This document describes the high level functions used to control the aircraft in the MatrixPilot software. It focuses on the quadricopter control part, which is coposed of three main functions :

* motor control, which stabilizes the airframe around target yaw, pitch and roll angles
* the altitude control, which stabilizes the airframe around a target altitude of a target vertical velocity
* the x-y positioning control, which stabilizes the airframe arund a target x-y coordinate

**Requirements**

1. Motor control

Motors are controlled by pairs of PID controllers.

* 1. Around the pitch and roll axis :

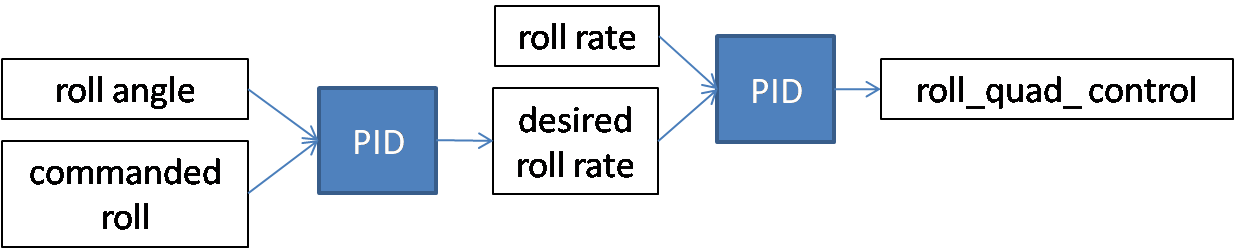
commanded\_roll = pwManual[AILERON] \* commanded\_tilt\_gain

with commanded\_tilt\_gain = sin(max\_tilt) / 1000

Idem for pitch.

Then the vector [commanded\_roll, commanded\_pitch, RMAX] is normalized to RMAX.

Finally, the following PID control is used :



Where roll\_angle = rmat[6]

Idem for the pitch axis, where pitch\_angle = -rmat[7]

In the first PID, only the integral and proportional terms are used (kd=0).

In the second PID, only the proportional and derivative terms are used (rate\_ki=0).

* 1. Around the yaw axis :

Example :

Considering only the proportional gains (ki=0, rate\_kd=0), commanded\_roll = 0 and roll\_rate = 0:

Desired\_roll\_rate = roll\_angle \* (-kp)

roll\_quad\_control = - Desired\_roll\_rate \* (-rate\_kp) = kp \* rate\_kp \* roll\_angle

1. Altitude control

When plane altitude is equal to target altitude, considering no integral term and that thresholds are not reached, the throttle should be :

throttle = throttle\_offset + 2 \* AircraftMass / (100 \* MaxThrust) \* zkp \* vzkp \* acczkp \* (target\_altitude – plane\_altitude)

with throttle\_offset = 2\*SERVORANGE\*AircraftMass / (100 \* MaxThrust)

**Resources**

Direction cosine matrix :

<rmat.pdf>

PID controllers :

