Antenna Lab Three

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Listings

1 Introduction

This report showcases the results of plotting the radiation patterns of both Binomial and Tshebysceff antenna arrays on MATLAB. All the simulation files and MatLAB codes used to produce this result can be found in the lab's Github Repository.

2 Binomial Array

2.1 MATLAB Code

```matlab
%% Initial Parameters
% Wavelength
f=3e8;
c=3e8;
lambda=c/f;
beta = (2 * pi) / lambda;
theta = 0 : 0.01 : (2 * pi);
phi = 0 : 0.01 : (2 * pi);

% Number of Elements (N), Elements' Spacing (d), and Progressive Phase
    Shift (alpha)
N = input('Enter the Number of Elements (N): ');
alpha = input('Enter the Progressive Phase Shift (alpha): ');
d = input('Enter the Spacing between Elements w.r.t Lambda (d): ');
d = d * lambda;

% Defining psi && u
psi = alpha + (beta * d * cos(theta));
u = psi / 2;

%% Normalized Array Factor (AF_n)
AF_n = cos(u) .^ (N - 1);

%% Plotting AF_n vs u
figure(1)
plot(u , abs(AF_n));
title('AF vs. u');

%% Plotting 2D Radiation Pattern of the Array
figure(2)
polarplot(theta, abs(AF_n));
title('2D Radiation Pattern of the Array');

%% Plotting 3D Radiation Pattern
[THETA PHI] = meshgrid(theta , phi);
psi = alpha + (beta * d * cos(THETA));
u = psi / 2;
AF_n = cos(u) .^ (N - 1);

X = AF_n .* sin(THETA) .* cos(PHI);
Y = AF_n .* sin(THETA) .* sin(PHI);
Z = AF_n .* cos(THETA);

figure(3)
mesh(X,Y,Z)
title('Binomial Array - 3D');
```

Code Snippet 1: Binomial Array Code

2.2   Results

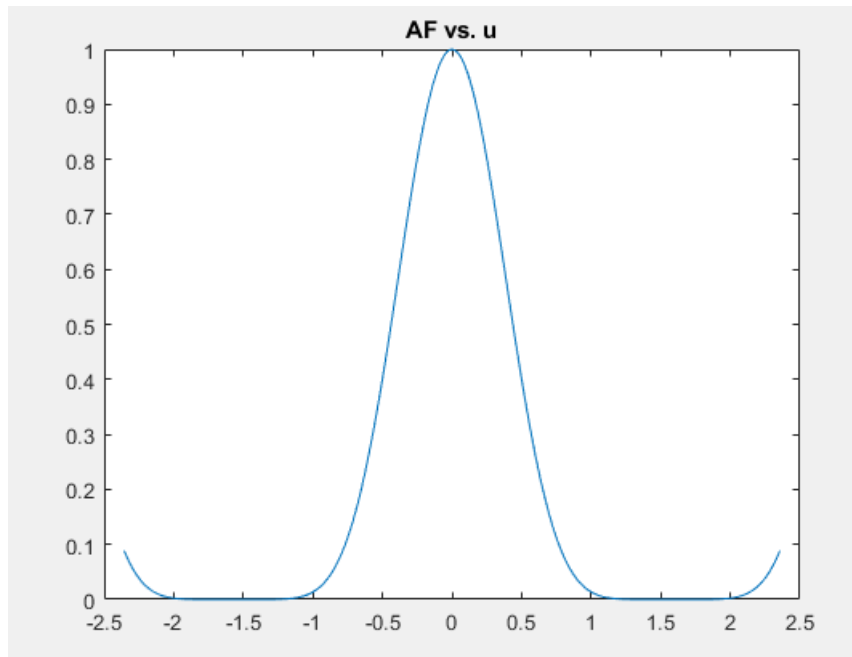Figure 1: Binomial Array $\boldsymbol{AF}$ vs $\boldsymbol{u}$ - Example 1
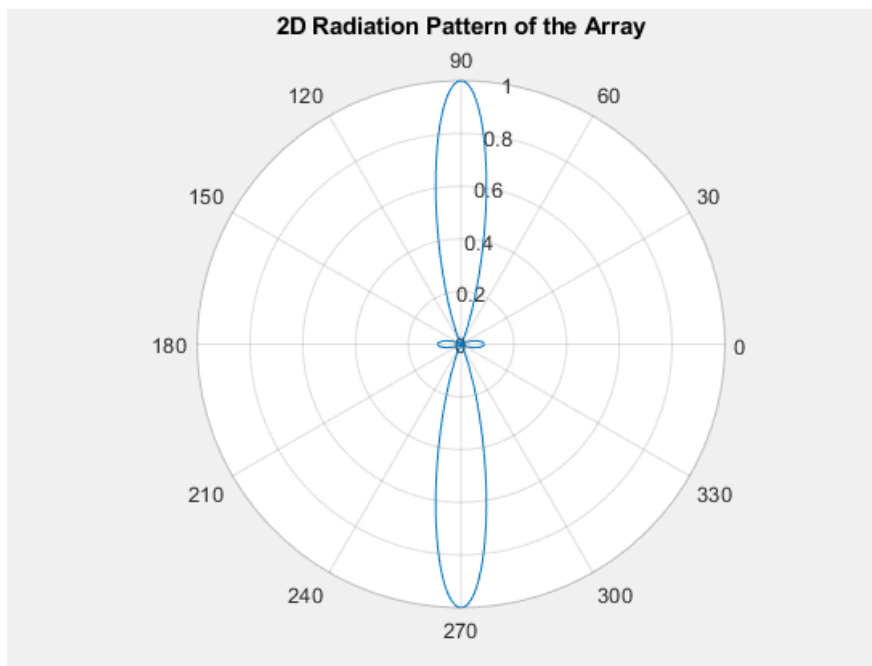

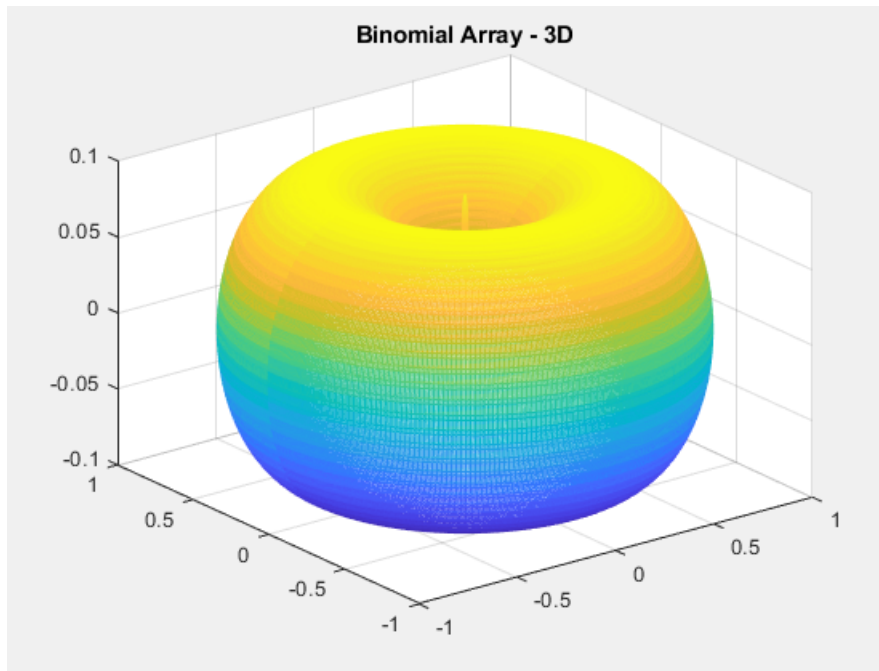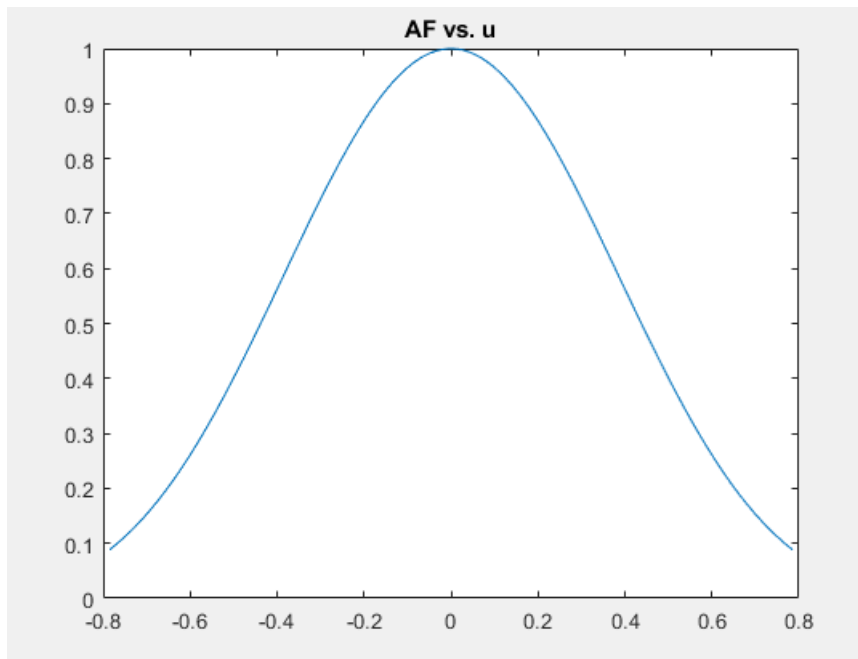Figure 2: Binomial Array 2D Radiation Pattern - Example 1

Figure 3: Binomial Array 3D Radiation Pattern - Example 1
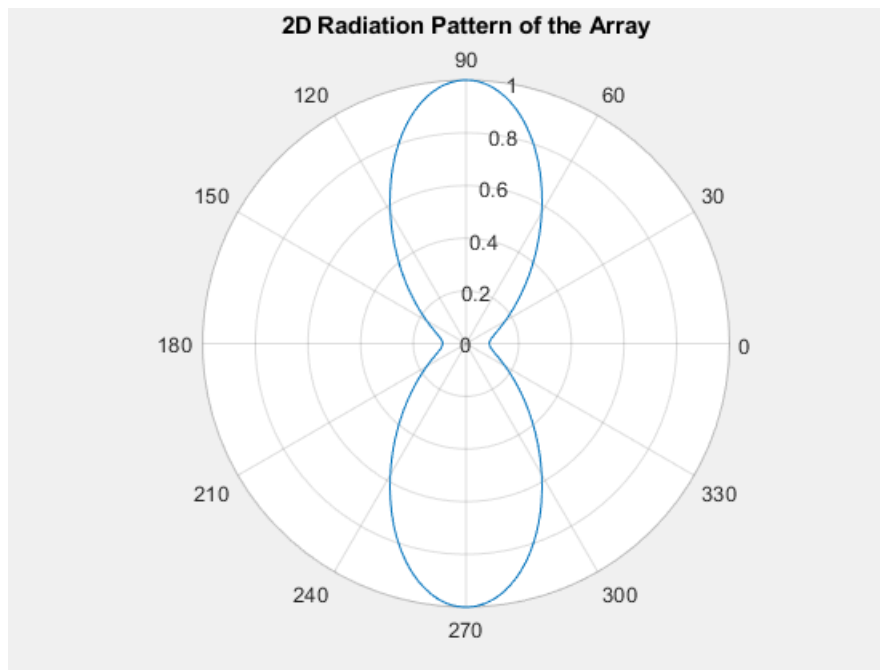

Figure 4: Binomial Array *AF* vs *u* - Example 2

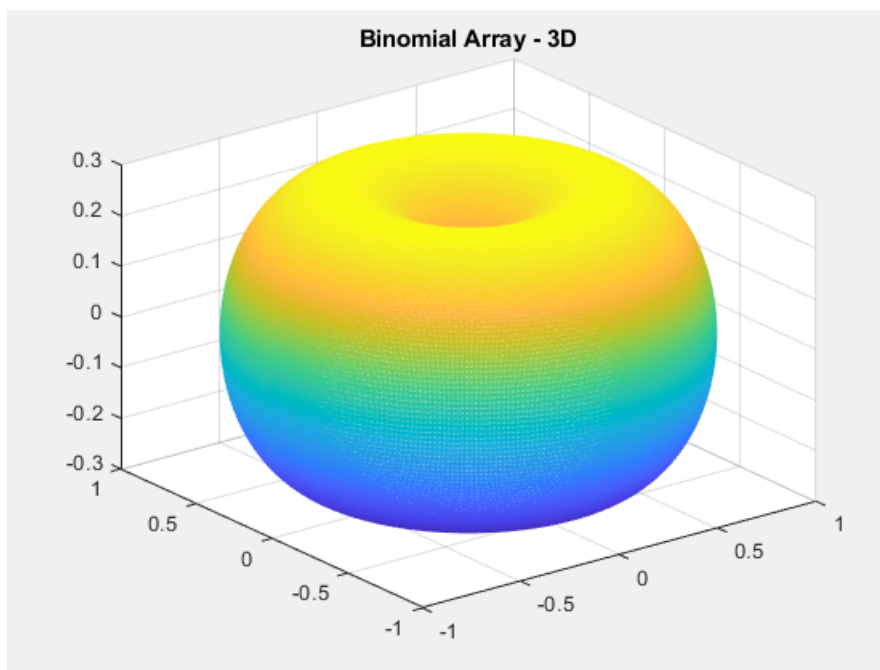Figure 5: Binomial Array 2D Radiation Pattern - Example 2

Figure 6: Binomial Array 3D Radiation Pattern - Example 2

3 Tshebysceff Array Antenna

3.1 MATLAB Code

```matlab
%% Initial Parameters
% Wavelength
f=3e8;
c=3e8;
lambda=c/f;
beta = (2 * pi) / lambda;
theta = 0 : 0.01 : (2 * pi);
phi = 0 : 0.01 : (2 * pi);

% (N), (d), (alpha), and (Ro)
N = input('Enter the Number of Elements (N): ');
Ro = input('Enter the Main-lobe to Side-lobe Level (Ro): ');
zo = cosh( (1 / (N - 1)) * acosh(Ro) );
alpha = input('Enter the Progressive Phase Shift (alpha): ');
d = input('Enter the Spacing between Elements w.r.t Lambda (d): ');
d = d * lambda;
% Defining psi && u && z
psi = alpha + (beta * d * cos(theta));
u = psi / 2;
z = zo .* cos(u);

%% Normalized Array Factor (AF_n)
AF = abs(chebyshevT(N-1, z));

%% Plotting AF vs z
figure(4)
plot(z, AF)
title('array factor VS Z');

%% Plotting 2D Radiation Pattern of the Array
figure(5)
polarplot(theta, AF)
title('2D pattern of the array');

%% Plotting 3D Radiation Pattern
[THETA PHI] = meshgrid(theta , phi);
psi = alpha + (beta * d * cos(THETA));
u = psi / 2;
z = zo .* cos(u);
AF = chebyshevT(N-1, z);

X = AF .* sin(THETA) .* cos(PHI);
Y = AF .* sin(THETA) .* sin(PHI);
Z = AF .* cos(THETA);

figure(3)
mesh(X,Y,Z)
title('Tshebysceff Array - 3D');
```

Code Snippet 2: Tshebysceff Array Code
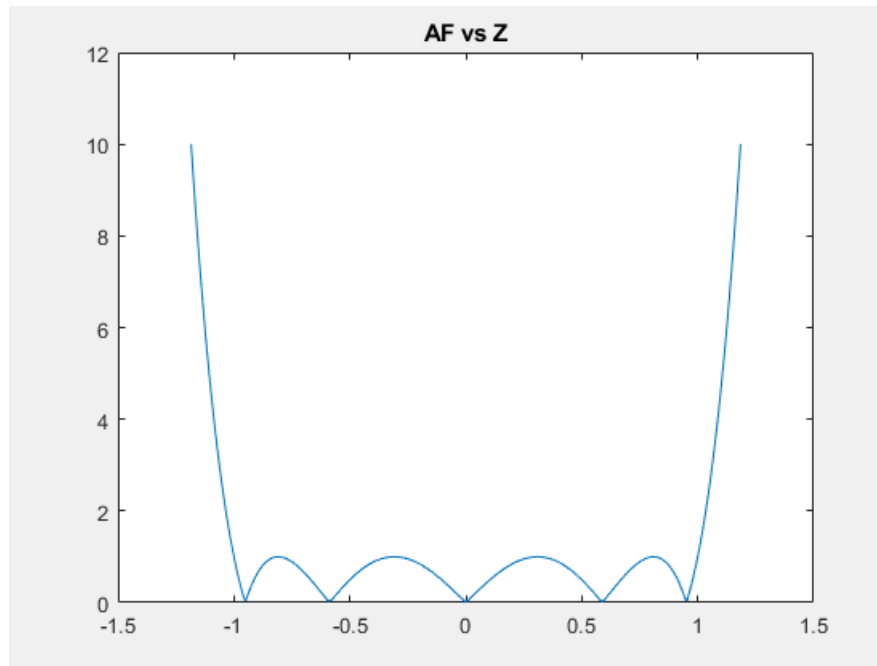
3.2   Results

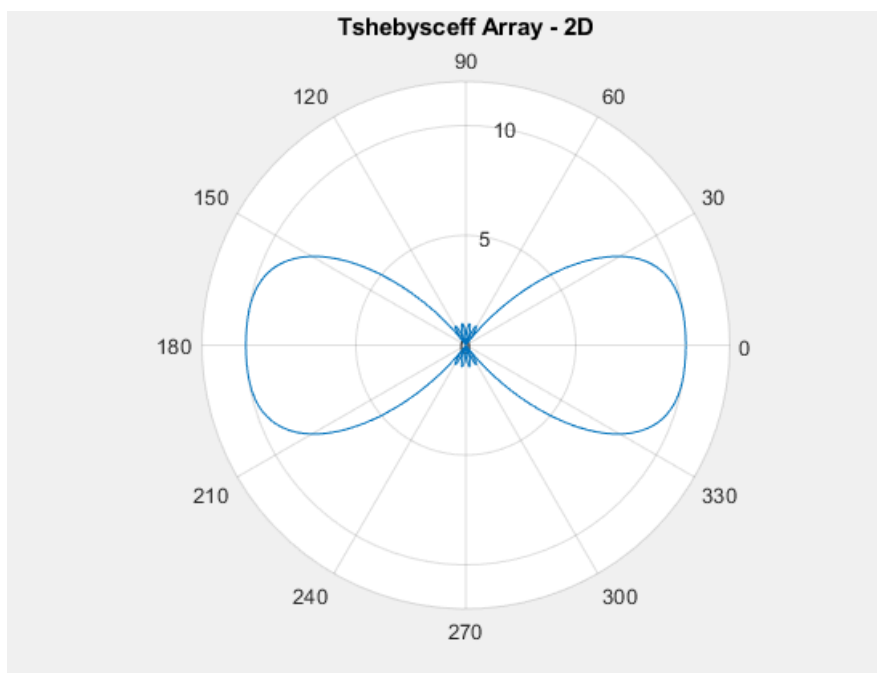
Figure 7: Tshebysceff Array AF vs Z - Example 1

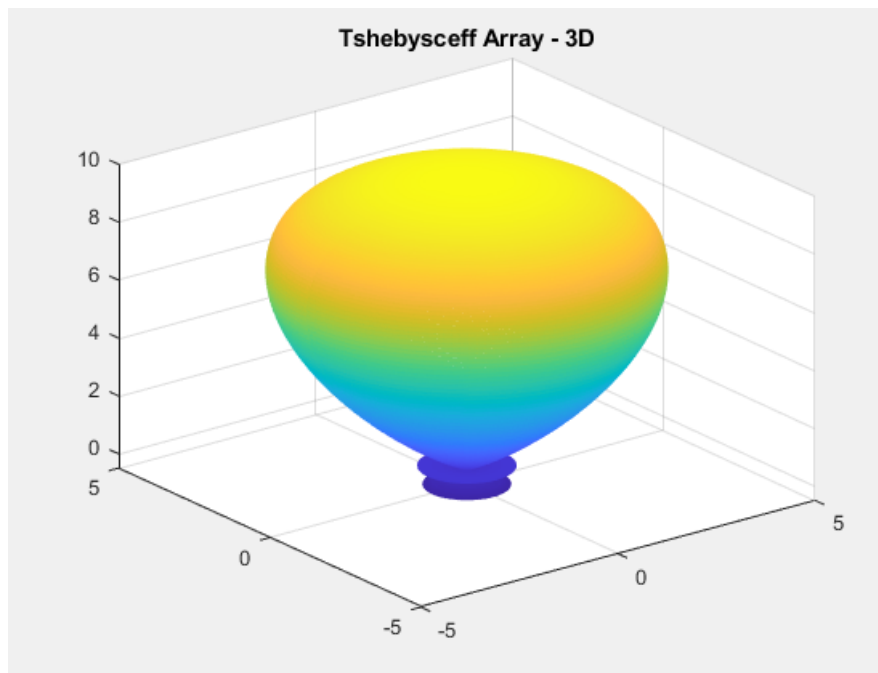Figure 8: Tshebysceff Array 2D Radiation Pattern - Example 1

Figure 9: Tshebysceff Array 3D Radiation Pattern - Example 1