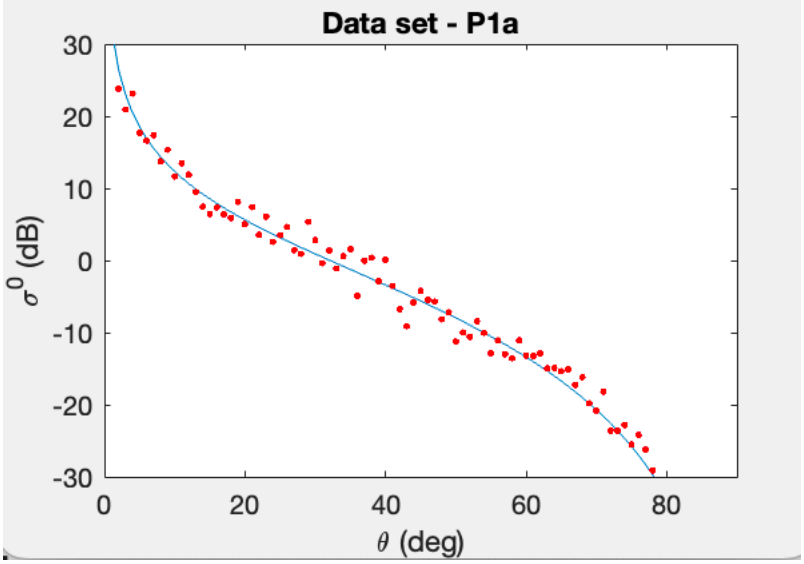
HW7 Scattering Solutions
NISAR/JPL Radar Short Course 2023

P1

For Problem 1, read in the data file. Then, for a range of h, calculate σ^0 expected from the range of θ to minimize the error between the actual σ^0 from the file and the expected σ^0. For P3, do the same with both slope and h.

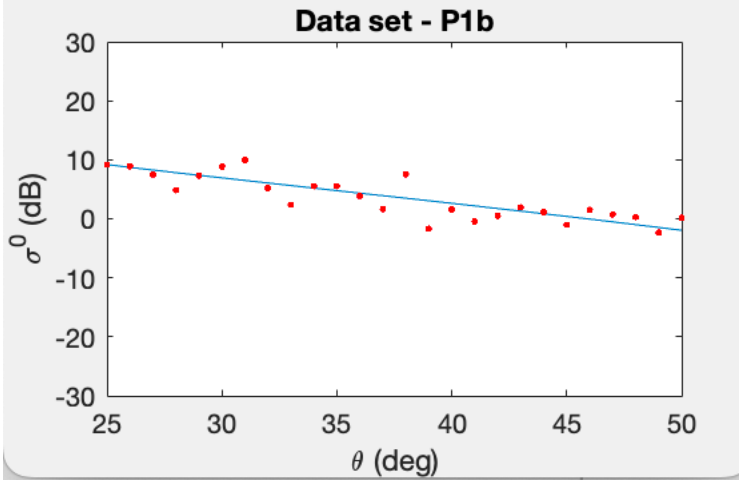
P1a

h = 0.02



P1b

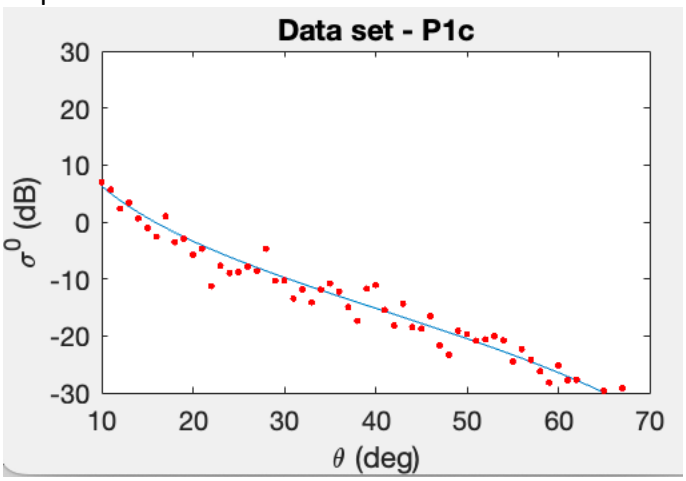
h = 0.04



P1c

h = 0.03

slope = 3



P2

Measured power: 1.738967e-10 watts, 0.173897 nanowatts

- **a.** Moon albedo: 0.070000
- **b.** Roughness for epsilon 9.000000 : 0.006078
- **c.** Roughness for epsilon 5.000000 : 0.003507

For P2c, if the surface is 50% porous, the average dielectric constant is

$$(50\%)(\epsilon_{moon}) + (50\%)(\epsilon_{vacuum}) = 0.5(9) + 0.5(1) = 5$$

MATLAB code (for reference on calculations):

```
% moon scattering calcs

clear all; close all;

lambda=0.12;
k=2*pi/lambda;

% radar equation to get the albedo
% moon params
d=384400000;
diameter=3475000;
Pt=1e5;
antennadiameter=64;

moonarea=pi*(diameter/2)^2;
Ar=pi*(antennadiameter/2)^2;
Gt=4*pi*Ar/(lambda^2);

Pr=Pt*Gt/(4*pi*d^2)*moonarea*Ar/(4*pi*d^2); % albedo=1
Pr=Pr*0.07;
fprintf('Measured power: %5e watts, %f nanowatts\n',Pr,Pr*1.e9);

% part a - solve for albedo
albedo=Pr*(4*pi*d^2)^2/Pt/Gt/moonarea/Ar;

fprintf('Moon albedo: %f\n',albedo);

% part b - solve for h assuming rock dielectric constant = 9

eps=9;
fresnel=((1-sqrt(eps))/(1+sqrt(eps)))^2;
hexp=albedo/fresnel;
h=-log(hexp)*lambda/8/pi;
fprintf('Roughness for epsilon %f : %f\n',eps,h)

% part c - repeat for fluffy rock 50% porous
eps=5;
fresnel=((1-sqrt(eps))/(1+sqrt(eps)))^2;
hexp=albedo/fresnel;
h=-log(hexp)*lambda/8/pi;
fprintf('Roughness for epsilon %f : %f\n',eps,h)
```