EECS 192: Mechatronics Design Lab
Discussion 9: Closed Loop Control Tips

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Controls Tips
Watch out for Pure Integral Control!

(See Piazza Post)
Run your control periodically! (what is a reasonable frequency?)
Velocity Control highly recommended!
(why might velocity control be a reasonable idea?)
Tuning PID Steering Gains
(Live Demo)
Tuning PID Steering Gains (Takeaways)

- Choose a fixed speed (hopefully using velocity control). Set $K_p, K_d, K_i = 0$
- Start with $K_p$! Raise $K_p$ until your steering starts to follow the line. Keep raising $K_p$ until you get reasonable line tracking performance. If oscillations get too wild, try lowering $K_p$
- Move on to $K_d$! You can add small amounts of derivative control to reduce overshoot (minimize oscillations!). Be careful as too much derivative control can decrease stability of the system
Data Type(s)....?
void pid_steer()
{
    float e = calculate_error;
    float control = kp*e + ki*e_sum + kd*de_dt;
    update_servo_duty_cycle(control);
}

void update_servo_duty_cycle(uint8_t servo_duty_cycle){
    FTM_UpdatePwmDutycycle(BOARD_FTM_BASEADDR, BOARD_FTM_CHANNEL, kFTM_CenterAlignedPwm, servo_duty_cycle);
}
Data Type(s) Takeaways?

- Watch out for type issues: \( \text{int} \neq \text{uint} \neq \text{float} \)
Pins in MCUXpresso

- Use the pin tool! Divides pins into ADC, FTM, GPIO, UART, etc
- But pins could be routed for multiple functionalities?
Pins in MCUXpresso
Live Demo!
General

- Start simple (1 camera, fixed speed, etc.). You can always increase complexity later!
Hardware Tips!

- Watch out for current limits through small headers.
- Perfboard- watch out for low current traces.
- Perfboard- dont try to wire up the Buck- it probably will not work. Use a linear regulator instead.
- STAR!!
- Heatsinks (especially linear regulators).