Intro to Forces

To aim our robot's laser, we change the current velocity value of its yaw and/or pitch motors. The definition of acceleration (a) is a change in velocity (v) over time (t):

$$a = \frac{\Delta v}{\Delta t} \qquad (1)$$

Whenever an object accelerates, it experiences a force. This force (F) is equal to the mass (m) of that object multiplied by the acceleration (a) that it is experiencing:

$$F = ma \qquad (2)$$

We can substitute (1) into (2) to arrive at the following equation:

$$F = m\frac{\Delta v}{\Delta t}$$

If we assume that the mass of our robot (m) doesn't change and that our robot's motors will always take the same amount of time (t) to accelerate to their new velocity, then the only term that will change the force experienced by the robot is its change in velocity (v). In other words, the force is directly proportional to the change in velocity:

$$F \sim \Delta v$$

This means that the larger our change in velocity, the larger the force that our robot will experience and vice versa.

Unfortunately, our robot is not indestructible. If the robot's arm experiences too much force, it will break. As we worked out above, we can reduce this force by reducing the change in velocity. We have performed some calculations for you and found that the maximum change in velocity that the robot can experience without breaking is 180 degrees per second.

The question now becomes: how can we make sure that our robot is never changing its velocity by more than 180, while still trying to aim at the mosquitos as quickly as possible? One potential answer is to implement a proportional controller.