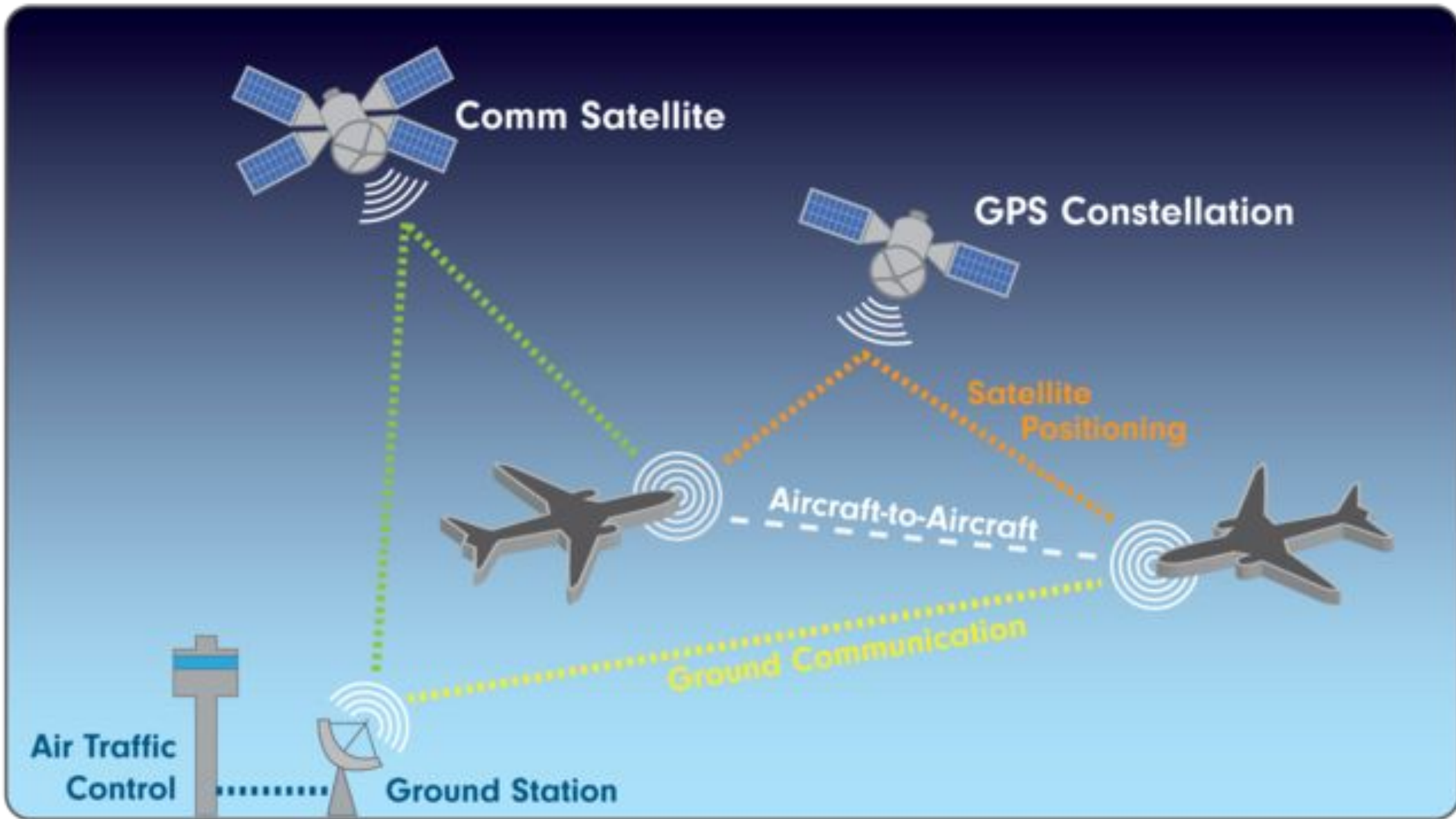


ATD Course Project



Gaurav Duggal
MT17091

What is ADS-B?



Flightradar24 Project








Leaderboard

TOP RADARS

TOP USERS

NEMESIS

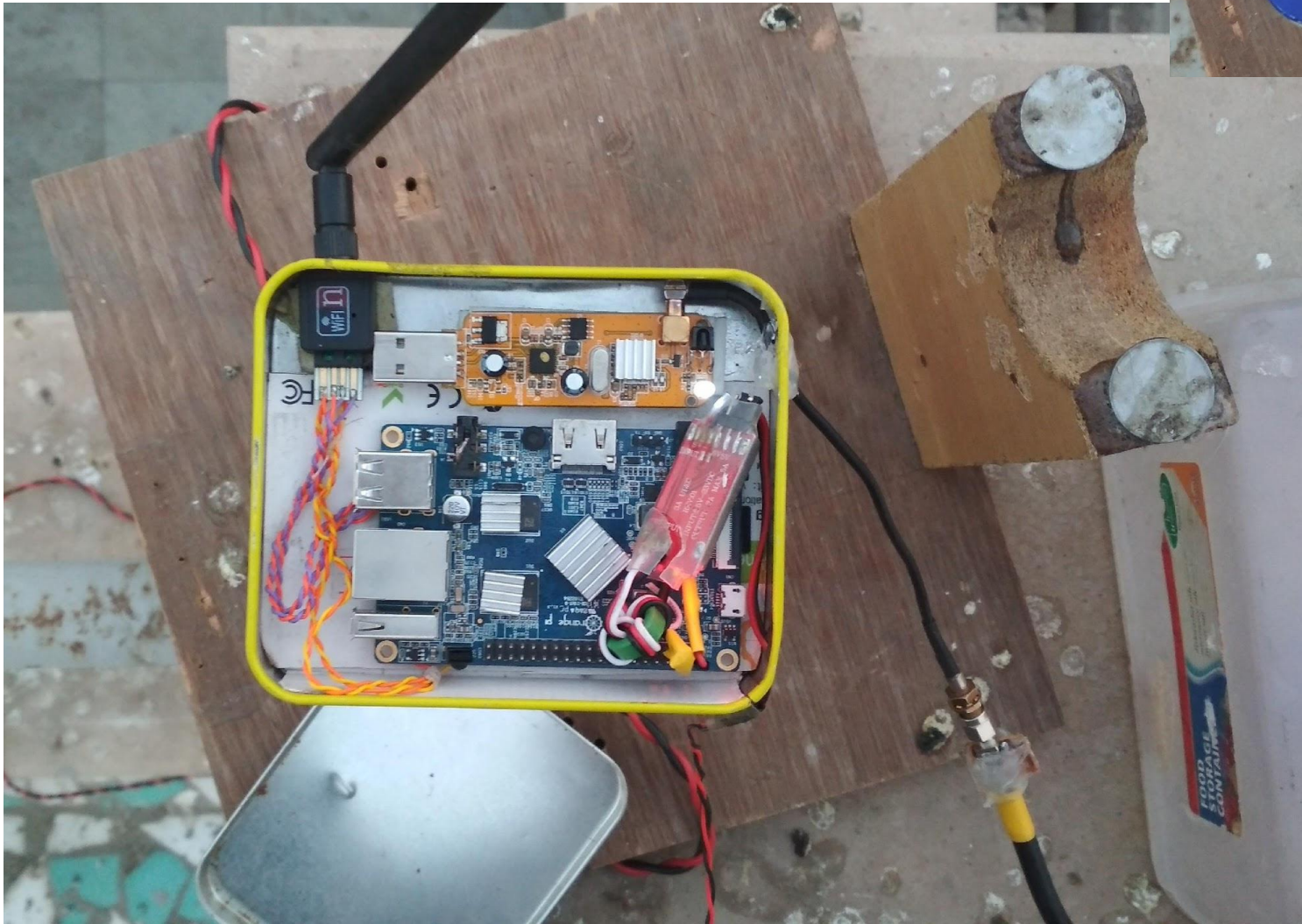
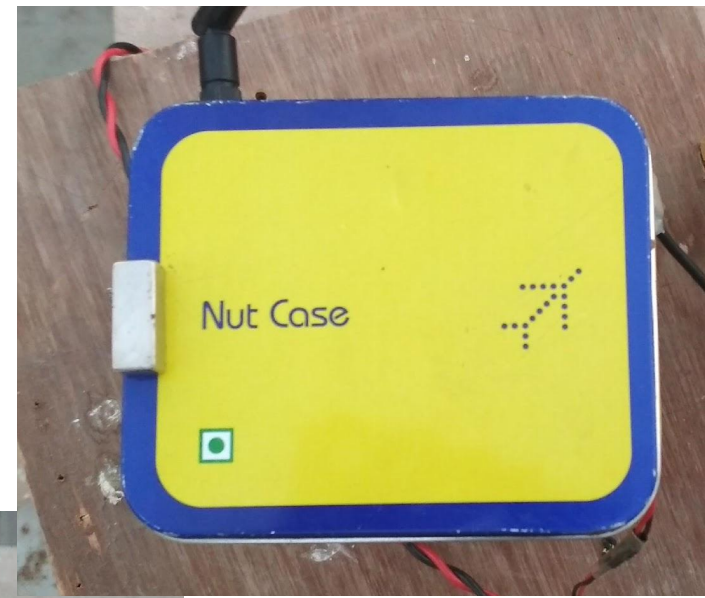
Q VIDP

Rank ?	Radar	Username ?	Country IND v	Score ? v	Upload time ?	Max range ?	Avg range ?
6	F-VIDP6	Anonymous	 India	10,552	719	320	172
25	F-VIDP4	Anonymous	 India	10,055	702	255	135
27	F-VIDP3	Anonymous	 India	9,989	719	190	111
102	T-VIDP26	Mimeakadug	 India	1,425	110	215	18
104 ↓1	T-VIDP12	AvGeek108	 India	1,195	97	15	3
105	T-VIDP28	prashant9996	 India	994	55	235	122
110 ↓2	F-VIDP7	Anonymous	 India	175	10	190	119

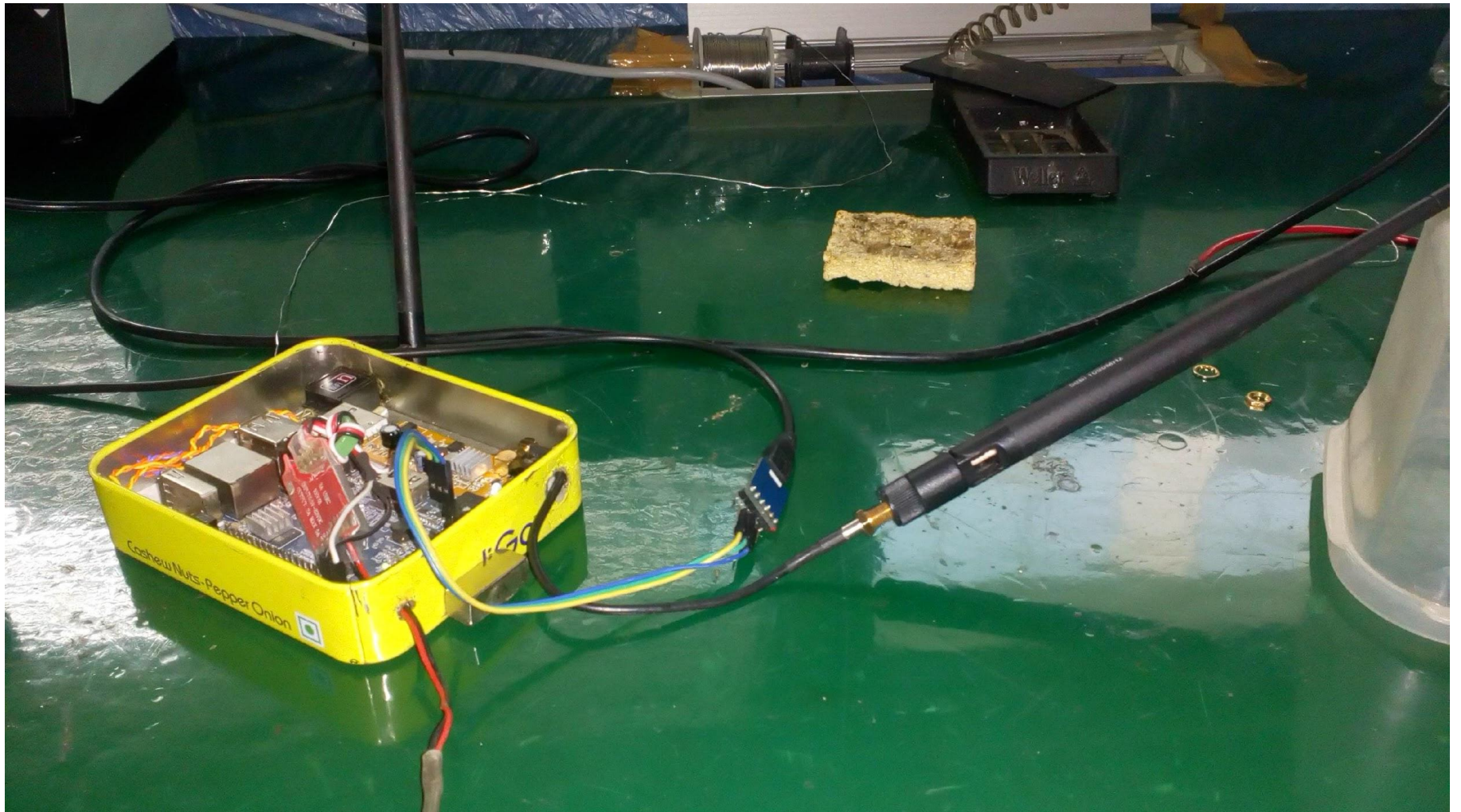
The Receiver

Major Parts:

1. RTL-SDR - software defined radio
2. Orange Pi – Single Board Computer
3. Generic Wifi Dongle
4. Indigo Nutcase



The Original Antenna



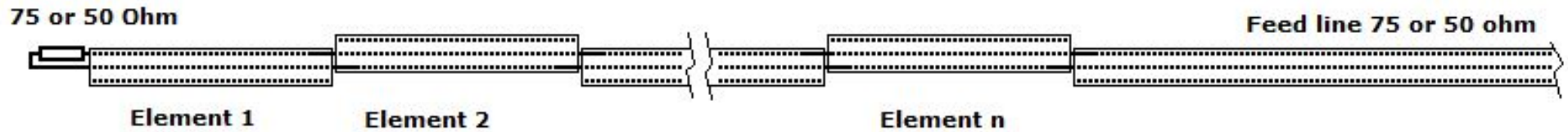
The Objectives

- High Gain (more than the original Antenna's 5dBi).
- Omnidirectional
- Narrow Bandwidth (centred around 1090mhz)
~20 MHz
- Relatively easy to assemble

Idea

- Antenna Arrays have high gain and an Array of Dipoles will give an omnidirectional Antenna
- Coaxial Collinear Antenna Design selected
-
- Balsley, B., and W. Ecklund. "A portable coaxial collinear antenna." IEEE Transactions on Antennas and Propagation 20.4 (1972): 513-516.
*In the Original paper they have designed an Antenna Array for Radar!

Collinear Antenna Design



My neighbour involuntarily contributed generously to the project by donating (?) 15 metres of RG6 Coaxial Cable

Design Parameters

- The length of a single element is given by:

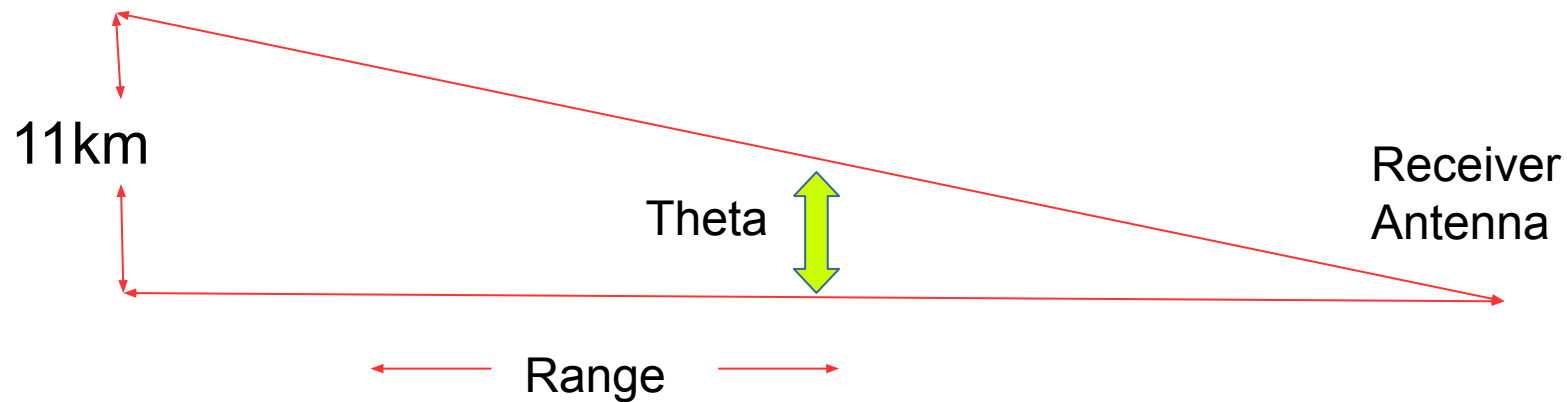
$$\frac{\lambda}{2} \cdot \text{Velocityfactor} = 11.6\text{cm}$$

- The velocity factor is given from the datasheet of the RG cable and is 0.85*
- ADS-B signals are vertically polarised.

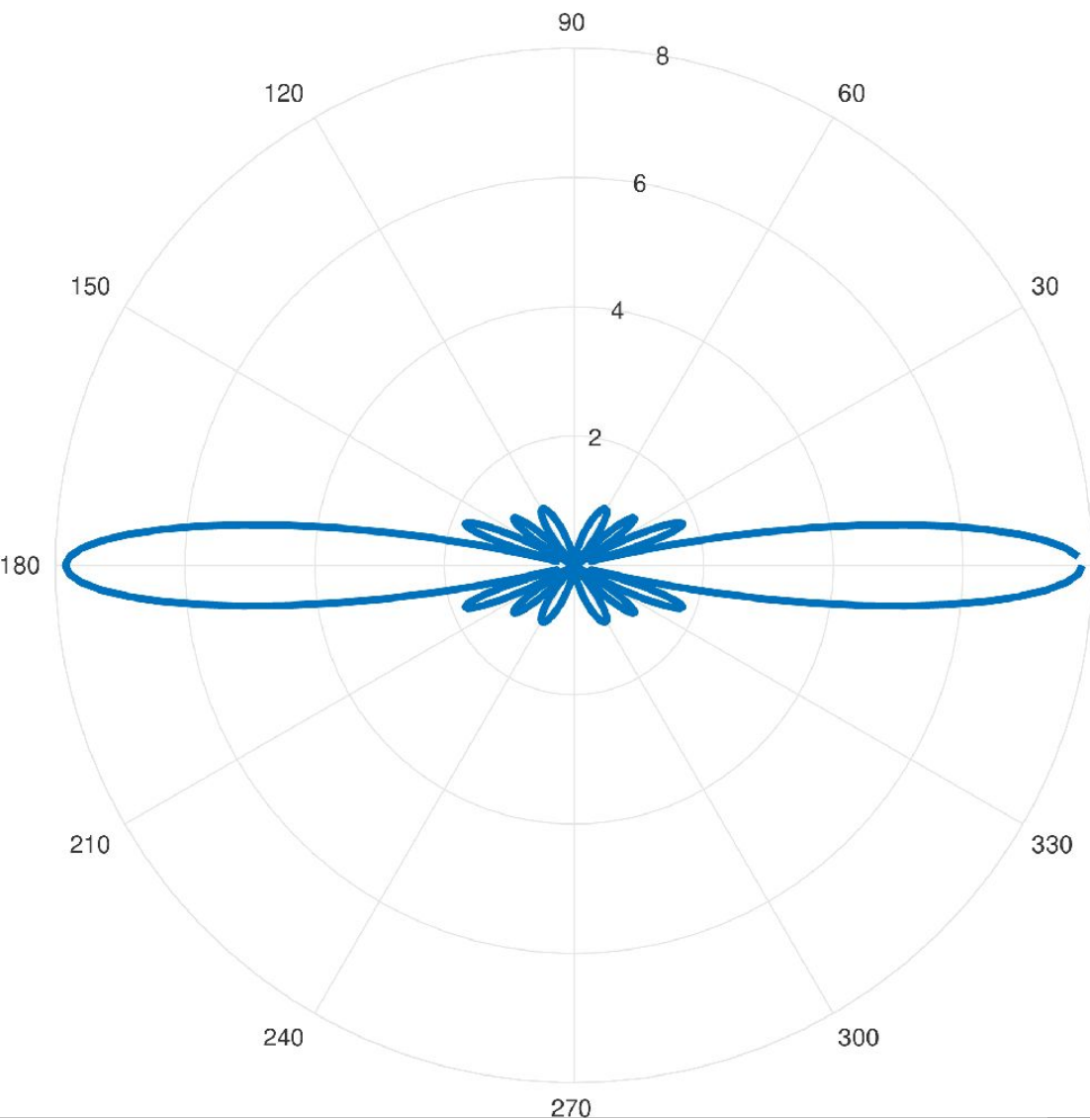
*Finolex RG6 CCS coaxial cable

Design Parameters

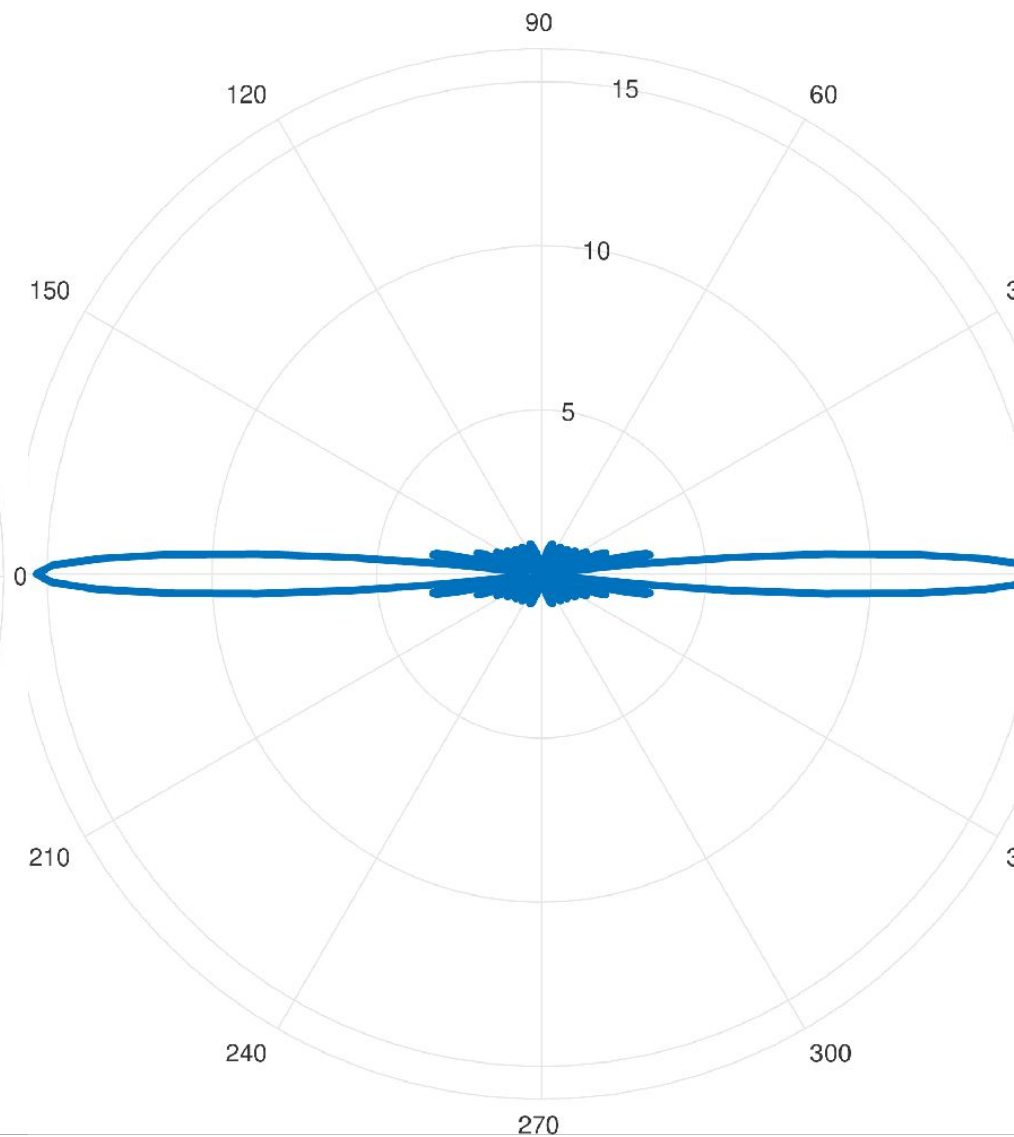
- Number of elements chosen: 16
-



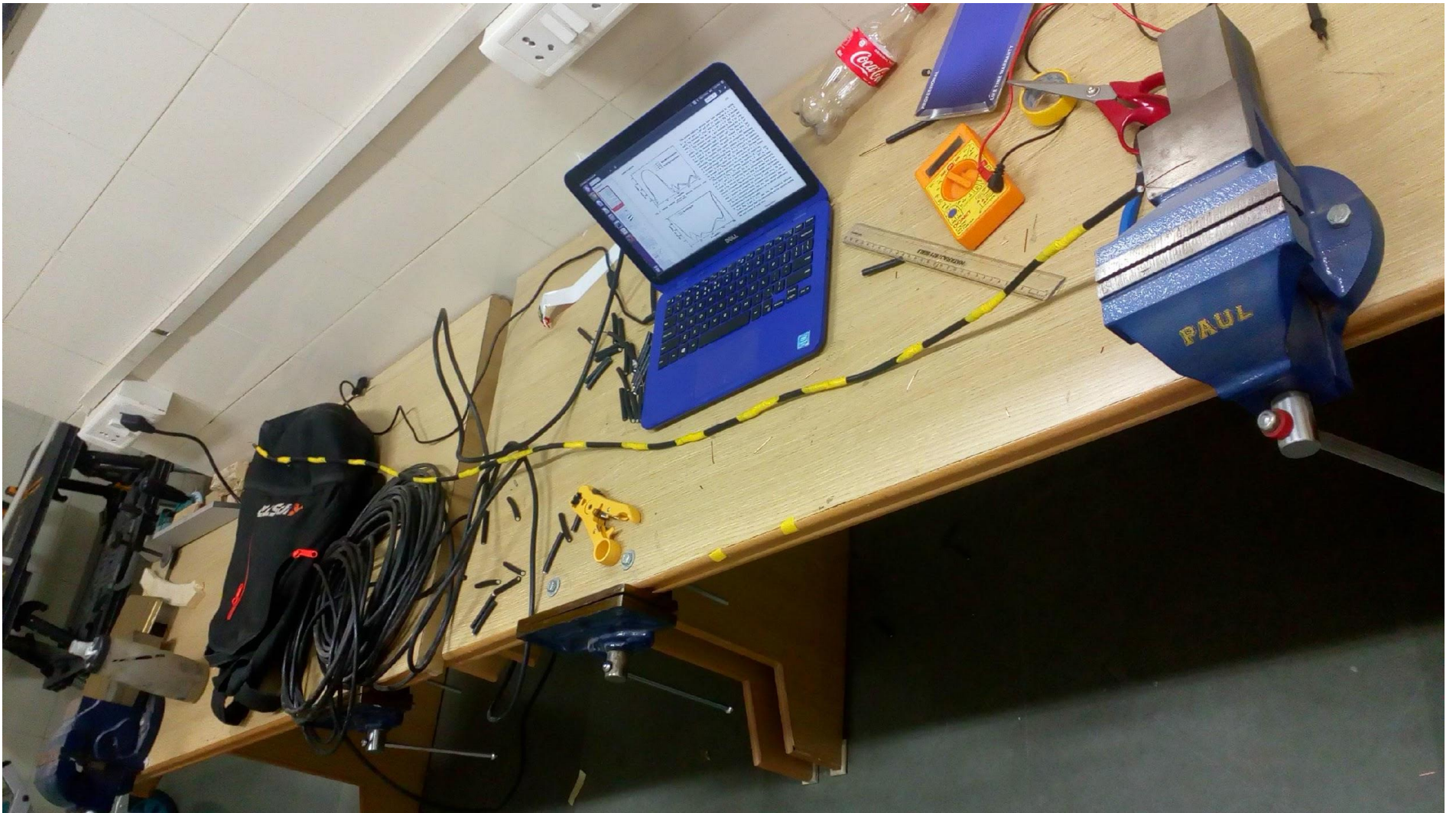
Typical Range 90-400 km results in Theta from 1.57 degrees to 6.96 degrees.



8 Element Array Factor
Beamwidth- 13 degrees



16 Element Array Factor
Beamwidth- 7 degrees



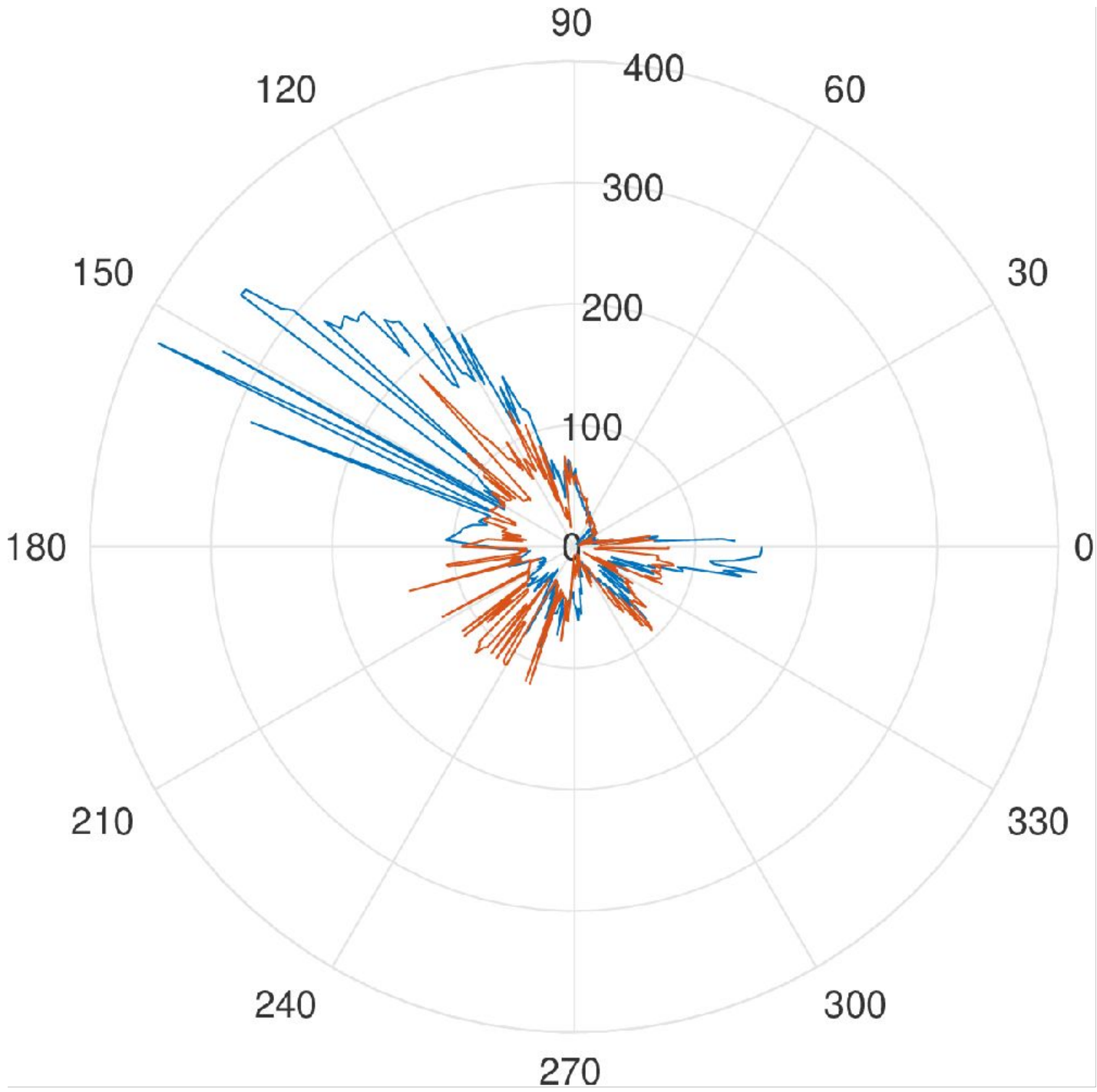
Construction



Installation

Results:

The maximum distance to the aircraft in 360 directions is plotted on the left.

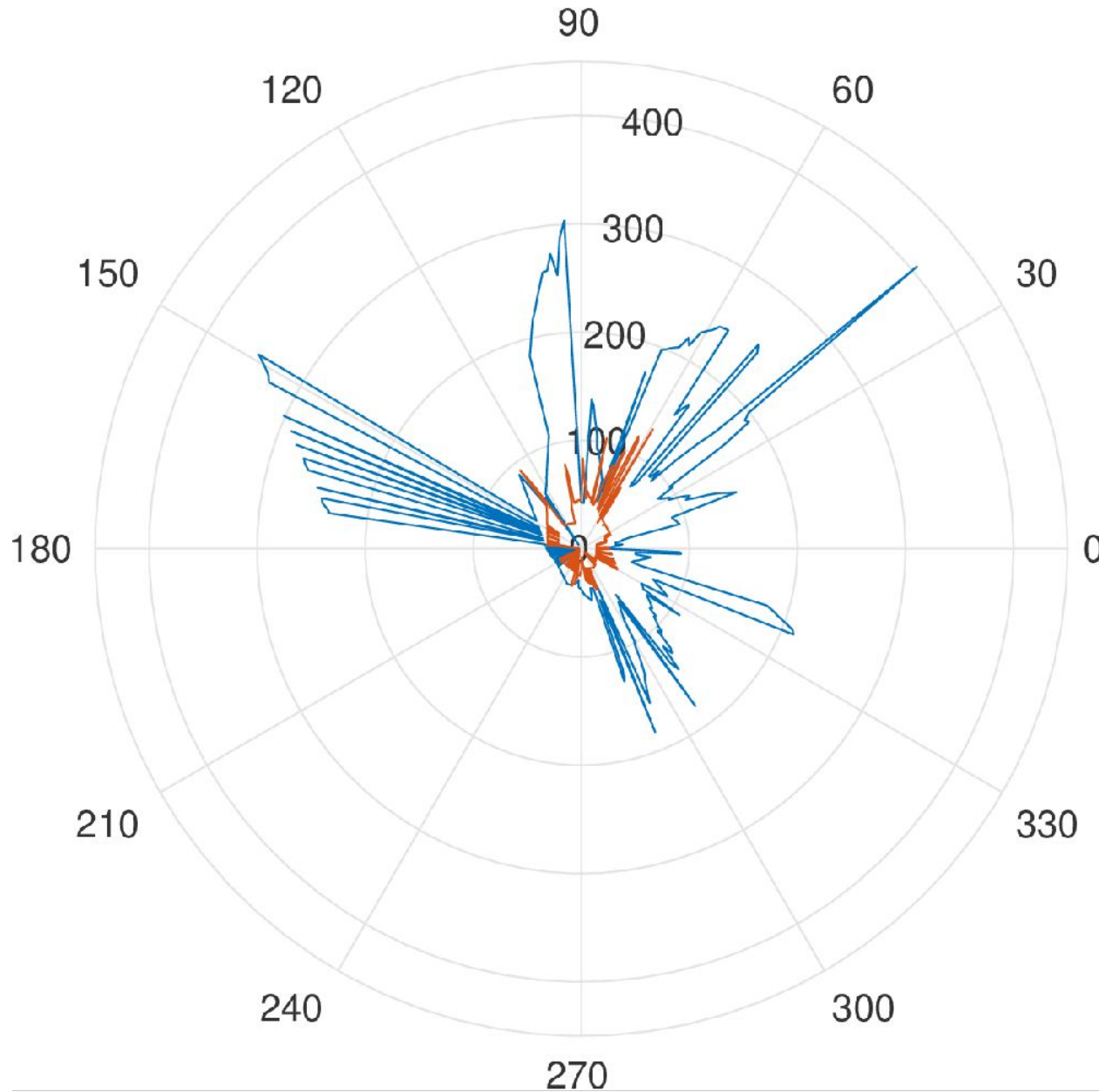


Interesting Statistics

Stastic	COLLINEAR ANTENNA	5Dbi ANTENNA
Distance > 100 Km	50	28
Distance > 150 Km	34	2
Distance > 200 Km	20	0
Maximum	344 Km	190 Km

Location- Mess Building

Duration- 20min



Interesting Statistics

Location- Mess Building

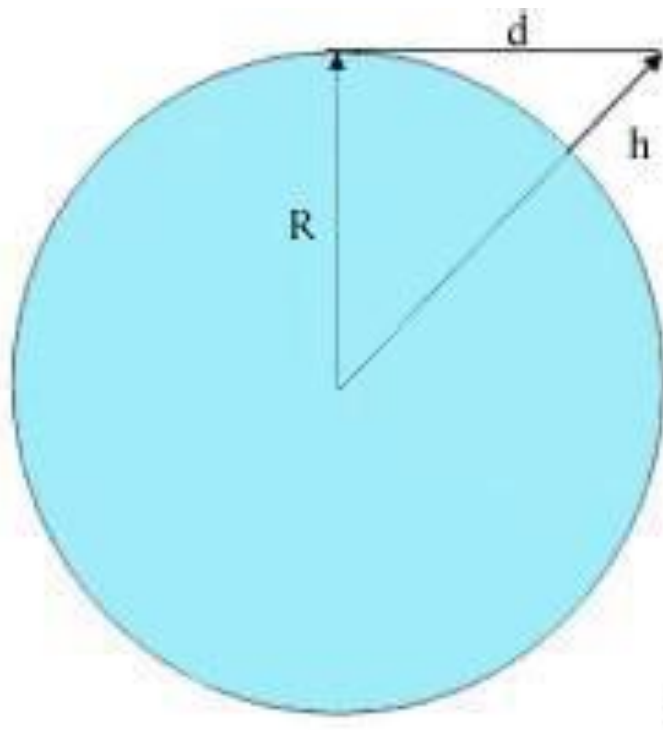
Duration- 20min

Stastic	COLLINEAR ANTENNA	5 Dbi ANTENNA
Distance > 100 Km	100	4
Distance > 150 Km	63	0
Distance > 200 Km	43	0
Maximum	405 Km	128 Km

More is not always better: Radio Horizon

$$d = \sqrt{2.R.h}; R = 6400km, h = 11km$$

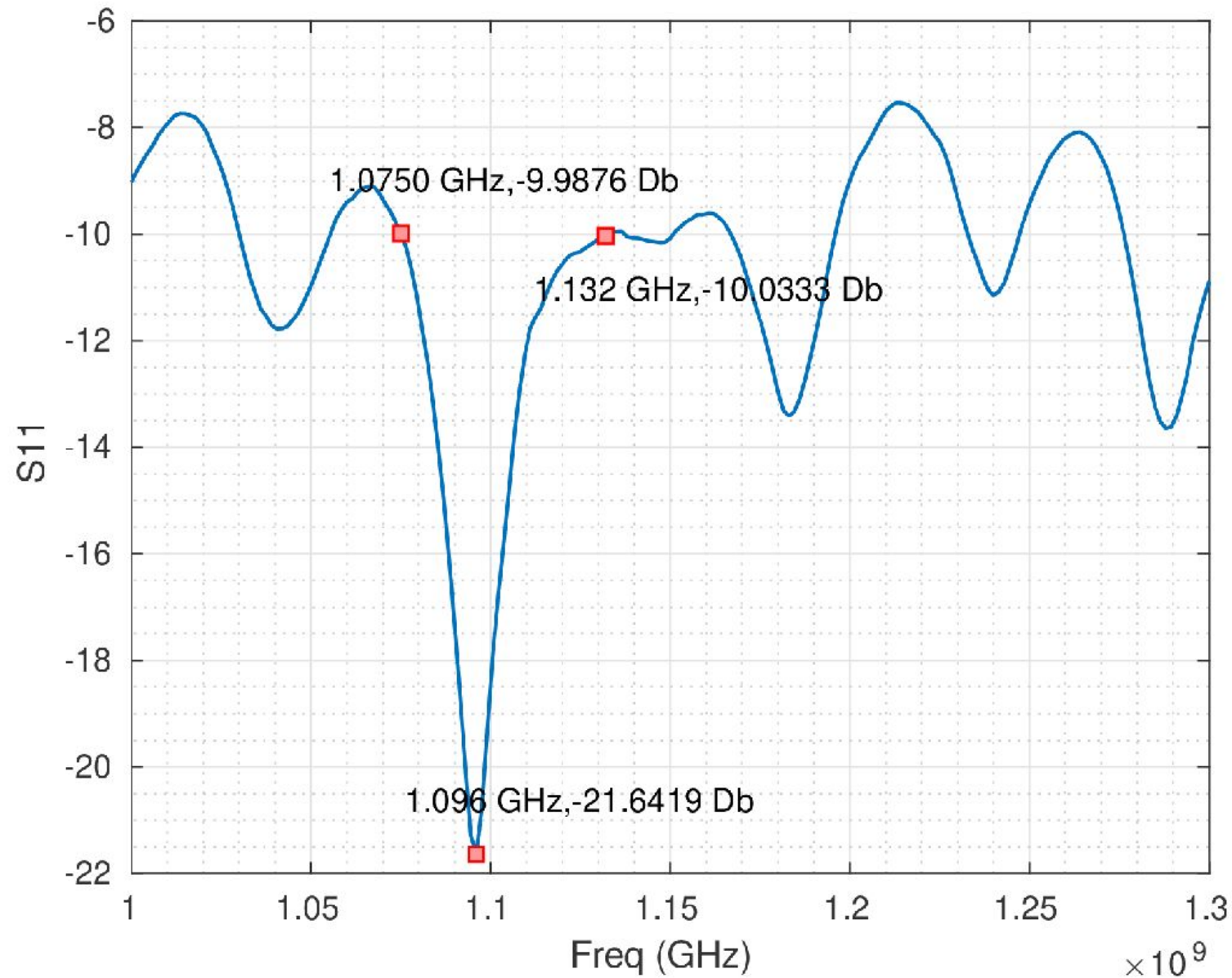
$$d = 375km$$



1090 MHz isn't skywave!

*https://en.wikipedia.org/wiki/Line-of-sight_propagation

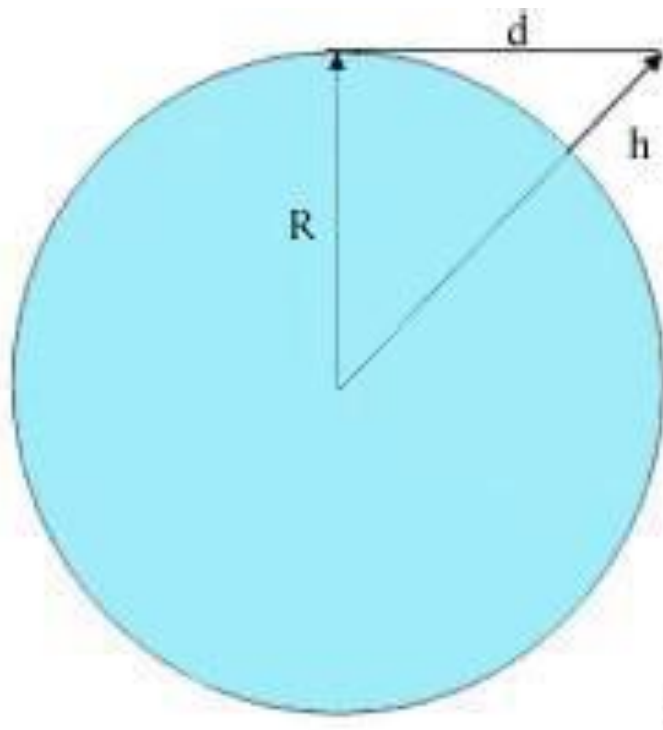
The Antenna, S Params



More is not always better: Radio Horizon

$$d = \sqrt{2.R.h}; R = 6400km, h = 11km$$

$$d = 375km$$



1090 MHz isn't skywave!

*https://en.wikipedia.org/wiki/Line-of-sight_propagation

Open Question

- Can we measure beamwidth by keeping the Antenna horizontal and then drawing a polar plot of the received aircraft signals?

Credit

- Dr. Shobha Sunderram : For the guidance and teaching the course ATD.
- Abhijit Mishra: Incharge, Garage Lab
- Neighbour for leaving Tata Sky Coax Cable unattended.