SMART THROTTLE CONTROL

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SUMMARY

Project started with the basic things like types of system, zeros, poles, DC Gain, Laplace transforms, conversion to frequency domain and how to analyse the system using bode plots and generate the plots manually(also MATLAB).
Then learned how to draw response to different outputs and and how to analyse a step response. Also modelled plants and analysed their step response by parameters like settling time ,overshoot ,steady state error ,type of damping ,etc.
Further assignments taught us about concepts like PID controllers and affects of each type of gain on the response and also the modelling of PID controller using MATLAB and how to set the gains for required results. Also windup ,anti-windup and filtering of the input from noise .
The choosing of types of compensators for the plant, adding feedforward control to the system and MIMO systems are the advanced concept of project.

LEARNINGS

1. Control theory concepts Laplace transforms ,LTI systems ,Transfer functions ,initial and final value theorem, Dominant pole and sensitivity, Bode plots, feedback controllers, PID controllers and MIMO systems and feedforward systems including theory and physical significance

2. MATLAB workspace, functions ,tools for the tuning and analysis of the system including Modelling of mentioned different control system using code also plotting and making tables.

3. Learned about the problem solving using different plant and different approaches like PID ,Feedforward ,PID+ compensator ,MIMO systems their specifications and how different types of problems require different modelling .

DRONE ALTITUDE/SPEED CONTROL

THEORY

Starting with newtons law

=ΔT=T-mg

T: Thrust by motor

= Z(s)/T(s) = Transfer function = 1/ms^2

Feedback is required as -180 phase and zero damping ,so open loop can't be used and P controller is used instead of it.(No poles in left half)

Thrust changes velocity almost immediately but altitude response is slow .So velocity can be chosen in the inner loop for faster response.

= V(s)/T(s) = 1/(m*s)

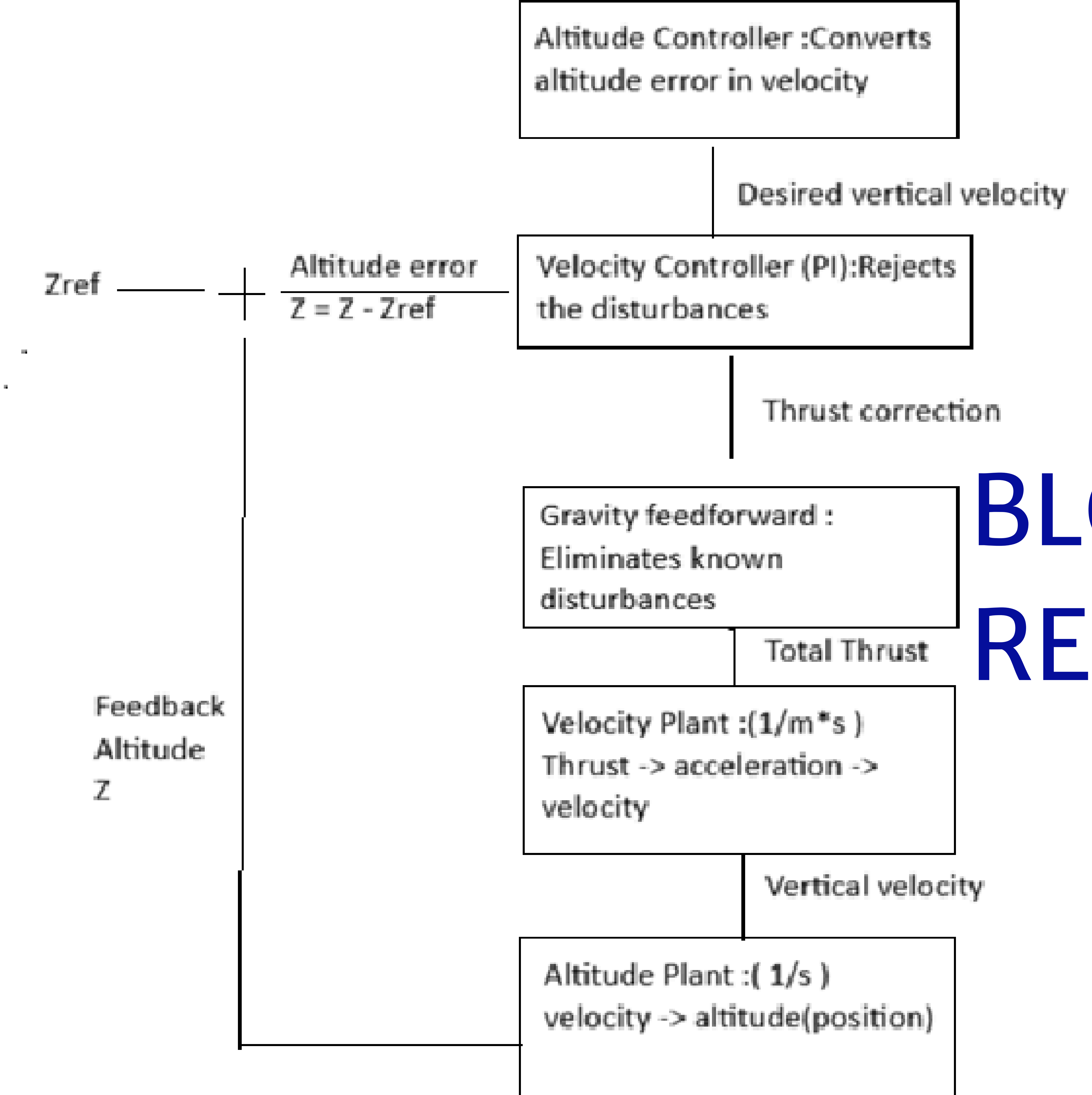
Controller use :

1. Integral removes steady state error.
2. Derivative amplifies noise but for velocity noise sensitivity is lower so PI controller is used in inner loop.
3. Feedforward control is added to the to cancel disturbances .

PHYSICAL INTERPRATION

- Why Closed Loop: Wind or payload change causes acceleration and if the system is open loop then there will be no restoring force to overcome it.
- Why velocity as input: Thrust causes immediate changes in velocity and altitude changes slowly so it is required as input. Humans also control motion in same way.
- Why inner loop: Velocity is changed due to acceleration and reacts quickly also it is single integral so stabilize easily .
- Why PI for velocity: velocity does not need aggressive damping also its noise sensitivity is lower (derivative on a single integrator amplifies noise)
- Why feedforward: As gravity is know so there is no need to estimate it using error also feedforward cancels known disturbances .

BLOCK REPRSENATATION



THANK YOU