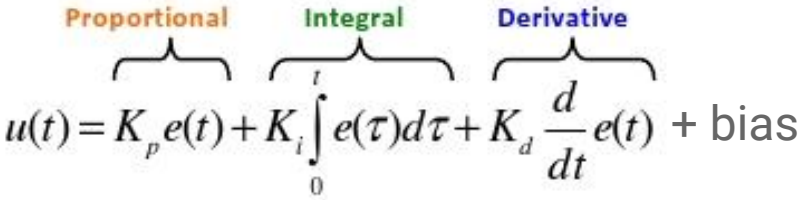
SGM 4/5

FLYING THE DRONE WITHOUT GPS

- **Unable to use API calls** of DroneKit/MAVLink to set velocity/acceleration because they **require GPS mode** (even on Ardupilot/Arducopter)

- **Directly set PWM** (pulse-width modulation) values for throttle/pitch/roll instead (and yaw, if needed)
    - This is basically like **overriding the two joysticks** on the remote control
    - 1000 is lower limit, 1500 is neutral (i.e., no movement) and 2000 is upper limit
    - Can get **fine-grain control** over the quadcopter

PID CONTROL SYSTEM (wiki)



- Equation for determining inputs to **throttle** (altitude), **pitch** (forward-backward), and **roll** (left-right)
- Ran single-directional **PID algorithm** in drone **simulator**
- Manually **tuned constants** K_P, K_I, K_D, and bias for each of the 3 axes
- The computation is non-intensive, so it can be **executed on the drone**'s processor. This will also be simpler and more readable.

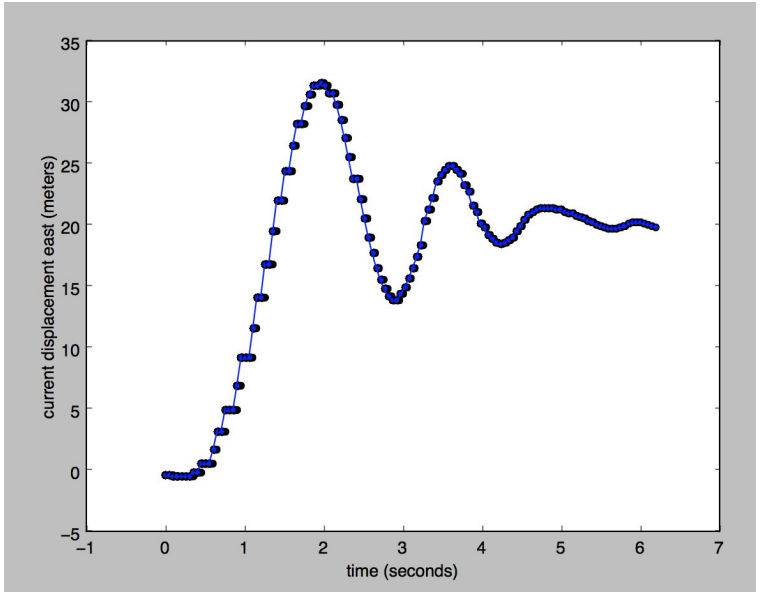
MULTI-DIRECTIONAL PID ALGORITHM

```
while target_(x, y, z) not reached:
    error_x = target_x - actual_x   // actual position given by Tango
    error_y = target_y - actual_y
    error_z = target_z - actual_z

    x_pwm = pid_equation(error_x)   // kP * error + kI * integral + kD * deriv
    y_pwm = pid_equation(error_x)
    z_pwm = pid_equation(error_x)

    set_pitch(x_pwm)                // adjust pitch, roll, throttle together
    set_roll(y_pwm)                 // to allow movement not just along axes
    set_throttle(z_pwm)

    sleep(dt)
```

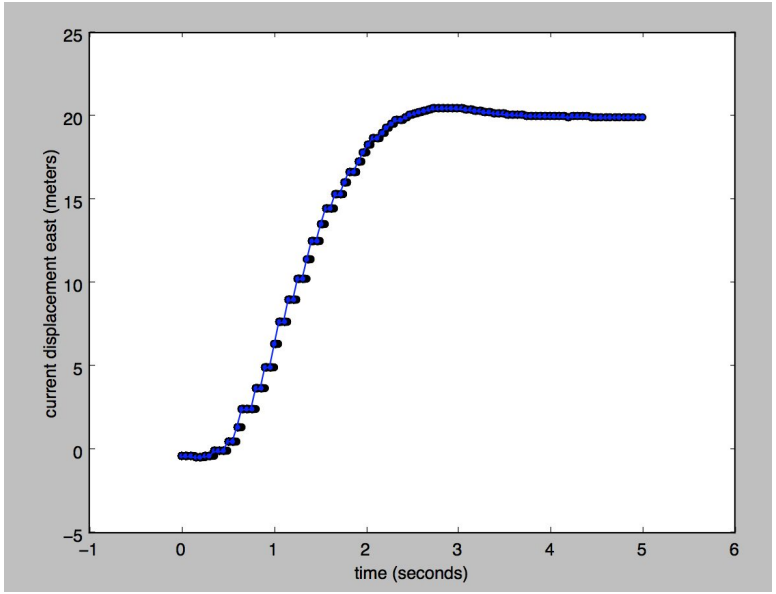
PID TUNING

Command: Move 20 meters east

Before tuning:



After tuning:



PID TUNING

Experimental values on the simulator, on STABILIZE mode[1]:

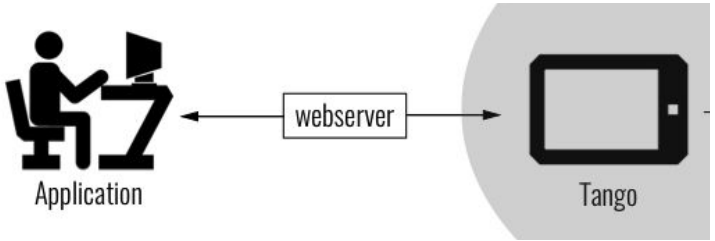
	K_P	K_I	K_D	Bias (pwm)
Pitch	-15	0	-1	1536
Roll	17	0	7	1537
Throttle	15	0.1	3.6	1400

We'll need to re-tune these values on the real drone, with the Tango attached.

[1]No altitude maintenance, no x-y position maintenance, only stabilization of the drone.

PIPELINE

- Server - Tango - UI loop has been established
- Path configuration is in place and is sent over to the server
- Tango position updates are sent over to server and broadcast to interested listeners (UI)
- UI displays real-time position updates of tango (attached to drone)



PIPELINE