ME 333 Quiz 7

PID Control

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Quiz 7

1) **Give pseudocode for a basic PID controller (without integrator anti-windup). There are functions get_ref() and get_sensor() to call, and you can make others if you want. There are already global variables, and you can add more:**
static volatile float eint = 0;
static volatile float eprevious = 0;
The ISR is already setup to run at 1kHz:

```
static volatile float err = 0;
static volatile float edot = 0;
static volatile float u = 0;
static volatile float s = 0;
static volatile float r = 0;
__ISR(timer at 1kHz) {
    s = get_sensor();                    // read sensor value
    r = get_ref();                       // get reference signal
    err = r - s;                         // calculate error
    edot = err - errprevious;            // error difference
    eint = eint + err;                   // error sum
    u = Kp*err + Ki*eint + Kd*edot;      // calculate control signal
    send_control(u);                     // send control signal
    eprevious = err;                     // update error
    interrupt_flag = 0;                  // clear interrupt flag
}
```

2) **Explain what integrator anti-windup is:**

When integrator error is allowed to build up to large values, a large control signal of opposite sign is created to dissipate the error. To reduce oscillation associated with this behavior, **integrator anti-windup** can be implemented by placing bounds on the integrator error (*eint*).

3) **You have picked Kp, Ki, and Kd gains.**

   a. **The response has too much overshoot. Which gain could you increase to reduce the overshoot?**

   K_d

   b. **The response has too much overshoot. Which gain could you decrease to reduce the overshoot?**

   K_p

   c. **The response has the right overshoot and settling time characteristics, but too much steady-state error. Which gain could you increase to reduce the steady-state error?**

   K_p