Lab 8 - Constructing and testing radio antennas

Introduction to Drone Technology

Group 8
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1 Antenna Construction

Figure 1: Close up of constructed dipole-antenna

The theoretical length of the antenna is calculated by equation 1. λ is the wavelength calculated by equation 2. c is the propagation velocity and f is the frequency. The ideal propagation velocity is the speed of light.

$$L = \frac{\lambda}{2} \tag{1}$$

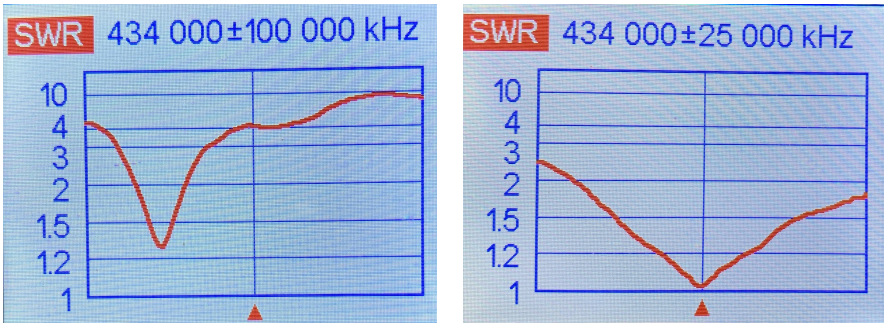
$$\lambda = \frac{c}{f} \tag{2}$$

The antenna is designed to resonate at a frequency of $434MHz$, and as such the initial length of the antenna should be 34.54 cm.

2 Antenna Tuning

The propagation velocity is not ideal, the atmosphere and the components will slow it down, causing the theoretical length to resonate at a lower frequency. By shortening the wire the resonating frequency is increased. It is not reasonable to calculate the propagation delay, and the antenna length is adjusted by trial and error.

During this process the resonating frequency and the SWR (Standing Wave Ratio) is measured using the RigExpert antenna analyzer.



(a) Initial reading (b) Final reading

Figure 2: Readings of SWR and resonance frequency on the RigExpert

The final length of the antenna is 29.56 cm.

3 Antenna Near Field Obstacles

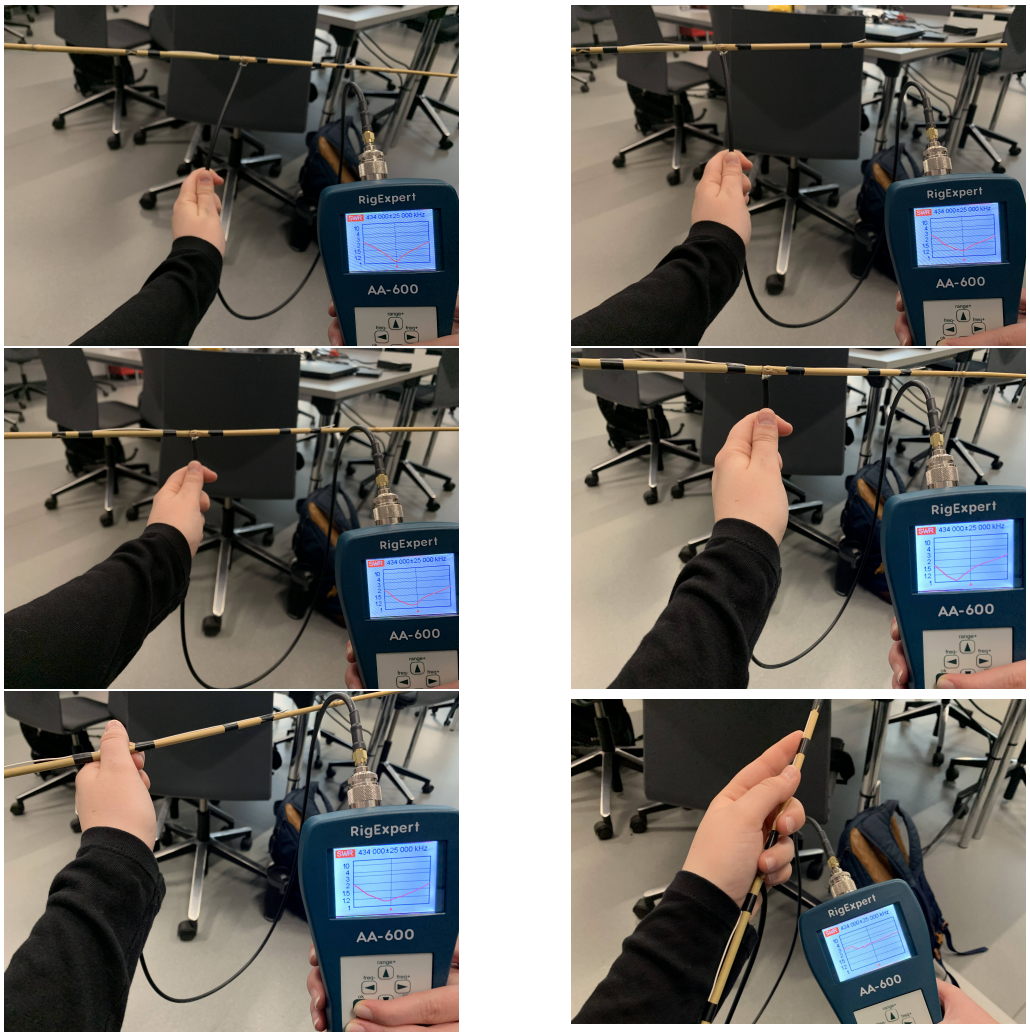


Figure 3: Pictures of disturbing the near field

In figure 3 a series of images is shown that increasingly disturb the near field of the antenna. It is seen that the SWR increases, which is explained by the increase in reflective power due to the the close obstacle. There is also a decrease in resonance frequency, this is due to an increase in the propagation delay.

In figure 4 it is shown that a conducting material also has a great effect on the disturbance in the near field.

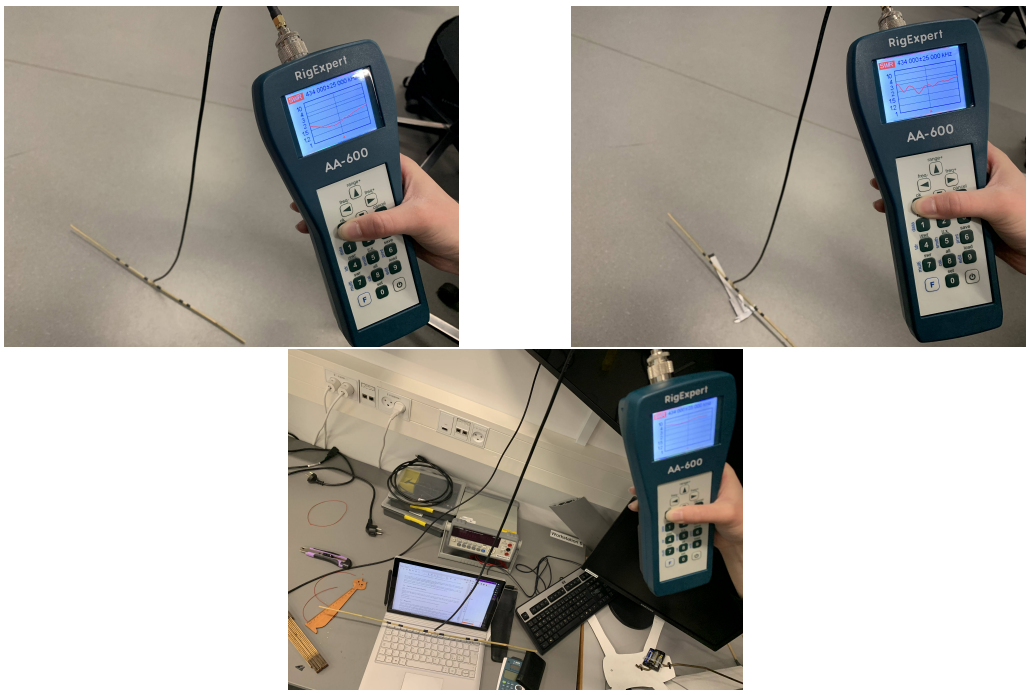
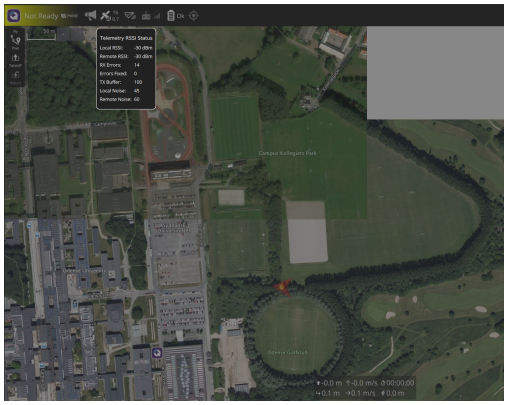
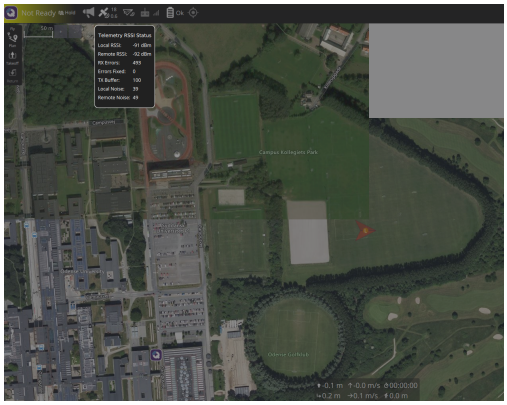


Figure 4: Pictures of disturbing the near field with conducting material. The first image is the floor with no conductive material

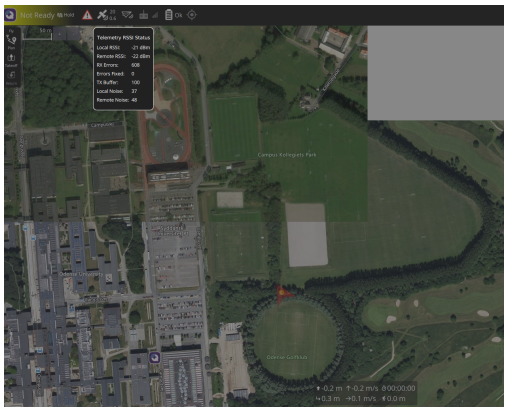
4 Range Test



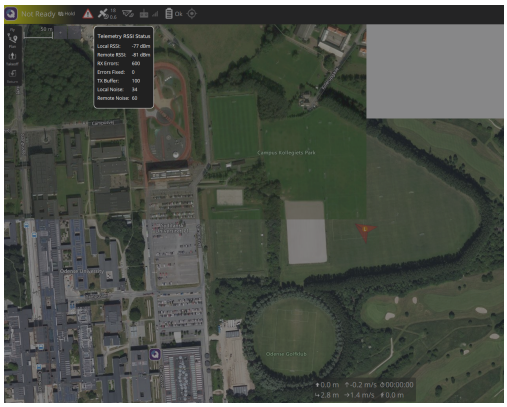
(a) Stock plastic antenna within 1 meter



(b) Stock plastic antenna 150 meters away



(c) Constructed antenna within 1 meter



(d) Constructed antenna 150 meters away

Figure 5: Screenshots of QGroundControl

Antenna, position	Local RSSI [dBm]	Remote RSSI [dBm]	Local noise	Remote noise
Stock, close	-30	-30	45	60
Stock, far	-91	-92	39	49
Constructed, close	-21	-22	37	48
Constructed, far	-77	-81	34	60

Table 1: Measurements of RSSI and noise when the antena is close to the drone, and when it is far

On figure 5 is screenshots from QGroundControl showing the RSSI measurements for the two antennas, and from two different distances from the ground station, roughly 150 meters away. From table 1 it can be seen that the difference in the stock and constructed antenna for the remote RSSI is 11 dBm. Due to this being dBm it means the constructed antenna is at least 10 times better than the stock plastic antenna.

This is due to the stock antenna having a larger bandwidth, meant to be compatible with a wide range of applications. The constructed antenna is made for a specific purpose and have a much smaller bandwidth of roughly 25MHz. This is read from figure 2b, the width of the curve that is below 1.5 SWR, which is the accepted threshold for a good antenna at those frequencies.