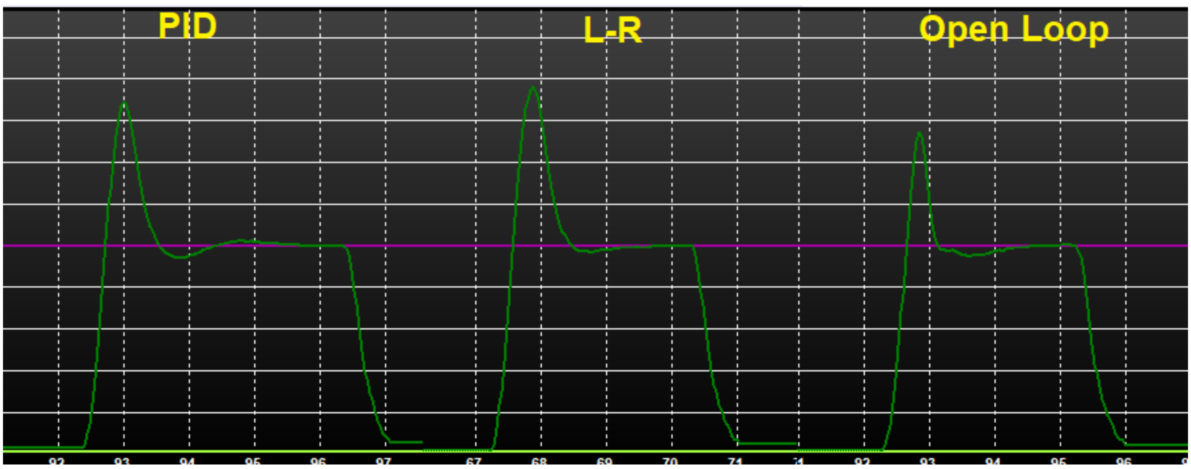
As the PWM include filters in the power supply (hardware and firmware) a little delay is added, this makes that the TD setting changes:

- **PWM:** KP = 3.5, TD=0.06
- **CAN:** KP = 3.5, TD = 0.04. Control is also a bit **more accurate**



PWS control loop: PID / LR / PWM (direct, hidden)

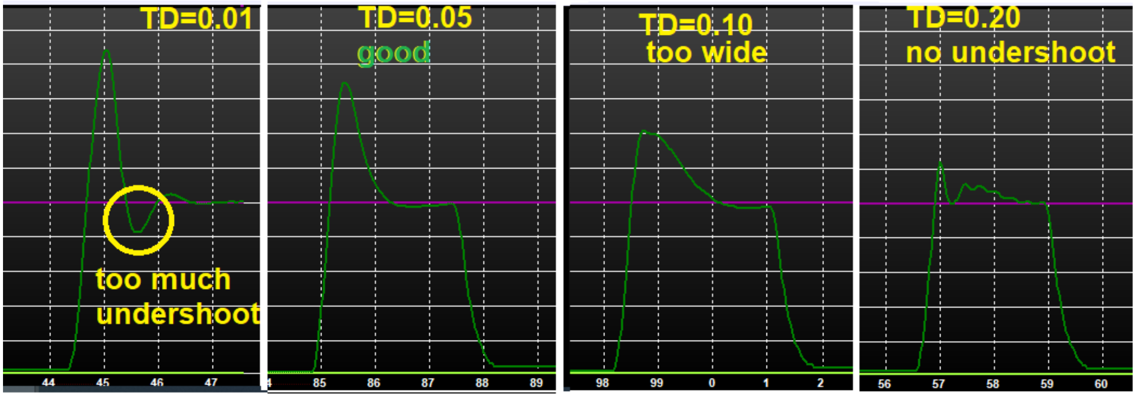
- **PID:** Closed loop is based on a PID. PIDs in general are not the faster modes, but are more accurate. The response of speed control is a bit slower.
- **LR:** L-R (Inductance & Resistance based control) mode is a faster control mode, but a little less accurate (although the exact current is not critical in a Brake Power Supply, it would be in a laboratory power supply). The response of speed control is a bit faster
- **PWM:** This mode is an **Open Loop** debug mode in the PWS, it is hidden. SP5/6 PID settings are different, it needs a higher KP and TD (due to the implementation for the target to PWM conversion), as it requires a higher TD (0.20) it distorts a bit more the graph.



Our recommendation is using L-R mode (the jumper at the right-most position in the voltage/current jumper array). Otherwise the default PID mode is ok.

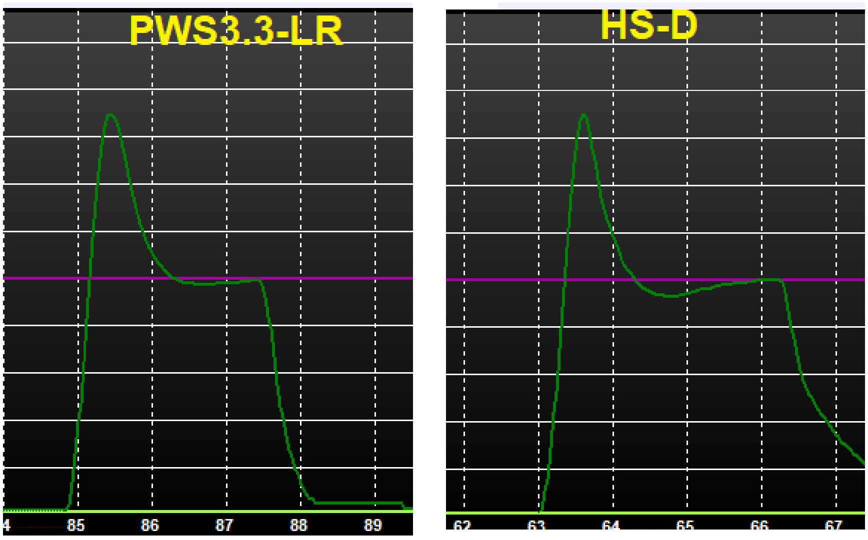
TD setup / tracking

Our recommendation is starting with a KP value at which the control starts to have big oscillations (in the example KP=1 is very slow with no oscillations and KP=3.5 has oscillations), and starting with TD=0.01, then increase it first in steps of 0.05 while it still produces the undershoot phase, and stop when the undershoot goes to the positive area OR the dampening is too slow (the overshoot becomes too wide). Then investigate if the system accepts a higher KP (this system accepts KP=5 or a bit more)



PWS3.3 vs HS-PWS

This is the comparison form PWS3.3 in LR mode and CAN control vs HS-PWS-D (discharge) in **PWM** mode. The results are similar, but the PWM is causing that HS-D is even slightly slower than PWS3.3. So the preferred option for most cases still is **PWS3.3**



Conclusions

The preferred configuration is PWS3.3, LR mode and CAN, but other configurations like PID mode and PWM signal will work too