Software Feature List

for

Loam: Data Analysis

Prepared by Christopher Diaz

Mississippi State University

August 31, 2022

Signatures for Project Approval

x Tanmay Bhowmik 10/10/2022

Dr. Tanmay Bhowmik (Major Professor/1st Committee Member)

x Stephen A Torri

Dr. Stephen Torri (2nd Committee Member)

x Shuvashis Dey

Dr. Shuvashis Dey (3rd Committee Member/Client)

Table of Contents

Table of Contents iii
1. Introduction 1
1.1 Purpose 1
1.2 Intended Audience and Reading Suggestions 1
1.3 Product Scope 1
1.4 Definitions and Acronyms 1
2. Overall Description 1
2.1 User Needs 1
2.2 Assumptions and Dependencies 2
3. System Features 2
3.1 Amplitude vs. Depth Plot 2
3.2 Dielectric Constant vs. Depth vs. Amplitude Plot 2
3.3 Volumetric Moisture Content and Recommendations 3
4. References 3

1. Introduction

1.1 Purpose

This project aims to build a software application to assist in analyzing and presenting data obtained from a sensor that measures the amplitude level of moisture in an area of soil. The sensor, placed in soil, will provide a numerical value for the amplitude of the area being tested. Graphical representations will be created, and specific recommendations will be given based on the data reported by the sensor. The specific data visualizations include a depth vs. amplitude plot and a three-dimensional plot of dielectric constant vs. depth vs. amplitude. These values will then determine the volumetric moisture content (VMC). A specific VMC will be calculated and presented to the user.

1.2 Intended Audience and Reading Suggestions

The purpose of this document is to explain the expected features of "Loam: Data Analysis" to all parties involved in the project. The software is being developed to assist North Dakota State University researchers in analyzing results from a sensor measuring amplitude levels in the soil. The following describes this project's scope, the user needs, and the features to be included in the final product.

1.3 Product Scope

The main objective of this application is to present meaningful data visualizations to be used by the user and provide essential recommendations based on the data provided by the sensor. By completing this objective, calculating the volumetric moisture content should be significantly simplified, and the necessary soil moisture level adjustments should be made more apparent.

1.4 Definitions and Acronyms

- Depth – how deep the soil sensor is in the ground.
- Amplitude – the value given by the sensor. This value will be used to present the amplitude vs. depth plot, the volumetric moisture content plot, and calculate the volumetric moisture content for the tested sample.
- Volumetric moisture content (VMC) – a quantifiable moisture level in a specified area

2. Overall Description

2.1 User Needs

The user needs an application that visualizes data in two different plots and gives a recommendation based on the data. The first plot is a visual representation comparing the amplitude and depth. The second plot is a visual representation comparing amplitude, depth, and dielectric constant. The results from the second plot will be used to calculate the VMC and give a recommendation.

2.2 Assumptions and Dependencies

The following table from the client will be used to calculate the VMC. A more accurate answer will be given by interpolating and extrapolating this data set.

Volumetric Moisture Content	Dielectric Constant
0	2.53
0.025	2.74
0.05	2.96
0.075	3.18
0.1	3.42
0.125	3.67
0.15	3.92
0.175	4.18
0.2	4.45
0.225	4.73

Table 1. VMC vs Dielectric Constant [1]

3. System Features

3.1 Amplitude vs. Depth Plot

3.1.1 Description

Once the amplitude data has been input from the sensor, a plot of amplitude vs. depth will be displayed to the user. The user will define the depth, showing the exact point.

3.1.2 Stimulus/Response Sequences

- The user will input the depth of the sensor and the amplitude reading
- A two-dimensional plot will be displayed with the expected point and a line graph corresponding to the approximated water level

3.2 Dielectric Constant vs. Depth vs. Amplitude Plot

3.2.1 Description

Another plot can be shown as a different option that displays a dielectric constant vs. depth vs. amplitude plot. The same depths and amplitudes from the previous plot will be displayed and then used to determine the corresponding dielectric constant.

3.2.2 Stimulus/Response Sequences

- The user will input the depth of the sensor and amplitude reading if not already entered previously
- A three-dimensional plot will display the point corresponding to the determined dielectric constant

3.3 Volumetric Moisture Content and Recommendations

3.2.1 Description

The dielectric constant will be used to calculate the VMC content, which will be displayed to the user. This calculation will be done based on data from the previous table containing VMC with the corresponding dielectric constant.

3.2.2 Stimulus/Response Sequences

- The user will input the depth of the sensor and amplitude reading if not already entered previously.
- The corresponding VMC will be calculated and displayed along with the expected recommendation to the user.

4. References

[1] Dey, Shuvashis. "Calibration Curve." North Dakota State University. August 18, 2022. Presentation