LULEÅ UNIVERSITY OF TECHNOLOGY
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F7003R Optics and Radar Based Observations, 7.5 ECTS

Problems Part 5 (3 points)
Optimization of phased array antenna radiation pattern and array configuration

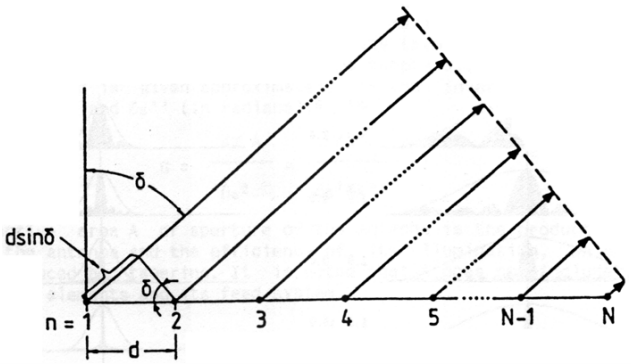
Configure a phased array consisting of 64 lined up individual isotropic antennas with the composite main antenna beam into vertical direction. Operational frequency is 52 MHz. Design a Matlab code basing on the governing equation (1) (J. Röttger, The Instrumental Principles of MST Radars, Ch. 2.1) and investigate how the radiation pattern changes if the following parameters are modified:

1. Ratio of the wavelength to the distance between individual elements. Find the optimal distance between the elements.
2. Number of antenna elements.
3. Spatial weighting.
4. Make a conclusion about the optimal design for your antenna array.
5. Determine the maximum and the width of the main lobe.

Discuss the following questions:

6. How does the radiation pattern change when the beam is not pointed vertically?
7. What is the electrical weighting? When can this method be applied? Would it be suitable to use it for your antenna?

$$E(\delta) = \sum_n E(\delta)_n \, exp\left(i\left(\frac{2\pi(n-1)d}{\lambda} sin\delta + \varphi_n\right)\right) \quad (1)$$



Schematic drawing of wave vectors of a plain wave radiated under a zenith angle δ from N isotropic antenna elements with spacing d.

The answers should be supported by the relevant Matlab plots. Matlab codes should be enclosed.

Please note that using “copy-paste” techniques will result in report rejection. Plagiarism will be reported to LTUs lawyer according to the Swedish national legislation.