# Discrete Fourier transform of the DDS output sequence

## MATLAB implementation

% ======================================================================= %

% This program was built by Sirapop Saengthongkam to study

% 1. Behavior of Spur

% 2. Spur locations for quadrature DDS (Complex in-input to Discrete

% Fourier Transform (DFT)) [Bin]

% 3. Power Spectrum of Carrier-to-Spur Relative Power [dBc].

% ======================================================================= %

clear, clc, close all;

% ======================== Initial Conditions =========================== %

j = 12;

k = 8;

dP = 619;

Pe = 4096;

N = 2^k;

M = (2^(j-k))/gcd(dP, 2^(j-k));

Y = M-1;

% ======================================================================= %

% ===================== Position of Spurs in bin ======================== %

fprintf("Number of Spurs are %d\n", Y);

r = [0:1:Y];

Fr = mod((dP/gcd(dP, 2^j)) + r\*(N\*dP/gcd(dP, 2^j)), Pe);

% Fourier Series De-Aliasing of spurs position

for n = 1:M

if (Fr(n) > (Pe/2))

Fr\_new = Pe - Fr(n);

Fr(n) = Fr\_new;

else

Fr(n) = Fr(n);

end

end

% Show the Fourier bin position of Carrier and Spurs

fprintf("Carrier bin[Fr(0)] = %d \n", Fr(1));

for i = 2:M

fprintf("Spur#%d bin[Fr(%d)] = %d \n", i-1, i-1, Fr(i));

end

% ======================================================================= %

% ======================= Magnitude of Spurs ============================ %

SP = [1:M];

SP(1) = (sin(pi/N)^2)\*((pi/(M\*N))^2)/(((pi/N)^2)\*(sin(pi/(M\*N))^2));

for r = 1:Y

SP(r+1) = 10\*log10((sinc(1/N)^2 \* sinc(N\*r/(N\*M) + 1/(N\*M))^2) / ...

(sinc(1/(N\*M))^2 \* sinc(r + 1/N)^2));

end

% ======================================================================= %

% ==================== Relative Power to Carrier ======================== %

for r = 1:M

Crr2Spr\_dB(r) = SP(1) - SP(r);

end

% ======================================================================= %

% ============================ Plotting ================================= %

Plot\_data = stem(Fr, Crr2Spr\_dB, "filled");

Plot\_data.BaseValue = -80;

ylim([-80, 0])

title("POWER SPECTRUM", 'fontsize', 10, 'fontname', 'Times New Roman')

xlabel("FREQUENCY BIN", 'fontsize', 10, 'fontname', 'Times New Roman')

ylabel("RELATIVE POWER (dBc)", 'fontsize', 10, 'fontname', ...

'Times New Roman')

% ======================================================================= %

**Results #1:**

**A table of numbers and symbols

Description automatically generated**

**A graph with numbers and lines

Description automatically generatedA screen shot of a graph

Description automatically generated**

รูปที่ 1 Discrete Fourier transform of the DDS output sequence for j = 12, k = 8 and ∆P = 619.

**Results #2:**

**A screenshot of a computer

Description automatically generated**

**A graph with numbers and lines

Description automatically generatedA screen shot of a graph

Description automatically generated**

รูปที่ 2 Discrete Fourier transform of the DDS output sequence for j = 12, k = 8 and ∆P = 1121.