University of Cassino and Southern Lazio

Antennas and Radiowave Propagation - 2018

Prof. M.D.Migliore

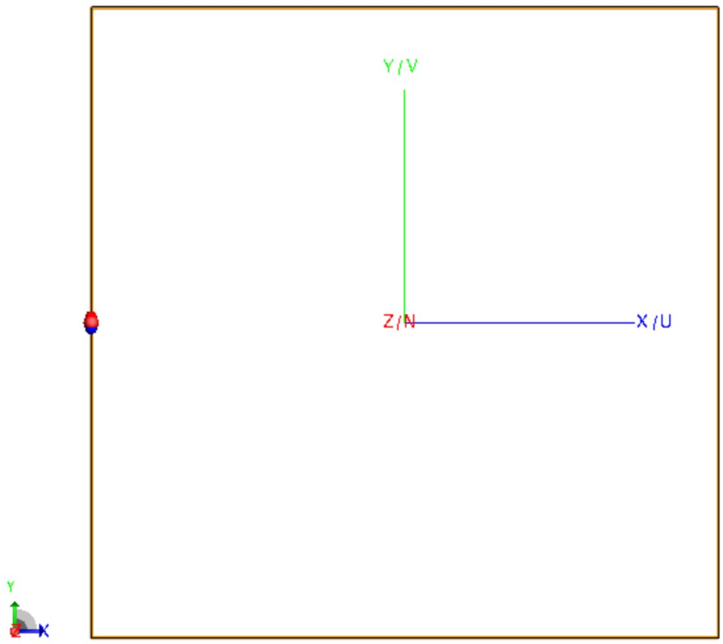
PROJECT REPORT

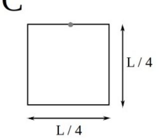
STUDENT NAME:	DIEGO TUZI
University ID:	50435

Antenna Element Type	C – “Coil” Antenna	C2
Array Layout #	2	
Frequency f_0	2.5 GHz	
Input impedance Z_0	150 Ohm	
Wire radius *a*	0.08mm	

SECTION 1	**Design of the radiating element to exploit the minimum reflection coefficient at f_0**	**Up to 3 points**

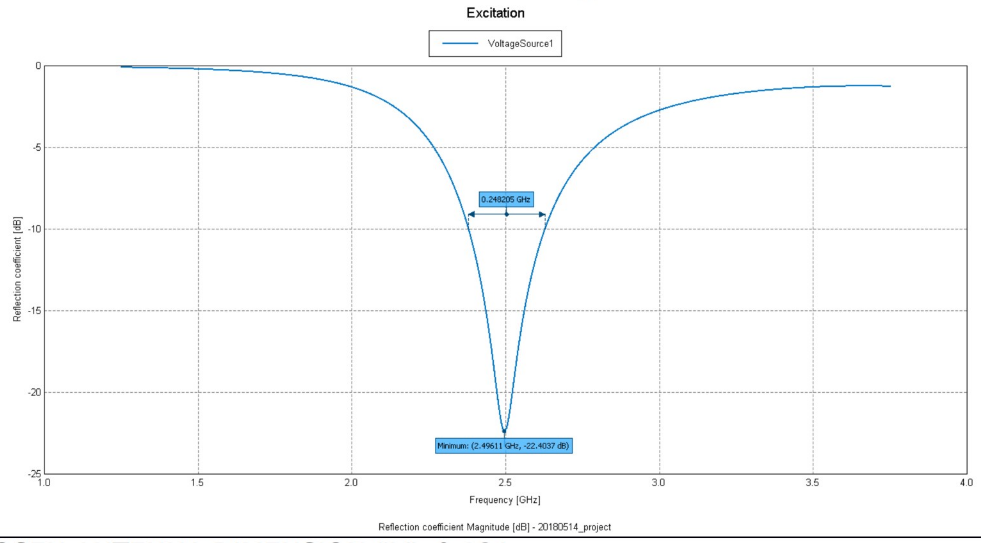
PLOT OF THE DESIGNED ANTENNA ELEMENT





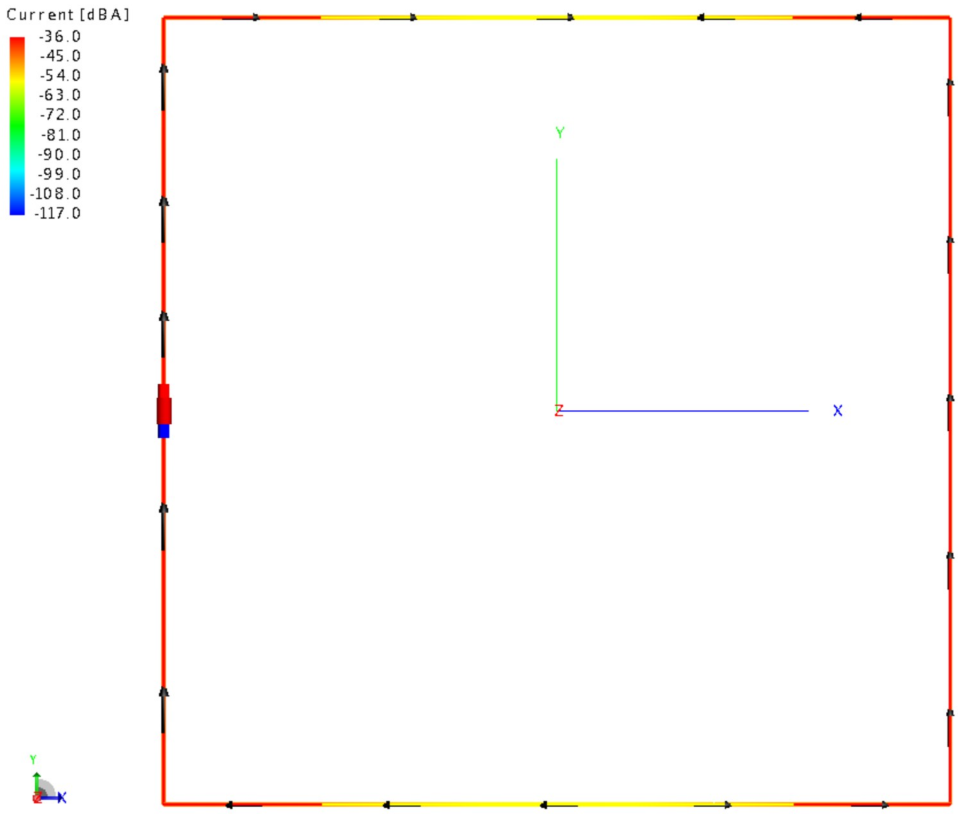
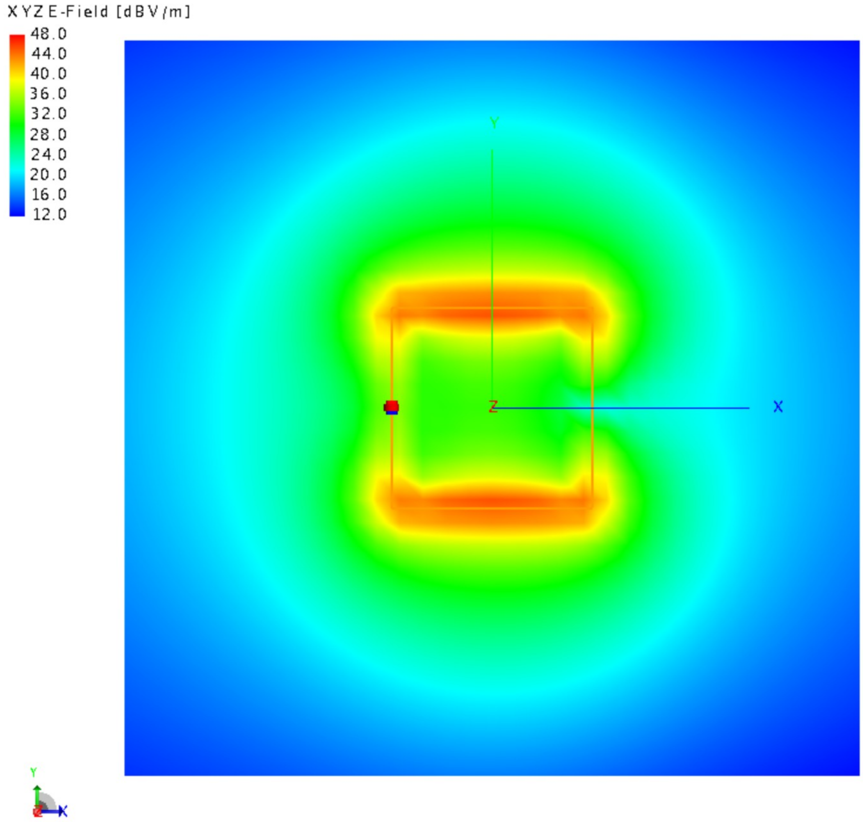
REFLECTION COEFFICIENT PLOT

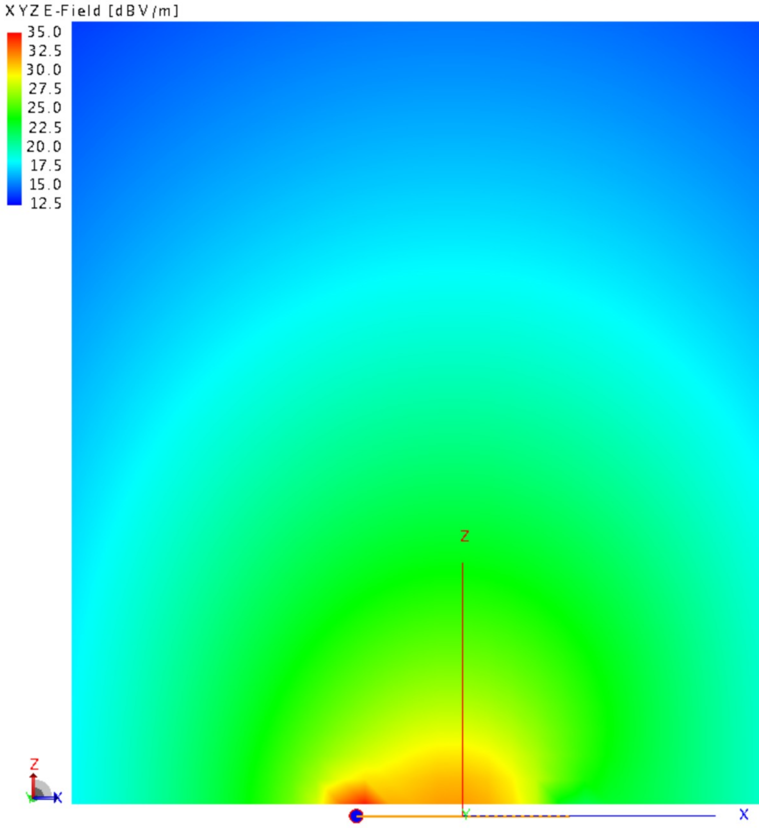
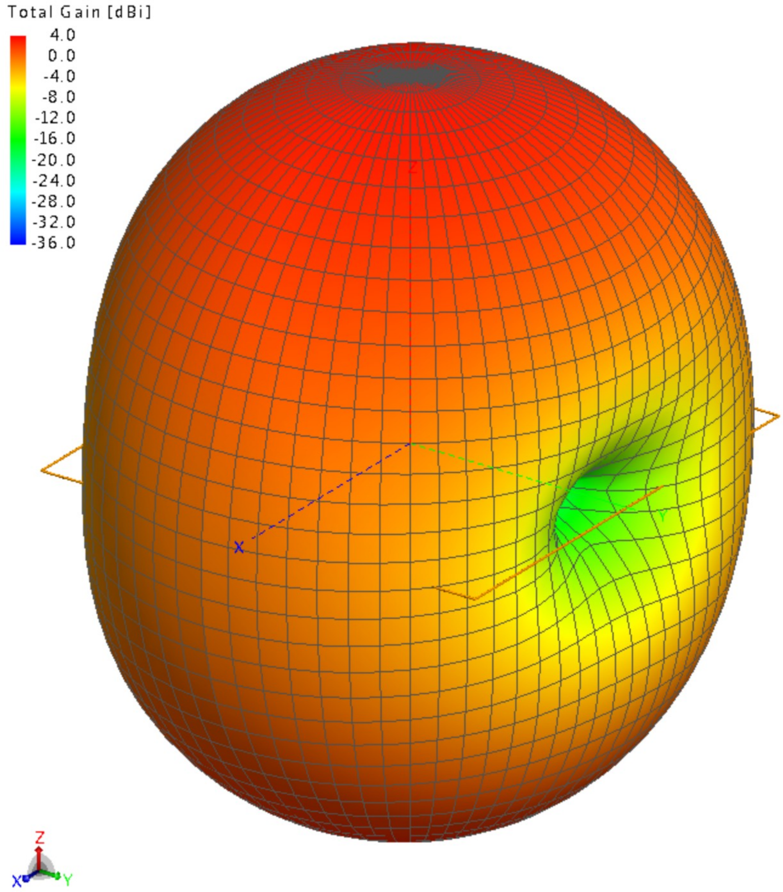
MINIMUM REFLECTION COEFFICIENT: -22.4 dB @ 2.5 GHz



CHOSEN ANTENNA DIMENSION “L”: 0.131m

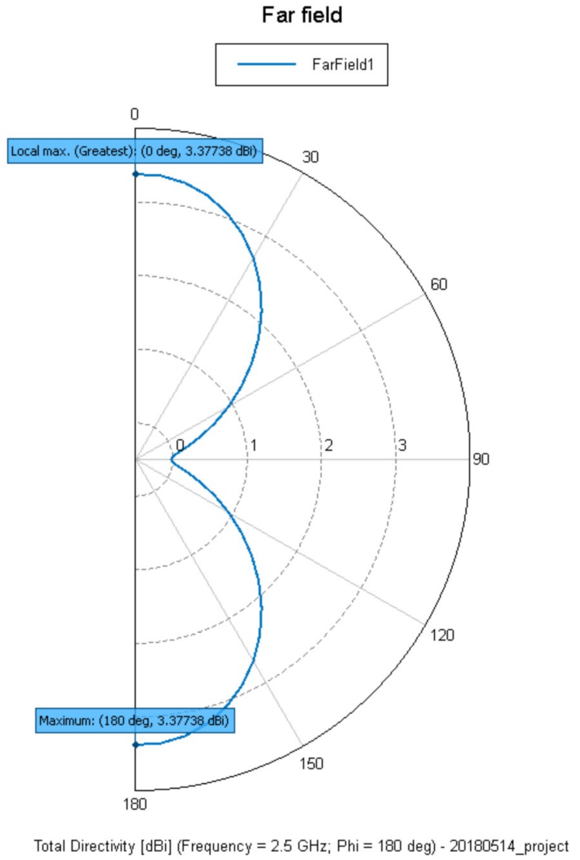
-10dB REFLECTION COEFFICIENT FRACTIONAL BANDWIDTH: 0.1

<table>
<tr><td rowspan="2">SECTION 2</td><td>Provide plots for the currents on the wires / surfaces</td><td>Up to 1 point</td></tr>
<tr><td colspan="2">CURRENT PLOT

</td></tr>
<tr><td rowspan="2">SECTION 3 (part1)</td><td>Provide plots for the near field, far field
Calculate the maximum directivity at f_0</td><td>Up to 2 points</td></tr>
<tr><td colspan="2">NEAR FIELD PLOT (XY-cut, top view)
$$x \in \left(-\frac{\lambda_0}{2}, \frac{\lambda_0}{2}\right) \wedge y\left(-\frac{\lambda_0}{2}, \frac{\lambda_0}{2}\right) \wedge z = -\frac{\lambda_0}{64}$$

</td></tr>
</table>

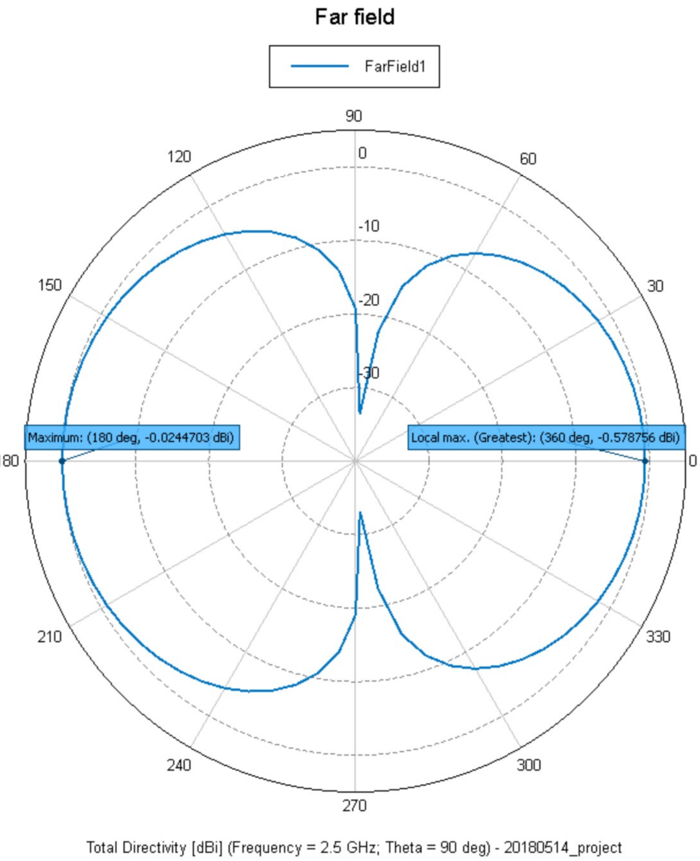
SECTION 3 (part2)	NEAR FIELD PLOT (XZ-cut, side view) $x \in \left(-\frac{\lambda_0}{2}, \frac{\lambda_0}{2}\right) \wedge y=0 \wedge z \in \left(\frac{\lambda_0}{64}, \frac{\lambda_0}{64}+\lambda_0\right)$ 
	3D FAR FIELD PLOT 

SECTION 3 (part3)

POLAR FAR FIELD PLOT (Phi cut at 180°)



POLAR FAR FIELD PLOT (Theta cut at 90°)



MAXIMUM DIRECTIVITY OF THE ANTENNA ELEMENT:

- 3.38 dBi @ ϑ=0°;
- 3.38 dBi @ ϑ=180°;

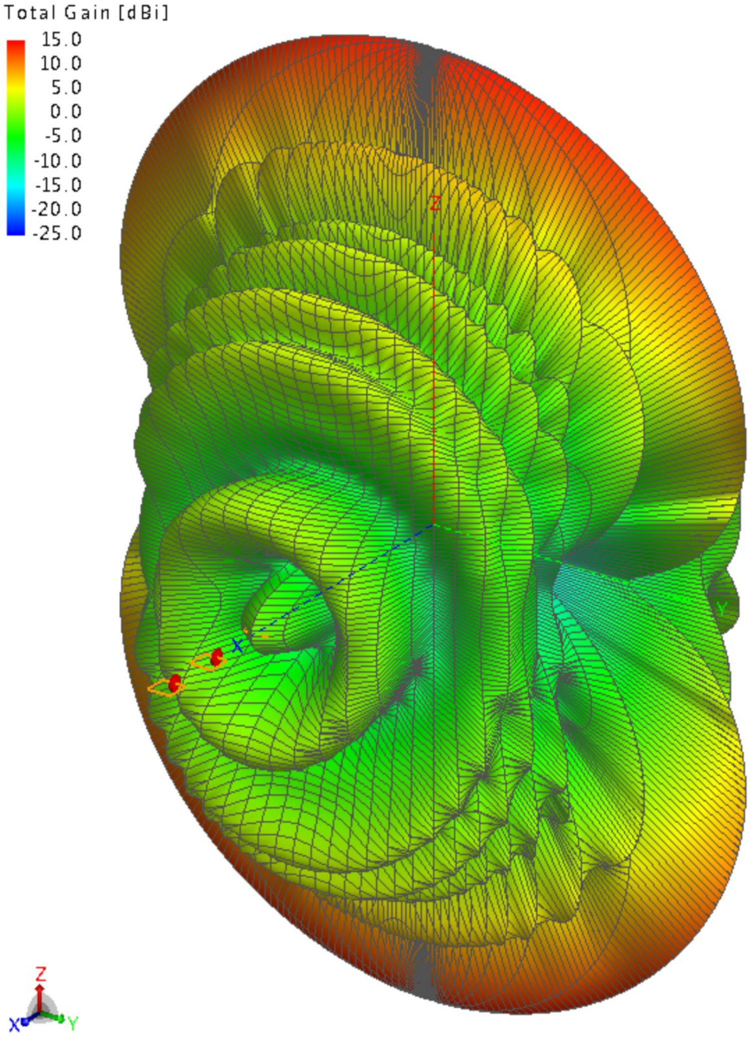
SECTION 4 (part 1)

Plot the array far-field and provide the maximum directivity for the broadside beam

Array Element Positions (normalized to the wavelength):
r= [-4.633222, -3.785787, -3.080594, -1.738782, -0.736516, 0.708019, 1.208061, 2.940615, 3.872522, 4.596599];

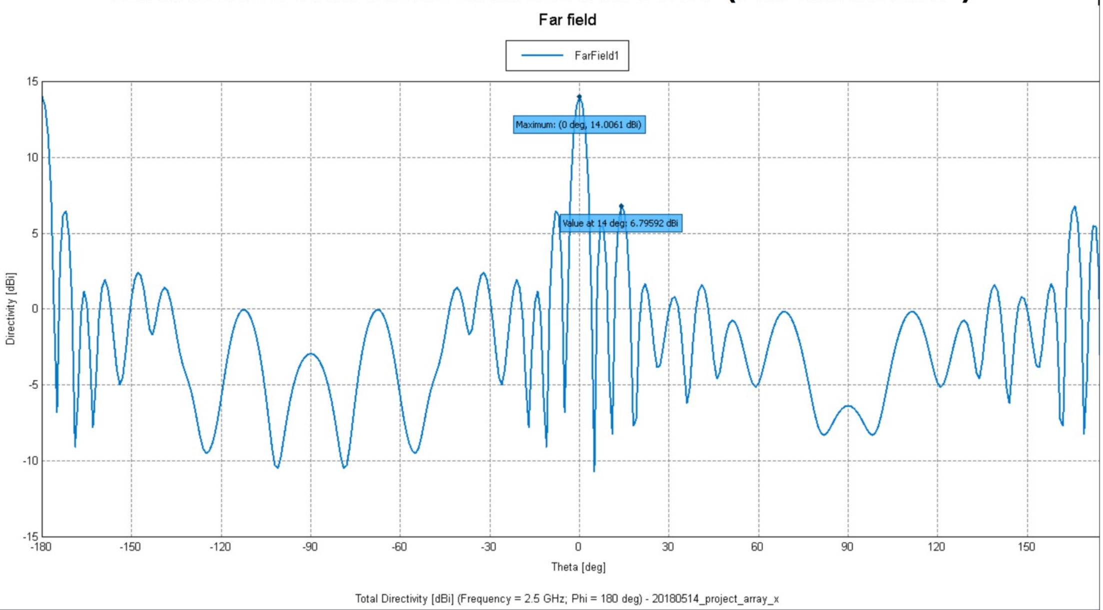
Up to 2 points

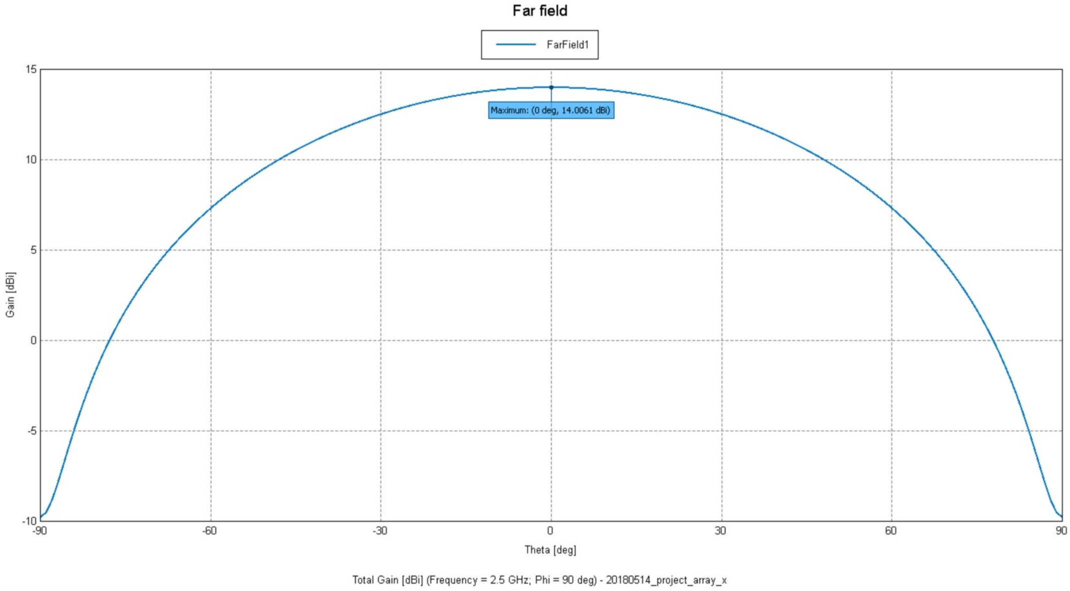
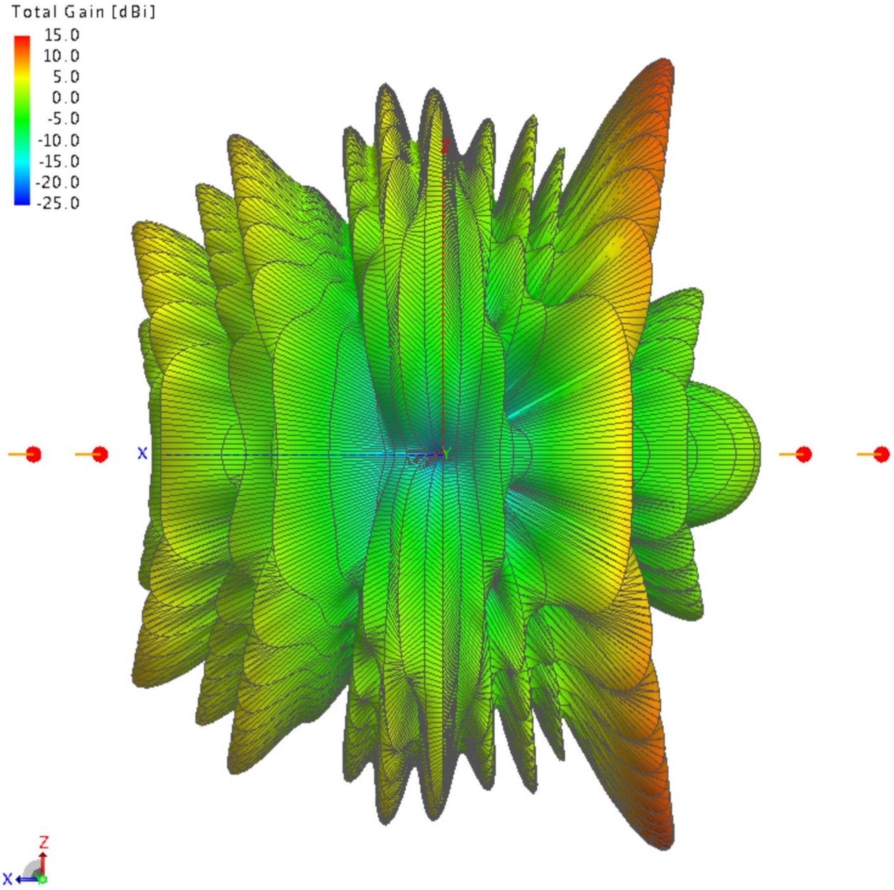
BROADSIDE FAR FIELD 3D PLOT



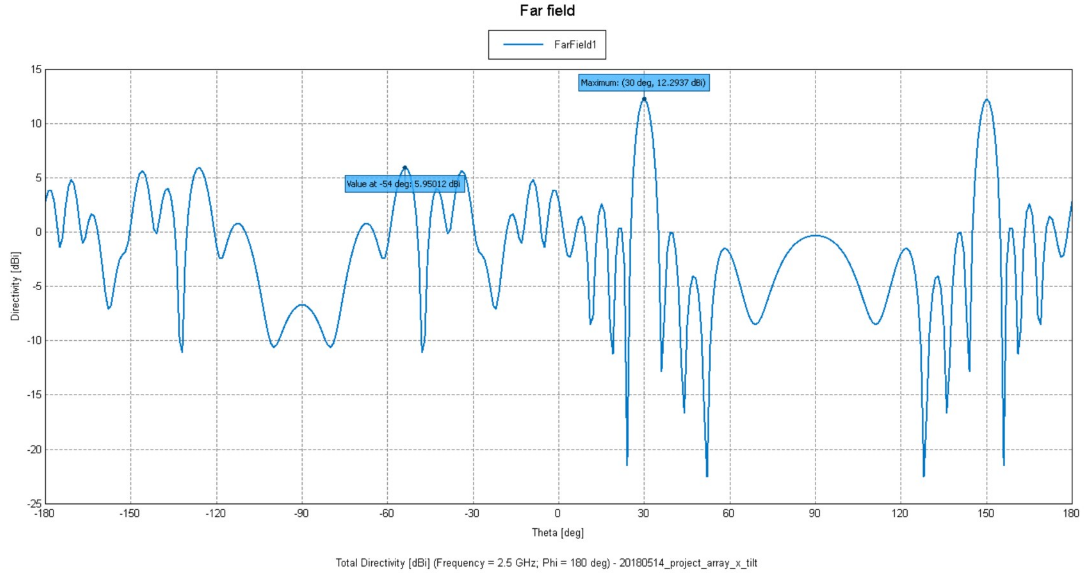
BROADSIDE DIRECTIONS: ϑ=0° AND ϑ=180°.

BROADSIDE FAR FIELD CARTESIAN PLOT (Phi cut at 180°)



<table>
<tr><td rowspan="2">SECTION 4
(part 2)</td><td colspan="2">BROADSIDE FAR FIELD CARTESIAN PLOT (Phi cut at 90°)

</td></tr>
<tr><td colspan="2">MAXIMUM DIRECTIVITY OF THE ARRAY FOR THE BROADSIDE BEAM:
• 14 dBi @ $\vartheta=0°$,$\vartheta=180°$;
SLL OF THE ARRAY FOR THE BROADSIDE BEAM:
• -7.2 dBi @ $\vartheta=14°$.</td></tr>
<tr><td rowspan="2">SECTION 5
(part 1)</td><td>Calculate the array far-field and provide the maximum directivity for the beam scanned in $\theta_1 = \pi/6$ and direction</td><td>Up to 1 point</td></tr>
<tr><td colspan="2">SCANNED FAR FIELD 3D PLOT

</td></tr>
</table>

SCANNED FAR FIELD CARTESIAN PLOT



[PROVIDE MAXIMUM DIRECTIVITIES AND SLL OF THE ARRAY FOR THE SCANNED BEAM]

MAXIMUM DIRECTIVITY OF THE ARRAY FOR THE SCANNED BEAM:

- 12.3 dBi @ ϑ=30°,ϑ=150°;

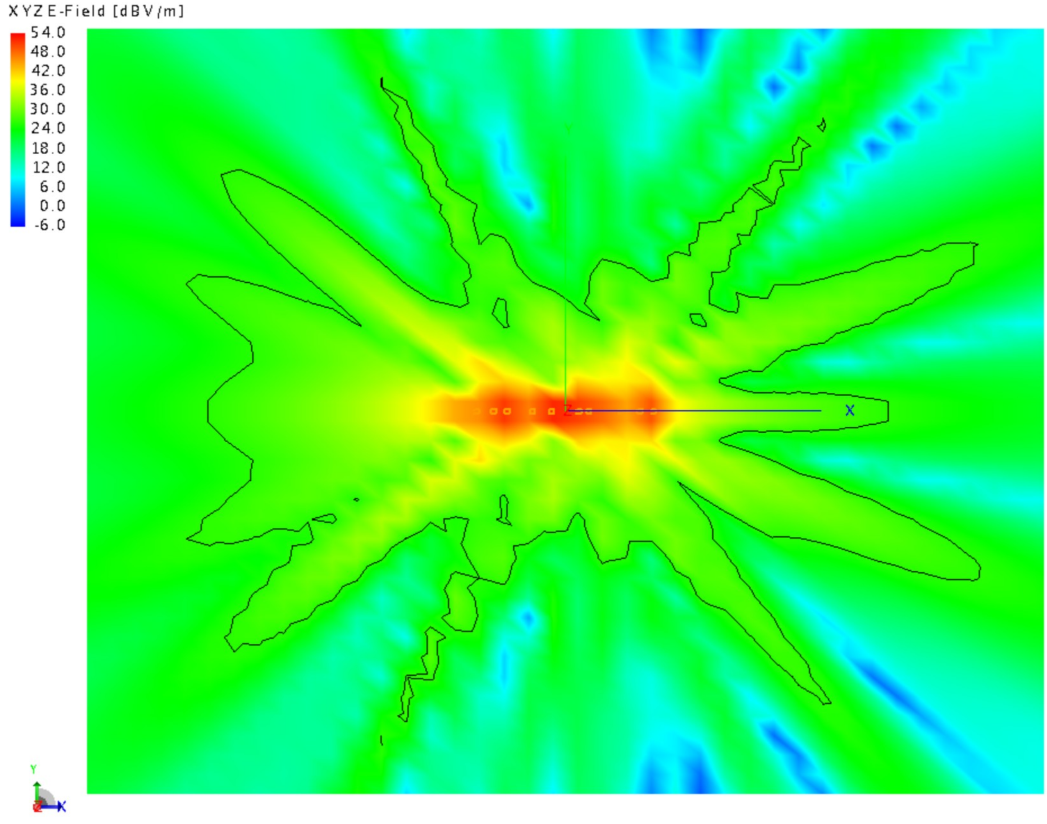
SLL OF THE ARRAY FOR THE SCANNED BEAM:

- -6.34 dBi @ ϑ=-54°.

SECTION 6 (part 1)	Supposing an overall radiated power of 100W, using the near field plots, calculate for the broadside beam the approximate size of the region including the antenna for which we have |E|>20V/m	Up to 1 point

NEAR FIELD PLOT CUT XY (top view - contours at 26dBV/m)

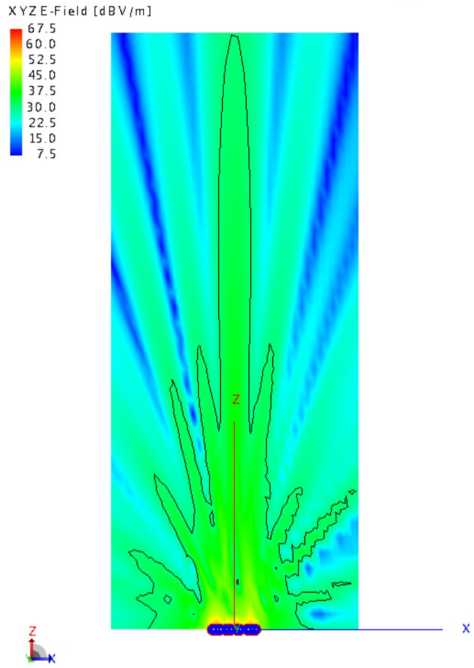
$$x \in (-25\cdot\lambda_0, 25\cdot\lambda_0) \wedge y \in (-20\cdot\lambda_0, 20\cdot\lambda_0) \wedge z = \frac{\lambda_0}{16}$$



SECTION 6 (part 2)

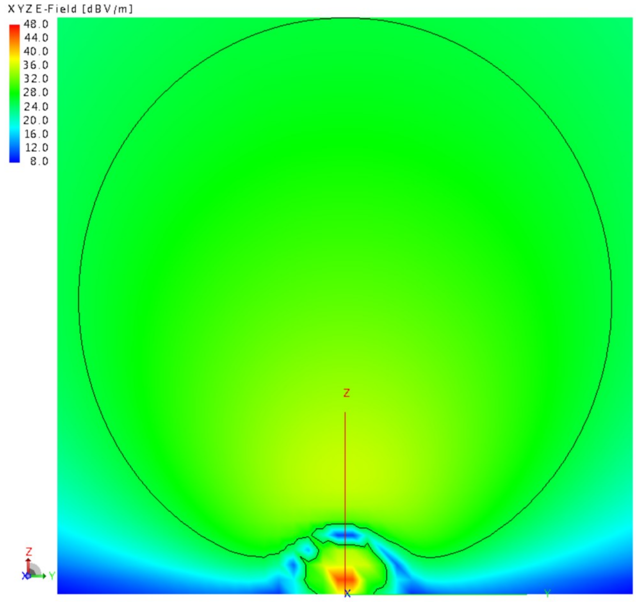
NEAR FIELD PLOT CUT XZ (side view - contours at 26dBV/m)

$$x\in(-27\cdot\lambda_0,27\cdot\lambda_0)\wedge y=0\wedge z\in(\frac{\lambda_0}{16},130\cdot\lambda_0)$$



NEAR FIELD PLOT CUT YZ (front view - Contours at 26dBV/m)

$$x=0\wedge y\in(-65\cdot\lambda_0,65\cdot\lambda_0)\wedge z\in(\frac{\lambda_0}{16},130\cdot\lambda_0)$$



DISCUSS THE RESULT

From NEAR FIELD PLOT CUT XY:

- |E|>20V/m in $x\in(-25\cdot\lambda_0,25\cdot\lambda_0)\wedge y\in(-20\cdot\lambda_0,20\cdot\lambda_0);$

From NEAR FIELD PLOT CUT XZ:

- |E|>20V/m in $x\in(-27\cdot\lambda_0,27\cdot\lambda_0)\wedge z\in(-0,130\cdot\lambda_0);$

From NEAR FIELD PLOT CUT YZ:

- |E|>20V/m in $y\in(-65\cdot\lambda_0,65\cdot\lambda_0)\wedge z\in(-0,130\cdot\lambda_0).$

From previous considerations a raw approximation is the following:
|E|>20V/m in $x\in(-27\cdot\lambda_0,27\cdot\lambda_0)\wedge y\in(-65\cdot\lambda_0,65\cdot\lambda_0)\wedge z\in(-130\cdot\lambda_0,130\cdot\lambda_0);$
Being $\lambda_0=0.12\,m$ a raw approximation is the following:
|E|>20V/m in $x\in(-3.24,3.24)\wedge y\in(-7.79,7.79)\wedge z\in(-15.59,15.59)\,meters.$

Attachments:

- 20180529_project_single_element.zip with the FEKO files for the single element project;
- 20180529_project_array.zip with the FEKO files for the array project.

Notes:

- Projects realized using Altair FEKO 2017.2 Student Edition

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