Title of the MSc Project

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by

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Abstract

To be written...

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Chapter 1

Micro Project

1.1 Objectives

A one-week project with the aim to assess the MATLAB programming experience and the antenna array knowledge of the MSc student candidate.

1.2 Tasks

1. Write a MATLAB function that computes the far field function of a short electrical dipole antenna placed $\lambda/4$ above a PEC ground plane.
   Input parameters: θ and ϕ observation angles, excitation current I.
   Output parameters: vector far-field function $\boldsymbol{G}(\theta, \phi) = G_\theta(\theta, \phi)\hat{\boldsymbol{\theta}} + G_\phi(\theta, \phi)\hat{\boldsymbol{\phi}}$.
   Hint: cf. chapter 5.1.13

2. Write a MATLAB function that computes the total radiated power through numerical integration.
   Input parameters: far-field function $\boldsymbol{G}(\theta, \phi)$.
   Output parameters: the radiated power P_{rad}.
   Hint: cf. chapter 2.3.8

3. Write a MATLAB function that plots the normalized far-field pattern in dBi for the

E- and H-plane cuts.
Input parameters: $\boldsymbol{G}(\theta, \phi)$, observation angles.
Output parameters: a plot of the power pattern E- and H-plane cuts in dBi.
Hint: for the normalization in dBi you will need P_{rad}, cf. chapter 2.3.9

4. Write a MATLAB function that computes the far-field function of an N-element dipole antenna array.
   Input parameters: matrix with antenna positions

$$\begin{bmatrix} x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \\ & \vdots & \\ x_N & y_N & z_N \end{bmatrix} \tag{1.1}$$

   vector of excitation currents $[I_1, I_2, \ldots, I_N]$.
   Output parameters: $\boldsymbol{G}(\theta, \phi)$ for the entire array beam.
   Hint: cf. chapter 10.1.1, 10.3.1

5. Write a MATLAB function that computes the phased array excitation vector in order to scan the array to a certain direction.
   Input parameters: scan angle (θ_0, ϕ_0).
   Output parameters: excitation vector $[I_1, I_2, \ldots, I_N]$.
   Hint: cf. chapter 10.1.4,10.3.3

6. Using the pattern plotting function of point 3, observe the array pattern of a uniform linear array of 5 dipoles in a side-by-side configuration when:

   - the beam is scanned scanned in the H-plane, element spacing is $d = 2/3\lambda$.
   - the beam is pointed broadside, element spacing is swept from $d = \lambda/4$ to 4λ

1.3 Report

Report the above results in this LaTeX document (this MSc template report): present it in a narrative way following the above points 1-6, while including and describing the results/plots, include the MATLAB scripts, and present it orally. The work is possible to finish in one week, if not, try to complete as many items as possible.

1.4 References

- Foundations of Antennas: A Unified Approach, Per-Simon Kildal, 2014
- MATLAB, The MathWorks Inc., Natick, MA, 200