This chapter discusses the results of simulation and thedesignincluding the hardware calibration, building testing phases and configuration.

4.1 Simulations

Result of Simulation

- Matlab has been used for simulation motors

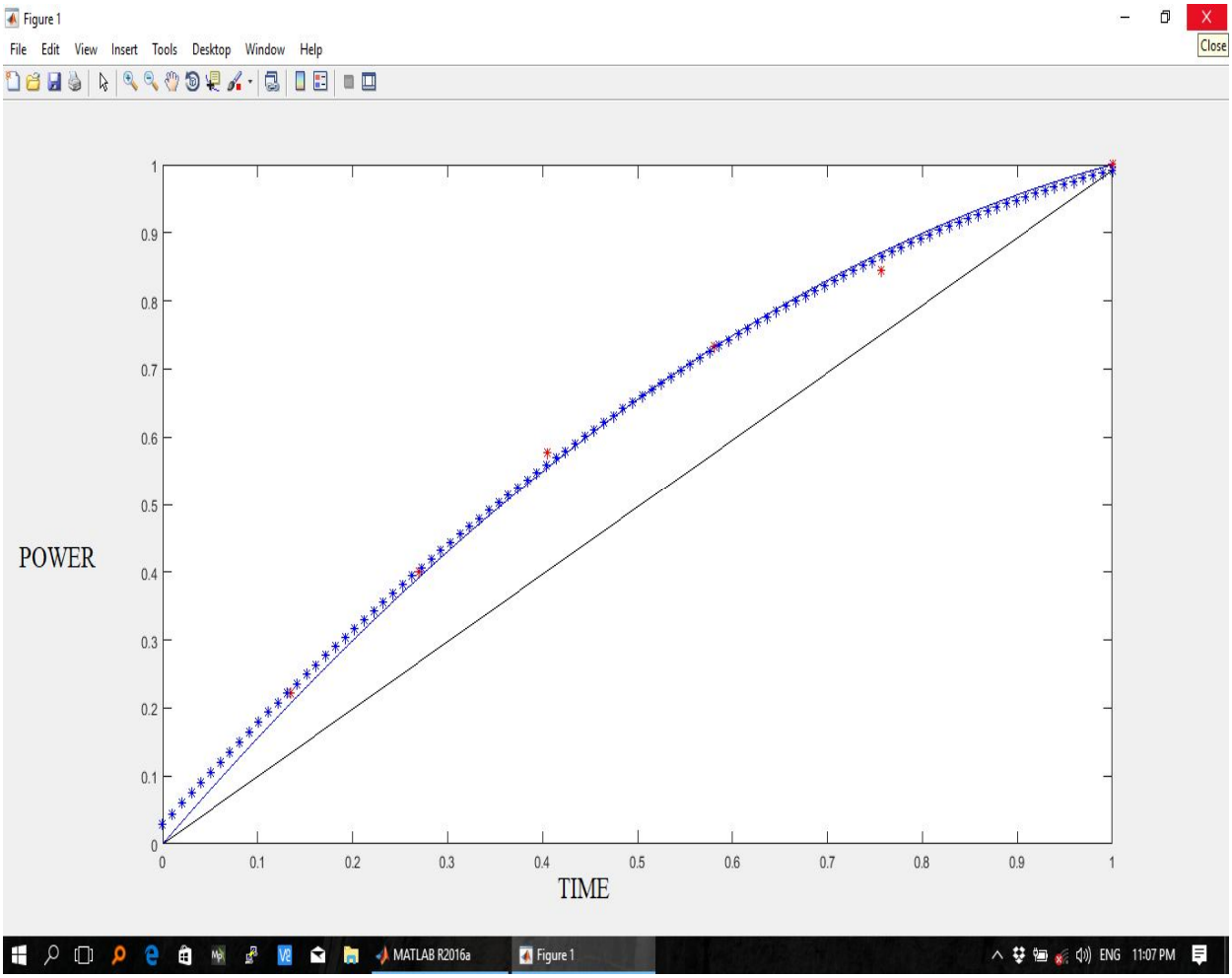

Figure 4.1: relation between power and time

Figure 4.1: show the relation between power and time for motor given ideal power factor any increasing in value of power factor causes overshooting in power and that may damage the motors. And any decreasing in power factor causes slow motor turn. (Appendix"B")

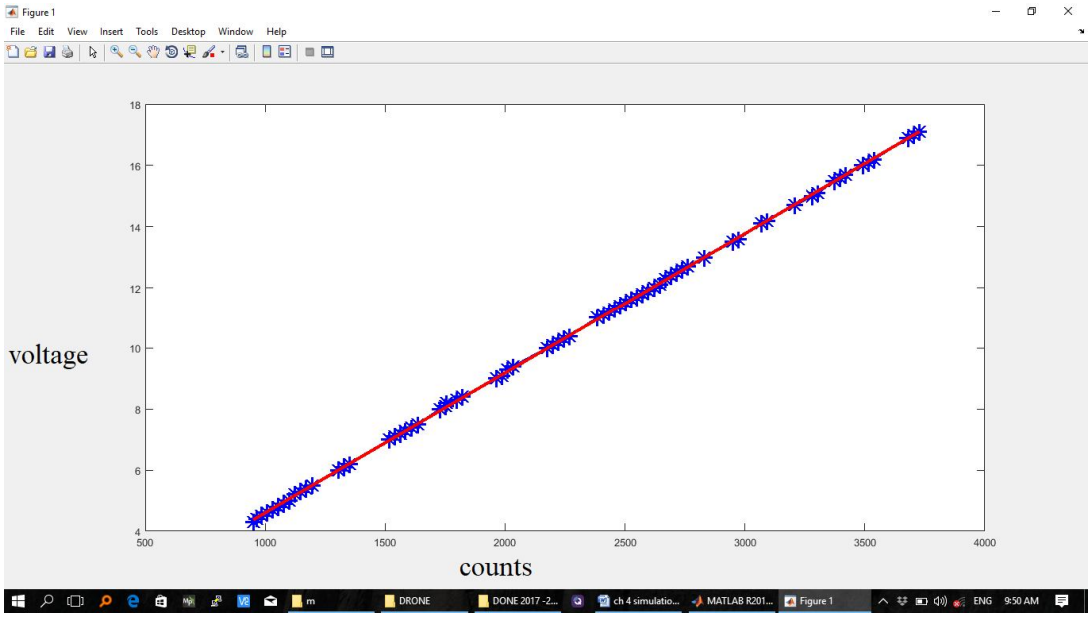

Figure 4.2:fit linear voltage

Figure 4.2:fit linear voltage show relation between voltage and counts.(Appendix"D")

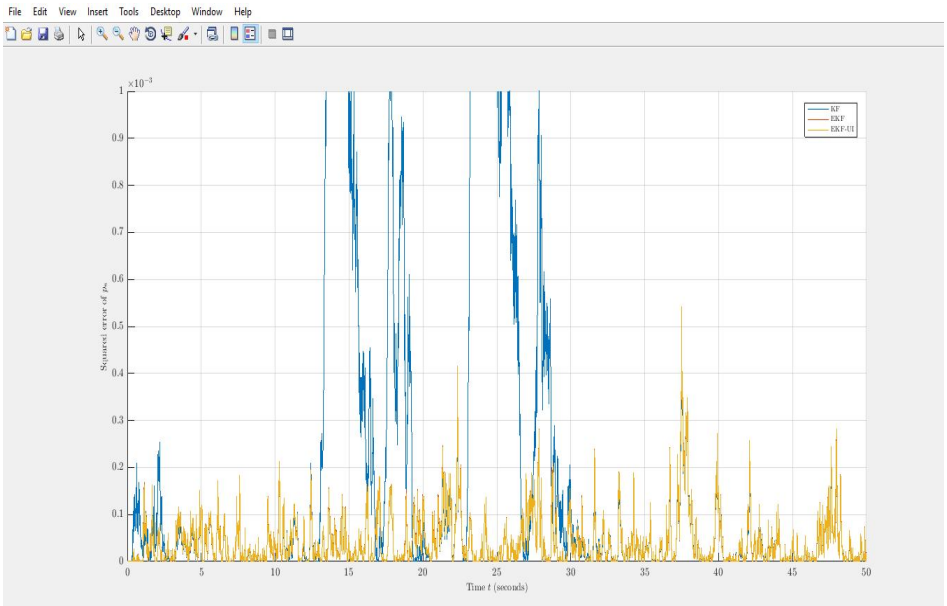

Figure 4.3: squared of error/time

Figure 4.3: squared of error over time this relation display compare between Extended Kalmen Filter-User Interface (EKF-UI) and Kalmen Filter (KF) and Extended Kalmen Filter (EKF) .this relation used to make faster response time.

4.2 Calibrations

APM firmware is the brains of your autopilot operation and must be installed before using Pixhawk. To load firmware onto Pixhawk, install a mission planner application on your ground station computer. Choose either Mission Planner (Windows) or APM Planner for (Windows, OS X, and Linux). Both applications are available for free download from ardupilot.com.

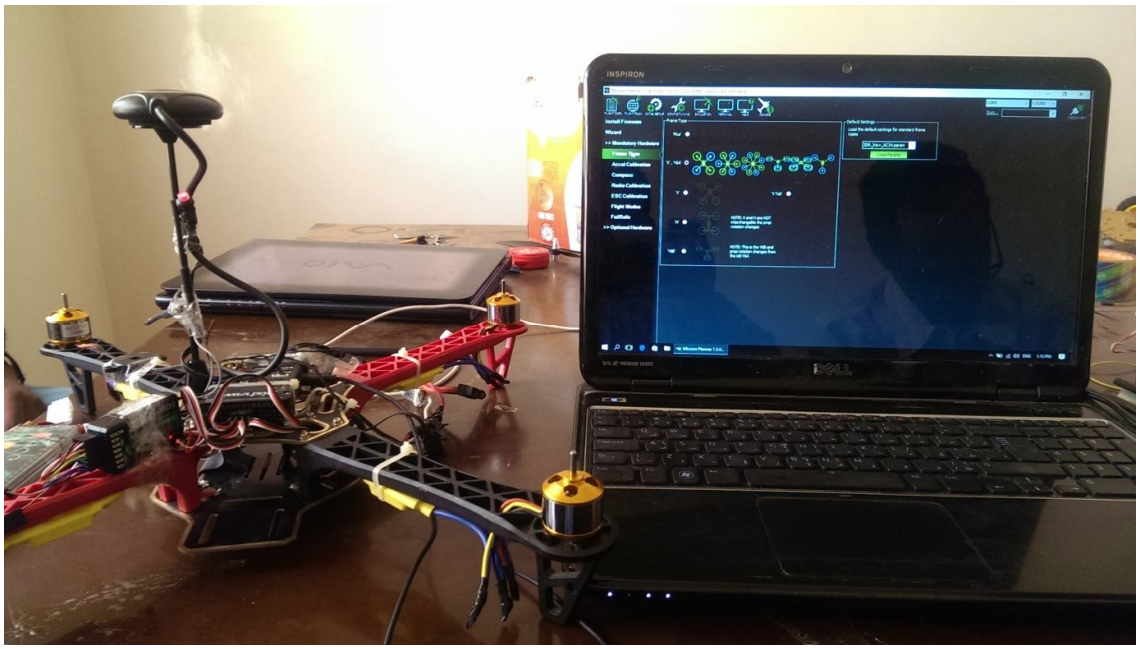

Figure4.4:firmware of pixhawk from mission planner

Select Initial Setup, Install Firmware, and select your vehicleSelectAccel Calibration, check the box for AC 3.0+, select Calibrate, and follow the prompts to calibrate Pixhawk's accelerometer. Make sure to wait a couple of seconds before and after changing the positions of the vehicle.

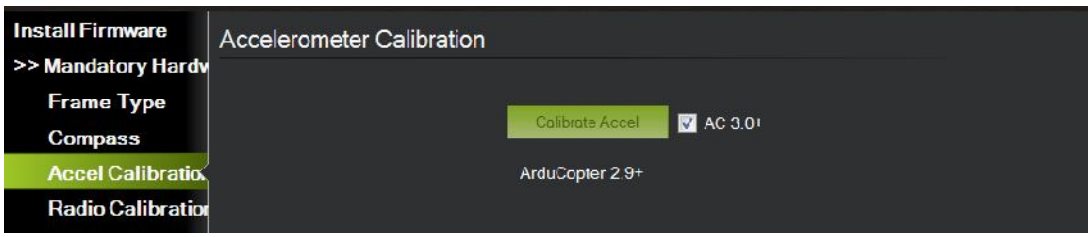

Figure 4.5: accelerometer calibration

Select Radio Calibration to teach Pixhawk to work with your RC transmitter. Turn on your transmitter, select Calibrate Radio, and move all sticks and

switches to their extreme positions. Select Click when Done once the red bars are set for all available channels.

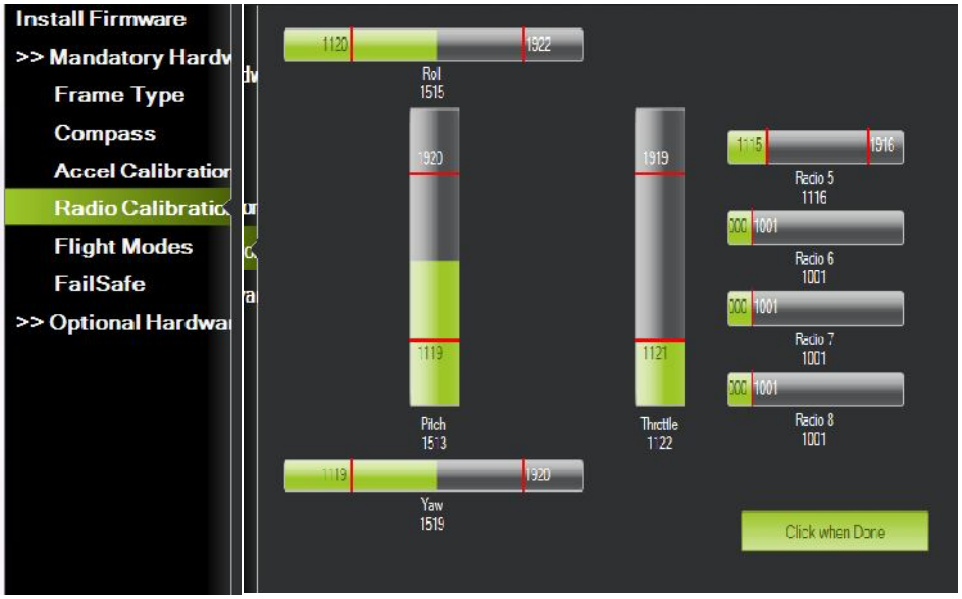

Figure 4.6:RC Calibration

Move each switch on your transmitter to its available positions. The mission planner will indicate the currently selected position with green highlighting. Select a mode for each switch position, and select Save Modes to assign.

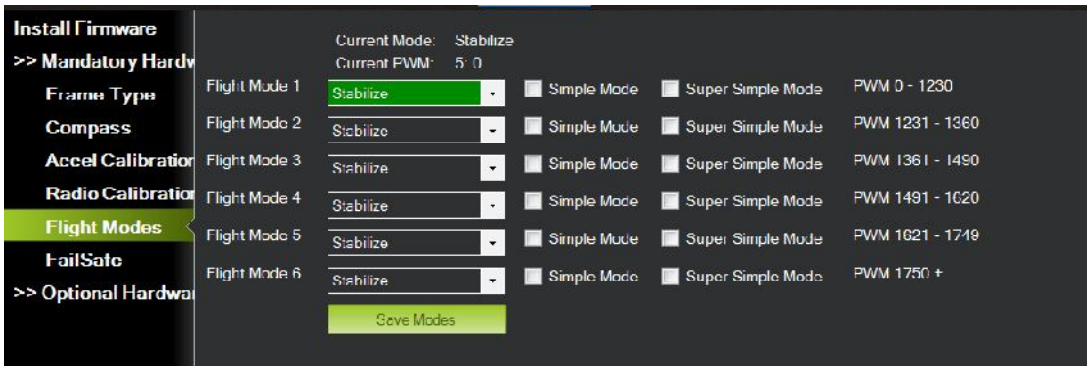

Figure 4.7: flight modes calibration

- Motors calibration:

All Motors have been calibrated to figure out the stating throttle of each motor which is shown in the following table.

Table 4.1**:** Motors calibration

Motor NO.	Starting duty cycle
1	1116 us
2	1116 us
3	1116 us
4	1116 us

Table 4.2**:** Compass calibration

Compass axis	**Value**
Compass Min X	-3.063191
Compass Min Y	-74.754135
Compass Min Z	-52.087727
Compass Max X	75.672134
Compass Max Y	2.896713
Compass Max Z	19.115725

Table4.3**:**Accelerometer calibration

Accelerometer axis	Value
Accelerometer Min X	-1.153897
Accelerometer Min Y	-1.066652
Accelerometer Min Z	-1.111786
Accelerometer Max X	1.259294
Accelerometer Max Y	1.099110
Accelerometer Max Z	1.032464

4.3 The Ground Station Testing

The ground control station has been tested to evaluate its performance against its range and the result shows that the performance of the communication between the ground control station and the quadcopter is pretty good.

To enable connection between ground control station and drone you need input ipaddress of ground control device the preferred solution require to having publicip address. Next you need also define port for streaming (default: 14550).

4.4 Configuration

OpenVPN services which is supported by UAVcast downloaded and setup (OVPN file). Use the generated OVPN file to establish connection between drone and server ,next connect ground station to server.

4.4.1 Modem configuration

Connect online using modem. There is also various modem diagnostics in RPI page modem will be activated when start UAVcast. However it will not be disconnected when stopUAVcast, do this Manually in RPI page under modem section

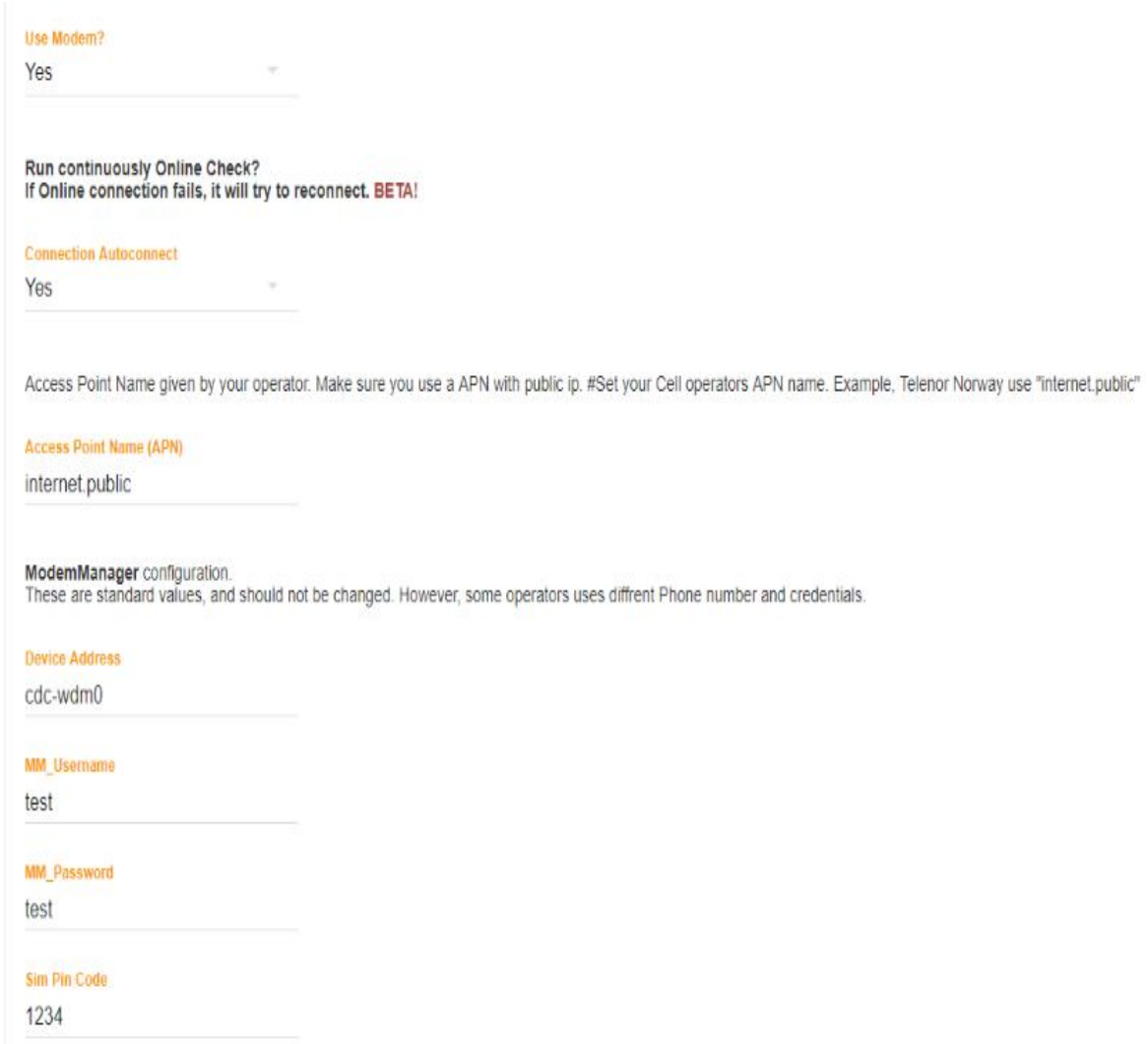

Figure 4.8: Modem configuration.

4.4.2 Camera configuration

There are three different camera devices supported currently by UAVcast.

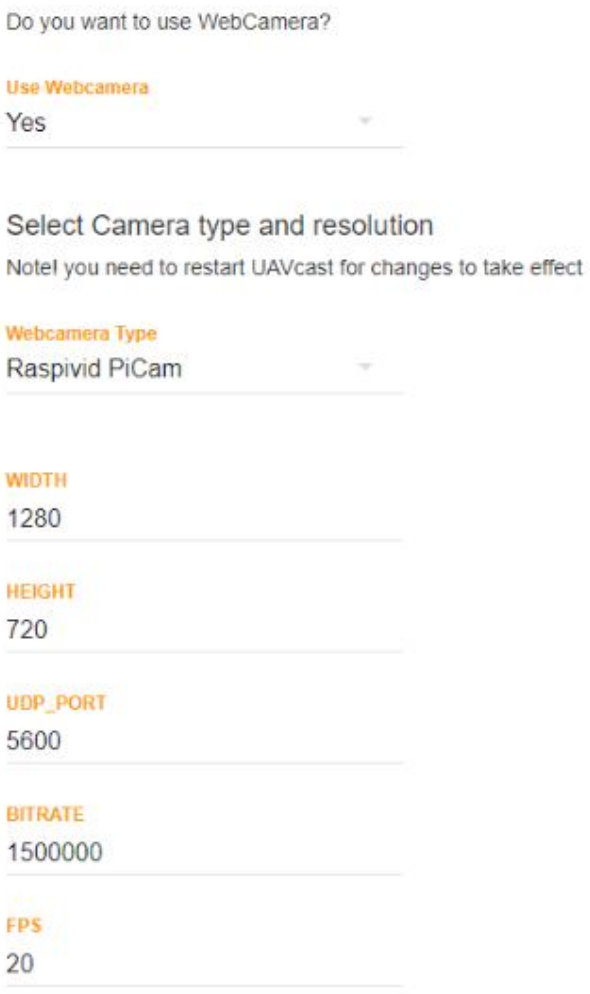

Figure 4.9: Camera configuration.

4.4.3 DNS configuration

Dynamic Name Server is convenient if you don’t have a static IP from your cell vendor. By using a DNS name you can easily connect to the RPI by name instead of ip address. Note remote access to RPI works with public IP only.

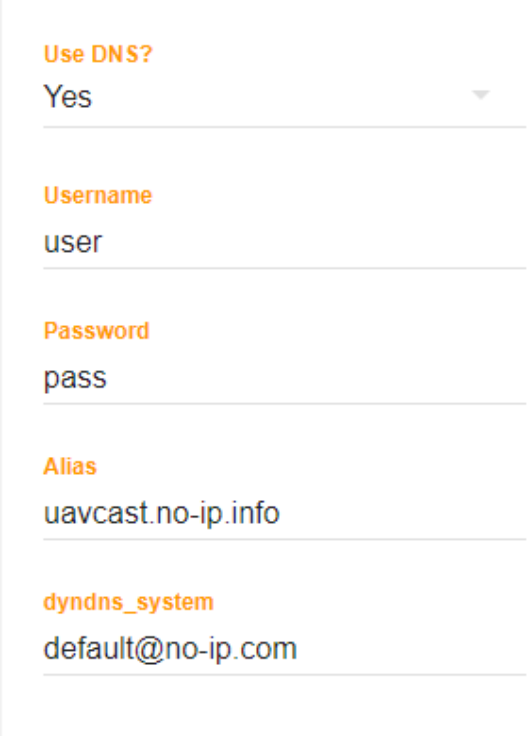

Figure 4.10: DNS configuration.