LSProbe 1.2 Application Note 8, Measuring Isotropy from 1 to 6 GHz

LUMILOOP GmbH

October 21, 2016

1 Introduction and Experimental Setup

The LSProbe 1.2 E-field probe offers superior sampling speed, accuracy and dynamic range. The field probe's design and calibration guarantee precise field strength measurements if any of the probe's axes is aligned with the field strength vector. This document examines the isotropy of the LSProbe 1.2 E-field probe by measuring x, y, z and magnitude values of the electrical field for different probe orientations.

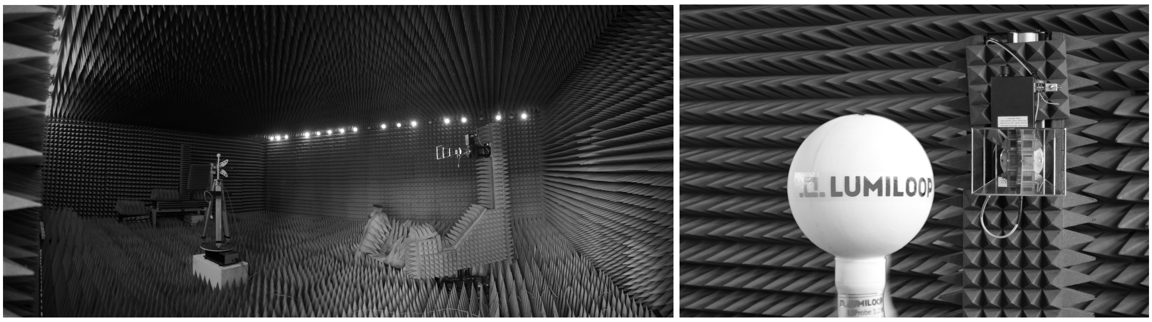


Figure 1: Field probe and ridged horn antenna in anechoic chamber

An LSProbe 1.2, serial number 16, as shown in Fig. 1 is placed in an anechoic chamber approximately three meters from a ridged wide band horn antenna, NSI-RF-RGP-10, pointing directly to the field probe's geometric center. The field probe is placed on to a wooden tripod with the x axis pointing up. The tripod can be rotated remotely by 360 degrees horizontally, the horn antenna's polarization can be controlled remotely from -180 to +180 degrees.

CW signals from 1 GHz to 6 GHz are fed to the horn antenna using an R&S SMB100A RF signal generator. For each frequency the maximum power supported by the signal generator is applied in order to maximize the signal to noise ratio.

Since the described mechanical setup has limited degrees of freedom, measurements are performed by effectively rotating the probe in three planes, see Fig. 2. Field strength measurements are taken at three degree intervals. The field probe is operated in mode 0, which is suitable for frequencies ranging from 30 MHz to 6 GHz. A low-pass cut-off frequency of 100 Hz is used for all measurements. The field probe has a complete set of calibration data consisting of in-house calibration data and accredited calibration data acquired by Teseq GmbH.

2 Experimental Results

Fig. 3 to 8 give the field strength distribution for 1 to 6 GHz. The orientation of each diagram matches the description in Fig. 2.

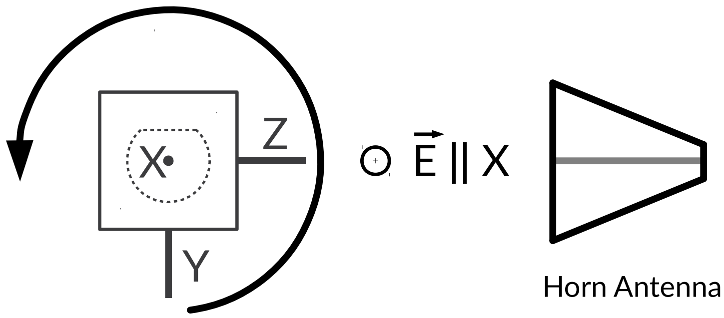
Rotating probe horizontally with vertically polarized $\vec{E}$ as shown in all sub-figures (a) yields next to unity isotropy up to 5 GHz with minor deviations at 6 GHz.

As shown in all sub-figures (c) rotating the polarization of $\vec{E}$ produces almost unity field strength. The observed deviations at 2, 3 and 5 GHz are unlikely to be due to the E-field-probe since the 6 GHz values exhibits a more ideal isotropy. The apparent non-isotropy can probably be attributed to non-ideal chamber and/or antenna characteristics when rotating the horn antenna's polarization.

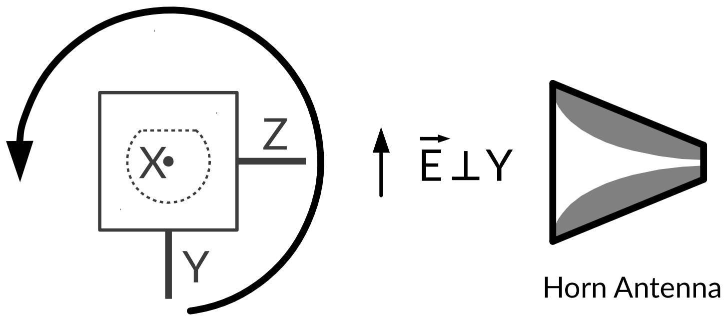
Rotating probe horizontally with horizontally polarized $\vec{E}$ exhibits the largest anisotropy, see sub-figures (b). For 1 GHz and 2 GHz the field probe's anisotropy remains well below 10%. For higher frequencies the field probe becomes increasingly anisotropic. A major lobes of increased field strength is observed at 45 degrees, minor lobes are observed around 150 and 330 degrees respectively. The peak values for 3, 4, 5, and 6 Ghz are approximately 30, 50, 60 and 70 percent.

3 Conclusions

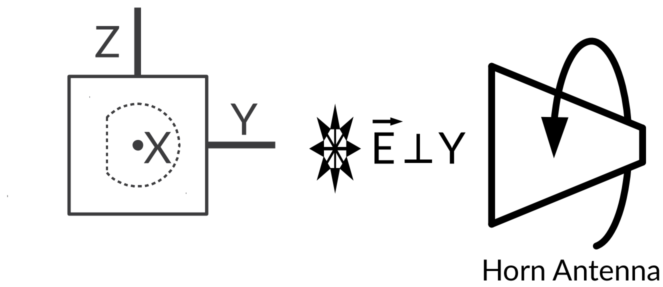
The LSProbe 1.2 E-field probe shows the directional characteristics to be expected from a triple monopole field probe of its dimensions. The body of the probe is a 21x21x21 mm^3 cube. The probe's monopoles have a length of 10 mm. The field probe has been shown to have good isotropic characteristics up to approximately 2 GHz. As expected, anisotropy



(a) Rotating probe horizontally with vertically polarized $\vec{E}$

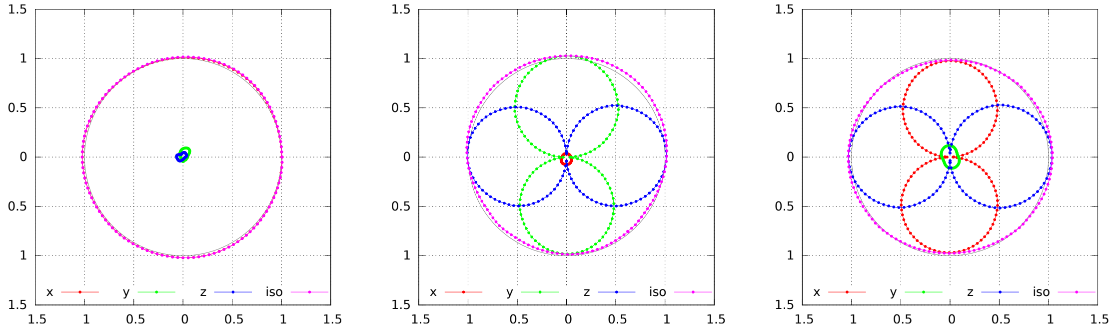


(b) Rotating probe horizontally with horizontally polarized $\vec{E}$



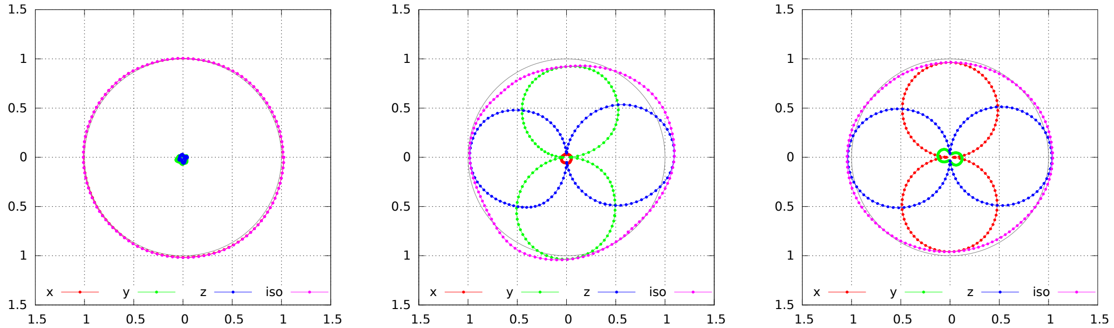
(c) Rotating the polarization of $\vec{E}$

Figure 2: Effective probe rotation in three orthogonal rotational planes



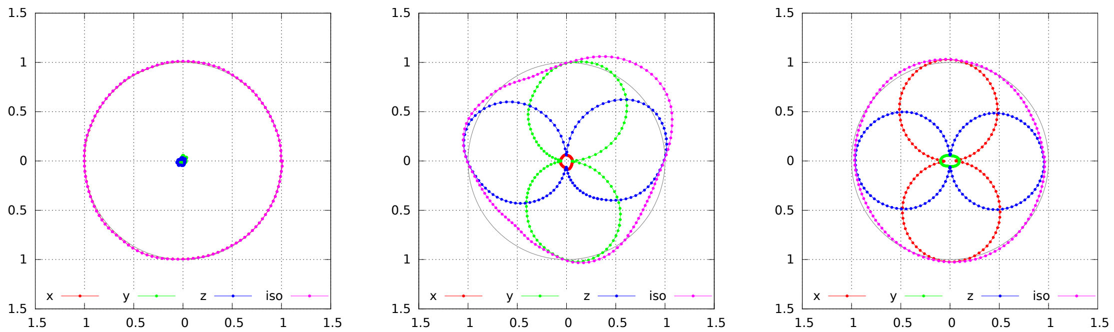
(a) (b) (c)

Figure 3: Normalized field strength at 1 GHz, orientation as shown in Fig. 2



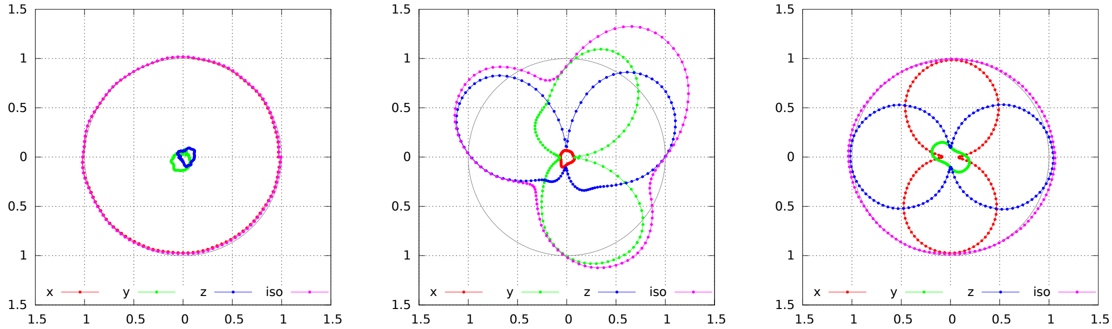
(a) (b) (c)

Figure 4: Normalized field strength at 2 GHz, orientation as shown in Fig. 2



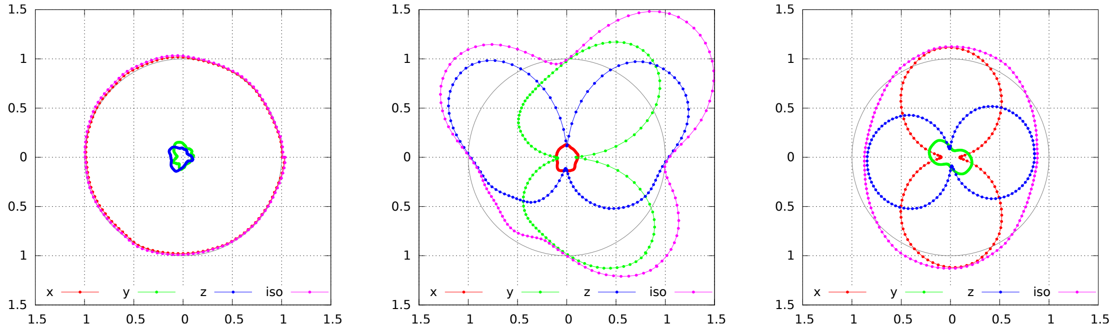
(a) (b) (c)

Figure 5: Normalized field strength at 3 GHz, orientation as shown in Fig. 2



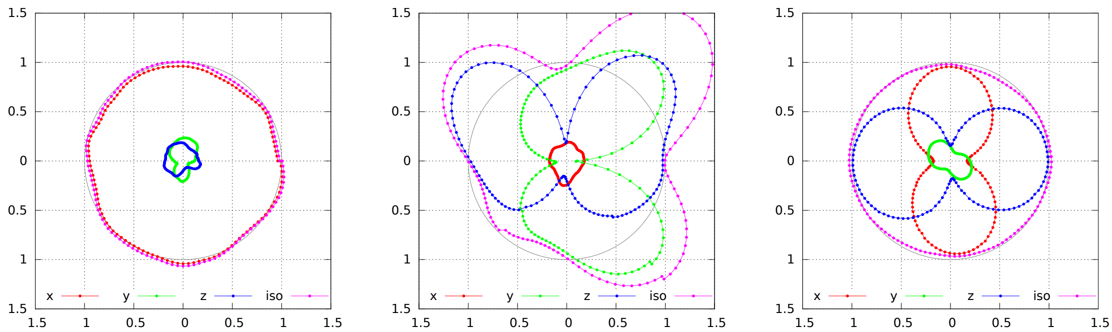
(a) (b) (c)

Figure 6: Normalized field strength at 4 GHz, orientation as shown in Fig. 2



(a) (b) (c)

Figure 7: Normalized field strength at 5 GHz, orientation as shown in Fig. 2



(a) (b) (c)

Figure 8: Normalized field strength at 6 GHz, orientation as shown in Fig. 2

increases significantly for higher frequencies. Aligning any axis of the field probe with the field strength vector $\vec{E}$ yields unity field strength.

The measurement results presented in this document have been obtained in an anechoic chamber that has not been characterized for this type of measurement. Only equipment readily available has been employed in the course of the experiments. Aligning the horn antenna, the field probe and the rotating platform is especially prone to error.

All results should thus be treated as preliminary measurements and be repeated for a larger number of angles and a defined reference field strength. Employing an antenna with higher gain and better polarization characteristics would also be beneficial.

4 Acknowledgement

We thank the Chair for High-Frequency Engineering of the TU Dresden, especially Mr. Wolf, for their kind support in the course of the experiments in their anechoic chamber.