ASSIGNMENT 4: Multi-Frequency GPR Imaging

Checkout: Friday, February 22
Due: Tuesday, February 26, 6pm

Name: _____

This assignment is to apply the multi-frequency backward propagation technique developed in Assignment 3 to FMCW GPR imaging.

 The data set was taken over the walkway pavement in front of the Broida Hall. The ground-penetrating radar imaging unit scanned along a linear path and took data at *200* spatial positions. The spatial spacing between the data-collection positions is *0.0213 m (2.13 cm).*

At each data-collection position, the system illuminates the walkway pavement with microwaves in the step-frequency mode, stepping through 128 frequencies with a constant increment, from *0.976 GHz* to *2.00 GHz*. The relative permittivity ε_r is approximately 6.0.

The data set is organized in the form of a *(200 x 128)* array, corresponding to 128 complex-amplitude values (for the 128 frequencies) at 200 receiving positions.

Your task is to perform the image reconstruction of the subsurface profile by using multi-frequency backward propagation. Your results are in the form of two-dimensional image plots. Please note:

1. The propagation speed needs to be adjusted by the relative permittivity.
2. The depth profile needs to be scaled by a factor of two for the round-trip propagation.
3. For simplicity, use the phase-only version of the Green's function for coherent backward propagation.

There are 128 coherent sub-images, corresponding to the 128 frequencies (128 wavelengths). Your goal is to produce a 128-frame video to illustrate the effect due to the increase of frequency bandwidth and the convergence to the final image.

Attachments:

1. *(200 x 128)* data array
2. Image of the test area
3. Final image

Report:

a. Cover sheet
b. Description of your algorithm (please include a diagram)
c. Code
d. Composite image from 32 frequencies
e. Composite image from 64 frequencies
f. Composite image from all 128 frequencies (final image)
g. Summary
h. Videos (for checkout only)