# AVN Training 2018

# Near Field Mapping of a DSTV Antenna

## 1. Objective

The objective of the experiment is to map the field strength of a signal radiated by a 60cm DSTV antenna. Many of the students are familiar with these antennas, and some of them have installed – even without signal finders.

Intuitively the students expect the field to fall of with an inverse square law, so the first part of the experiment quickly shows them that this is not the case.

## 2. Experimental set up.

The experiment makes use of two relatively non-reflective frames made out of PVC water pipe. The first of these supports an inverted DSTV antenna, i.e. the feed arm is above the antenna, suitably modified to allow the beam to point horizontally. The antenna is fitted with a modified feed from a defunct block converter. This is connected to a frequency synthesiser set to 11.85(?) GHz and an output power level of +10 dBm. Other items provided are a 30m fibre tape measure and a 3m steel tape measure.

The second frame is of similar construction and is fitted with wheels. It carries a power meter and a small Potter feed horn, originally designed to test the XDM HartRAO 15m antenna at 12 GHz. This is used to measure the relative power level at various distances from the DSTV antenna, and to sample the transverse field pattern.

The test should ideally be carried out in the open where there are no significant reflections. Because of possible bad or very hot weather outside, the experiment has usually been carried out in the lecture area behind the control room, after moving chairs out of the way. This allows measurements to be made over a 12m distance.

The DSTV antenna is set up outside the maser room, where there is a convenient mains outlet, with the antenna pointing west. A 30m fabric tape is laid out along the floor in front of the DSTV antenna with the zero mark directly under the mid-point of the antenna aperture. Ensure that the antenna points along the line of he tape.

## 3. Experimental Method.

3.1 Connect the DSTV antenna to the microwave synthesiser with a length of flexible cable terminated with SMA male connectors.

3.2 Place the power meter on the monitoring trolley and secure with a strap. Use a long mains extension cord to power the power meter so that it can be moved along the full length of the tape.

3.3 Position the trolley so that it can move along the fabric with monitoring horn pointing at the centre of the DSTV antenna and so that the aperture of the monitoring horn is above the 50 cm mark on the tape, i.e. 50cm from the centre point of the DSTV antenna aperture.

3.4 The power meter reading should be -20±1 dBm. If the trolley is moved away from the DSTV antenna how will the power vary? Inverse square law?

3.5 Move the trolley away from the DSTV antenna, doubling the distance each time, i.e. to 1m, and then 2m. (Note: expected decrease for square law should be -6dB each time the distance is doubled). Does it follow a square law? NO!

3.6 The rest of the experiment is designed to explore how the measured field in front of the DSTV antenna varies in what is known as the near field or the Freznel zone. Each of the two groups will make measurements at different interleaved distances to save time and provide independent measurements, which can be consolidated in the final analysis.

3.7 To ensure that the DSTV antenna is pointed directly along the fabric tape, move the trolley 8m away from the DSTV antenna and check the power meter readings 70 cm either side of the centre line. They should be equal to within ±1dBm or less. If not adjust the angle of the DSTV antenna until near equal levels are obtained.

3.8 Now position the trolley so that it can move transversely to the tape with the monitoring horn pointing at the DSTV antenna and so that the aperture of the monitoring horn is above the 50 cm mark on the tape, i.e. 50cm from the centre point of the DSTV antenna aperture.

3.9 Record the reading on the power meter on the data sheet provided. The nominal level should be -20±1 dBm. The data sheet is appended in Appendix I.

3.10 Move the trolley in the transverse direction to 70 cm offset from the centre line defined by the tape. Record the power meter (to nearest 0.1 dBm) on the data sheet.

3.11 Move the trolley at 10 cm intervals along the transvers tape, recording the power meter readings at each point until reaching 70 cm on the other side.

3.12 Set up the trolley at the 1m mark on the fabric tape and then move off transversally by 70 cm, and repeat the measurements as in steps step 3.5 and 3.6

3.13 Repeat these measurements at distances of 1.5m, 2m, 3m, 4m, 6m, 8m, and 12m. Note that the change in the power meter reading should be symmetrical either side of the longitudinal fabric tape. If not, it means that the DSTV antenna is not pointing along the line of the fabric tape.

## 4. Analysis of results.

4.1 The analysis of results is most easily achieved by plotting a family of curves displaying each transverse set of measurements superimposed on the same axes. This can be done in an Excel spread sheet or using i-Python notebook. The horizontal axis will be the offset distance, and the vertical axis the measure power output, including the sign.

4.2 Typical results from the previous AVN training session, supplemented by a few additional measurements, are shown in Figure 1.

4.3 One can also plot the on-axis values to see how the signal level changes with distance from the DSTV antenna. This is shown in Figure 2, with distance on a logarithmic scale so that the square law relationship appears as a straight line

## 5. Conclusions.

This experiment demonstrates the nature and behaviour of the radiated field in the vicinity of a 60 cm DSTV antenna. Specifically, close to the antenna the field is radiated as a column of emission equal to the diameter of the antenna. Theory show that the near field extends to a distance given by $2D^2/\lambda$ or for the DSTV antenna at 2.5 cm wavelength, 28.8m. For the 26m antenna, the near field extends many kilometres into the atmosphere.

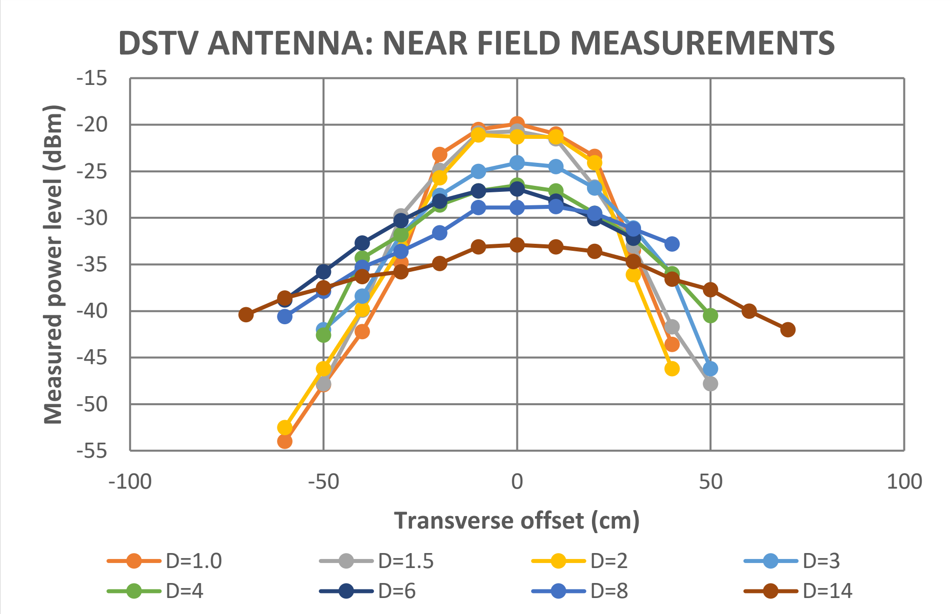


**Figure 1. Transverse near field power measurements for 60 cm DSTV antenna. Note that within the first few metres the power does not spread, but is confined to a column known as the near field or the Freznel diffraction zone. This zone extends typically for a distance of $D^2/(\lambda)$ or 2*0.6*0.6/0.025 = 28.8m.**

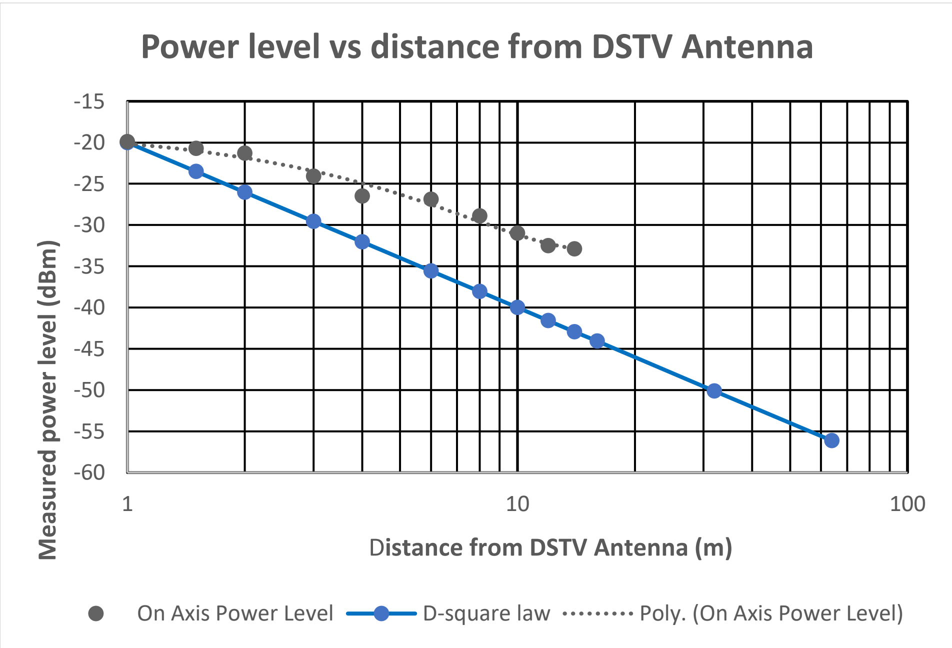


**Figure 2. This figure shows that close to the antenna, the signal level does not decrease as a square law, but remains relatively constant for the first few metres. Only in the far field would one expect the the square law to apply, i.e. at distances > 14 metres.**