Pipe, Inspect, Extract: (PIE)

User Manual

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Introduction

1.1 Overview

Pipe, Inspect, Extract (PIE) is a data visualization system designed for analyzing pipeline data to detect defects using various plots and heatmaps.

1.2 Purpose

Analyzing pipe wise data in no time with PIE. Here is the purpose of this software:

- Visualization: Generate custom plots, telemetry plots, anomalies distribution plots, and heatmaps for pipe
- User Interface: View everything about pipe in a single report(Dig Sheet)
- Statistics: Transform sensor based data to quantitative visualizations

1.3 Data

The client will be given pipe wise data in a specific folder. Now the user has to load this folder from the app. *(Fig. 1-1)*

Fig. 1-1

Note: Each Pipe folder contains various file formats, so it is advised to not alter or modify any of its contents.

Installation and Setup

2.1 System Requirements

Minimum RAM: 8GB

Minimum Processor: i5 and(or equivalent) 5th generation

Operating System: Windows, MacOS

Disk Space: Minimum of 2GB of free disk space for installation

Graphics Card: DirectX 11 compatible graphics card with at least 512MB of VRAM (for optimal performance)

2.2 Installation Instructions

Windows: Double-click the downloaded .exe file (e.g., *PIE.exe*) to start the installation process. If prompted by User Account Control (UAC), click "Yes" to allow the installer to make changes to your system. *(Fig 2-1)*

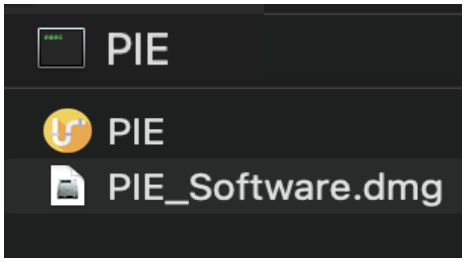

Fig. 2-1

macOS: Open the .dmg file and drag the PIE application into your Applications folder.

Getting Started

3.1 Initial Setup

When the app loads, we first need to load the project (Data folder of pipes).

You can do that by clicking on: ***File > Create Project***

3.2 First-Time Use

Now that data is loaded of a pipe, user can see different tabs:

Tab Widget and Back Screen *(Fig. 3-1)*

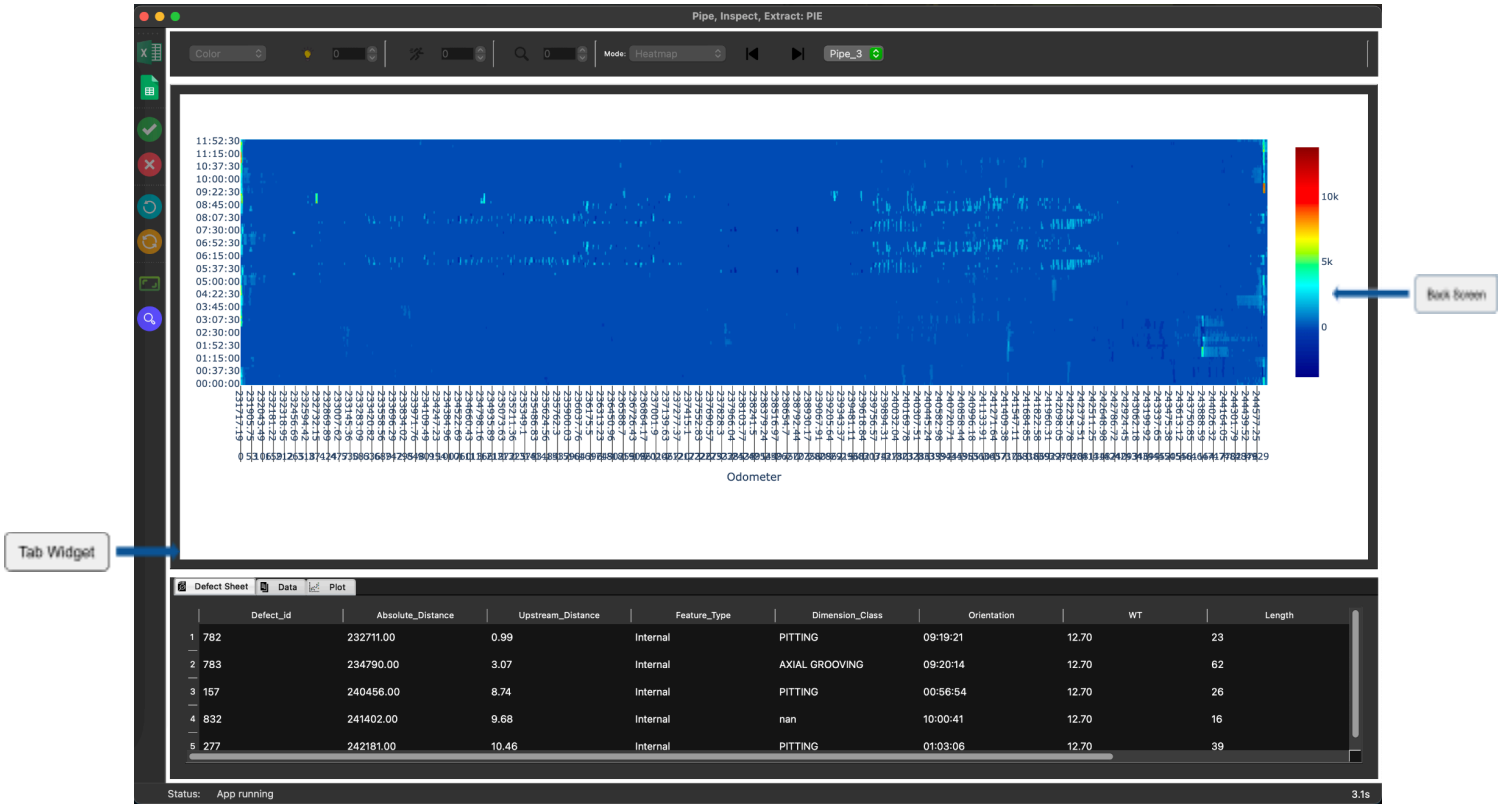

Fig 3-1

User Interface

4.1 Main Components

Some components of software are:

1. **Menu Bar**
2. **Status Bar**
3. **Tool Bar**

Menu Bar is used to trigger action buttons for various functions of the software. *(Fig. 4-1)*

Tool Bar has various tools for processing and exporting defect sheet. *(Fig. 4-2)*

Status Bar shows the current status of application and time of loading. *(Fig. 4-3)*

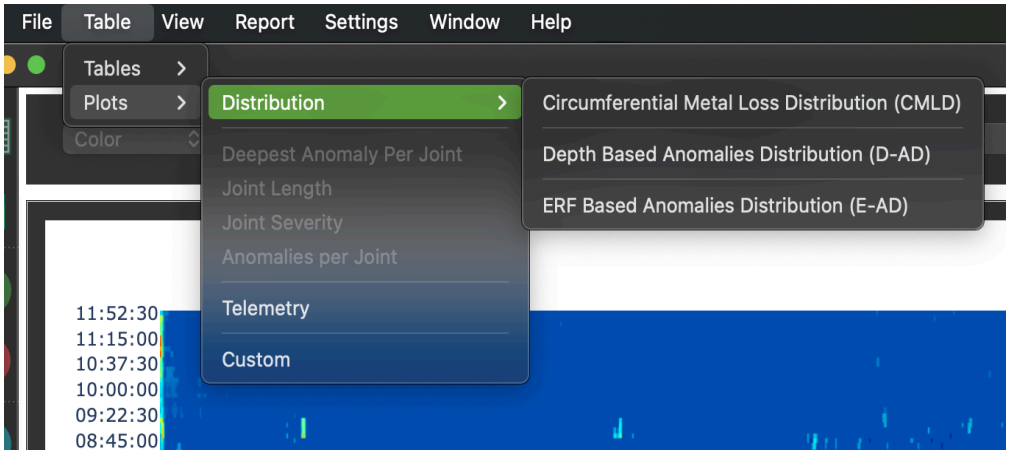

Fig 4-1

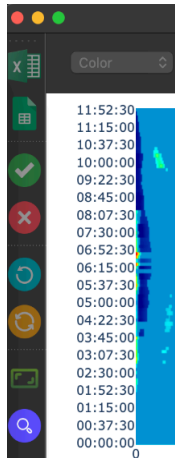

Fig 4-2

Fig 4-3

4.2 Navigation

We can navigate through different tabs of the Tab Widget, which are:

1) **Defect Sheet Tab**

   Here we can see the calculated defects and all their attributes like; length, width, depth peak, orientation, feature class, etc. *(Fig. 4-4)*

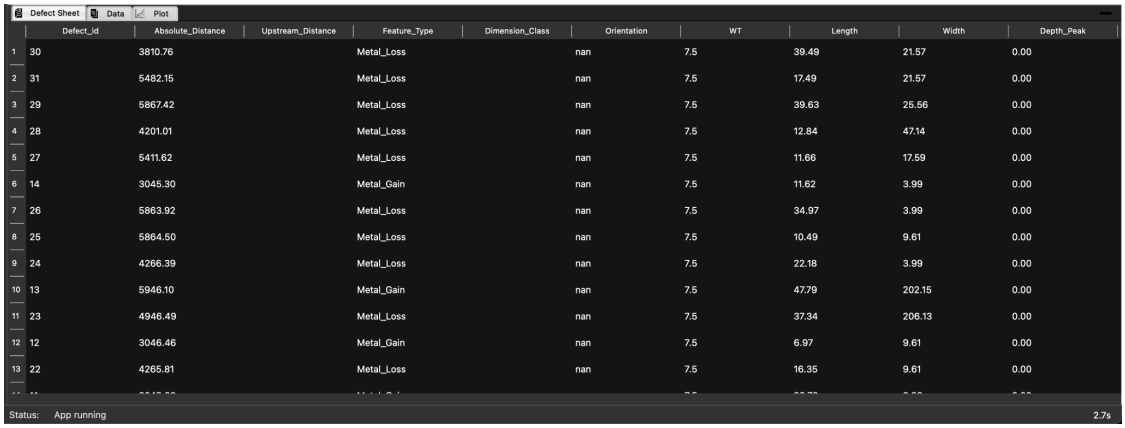

Fig 4-4

2) Data Tab

The data related to the pipe collected by the MFL tool is displayed in raw form. Users can perform analysis on this raw data.

3) Plot Tab

Here the user can import different types of plots from the data. *(Fig. 4-5)*

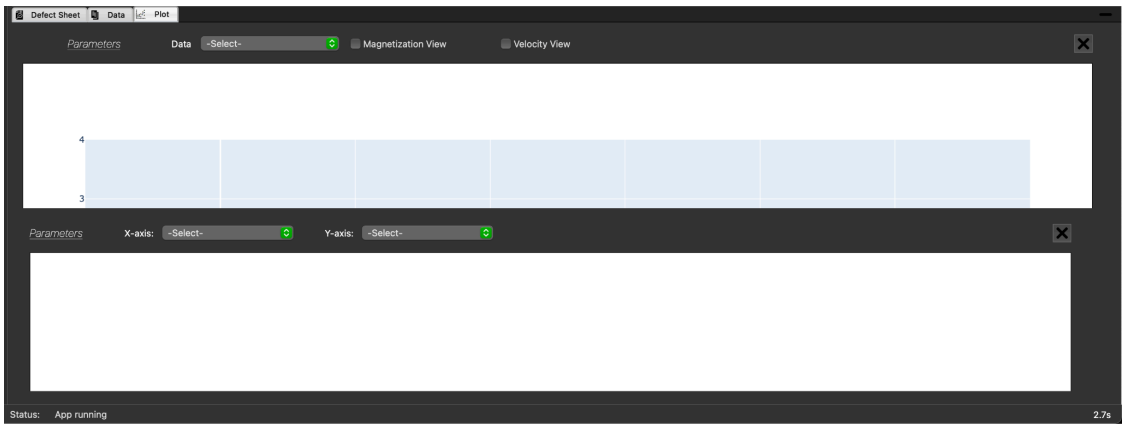

Fig 4-5

Back Screen Navigation

When switching through tabs in Tab Widget, the various plot changes in Back Screen which changes when switching tabs.

Under the Defect Sheet, we have Heatmap for the current pipe and under the Data Tab, we can see the multi line plot between sensors and their flux variations throughout the odometer reading. *(Fig. 4-6)*

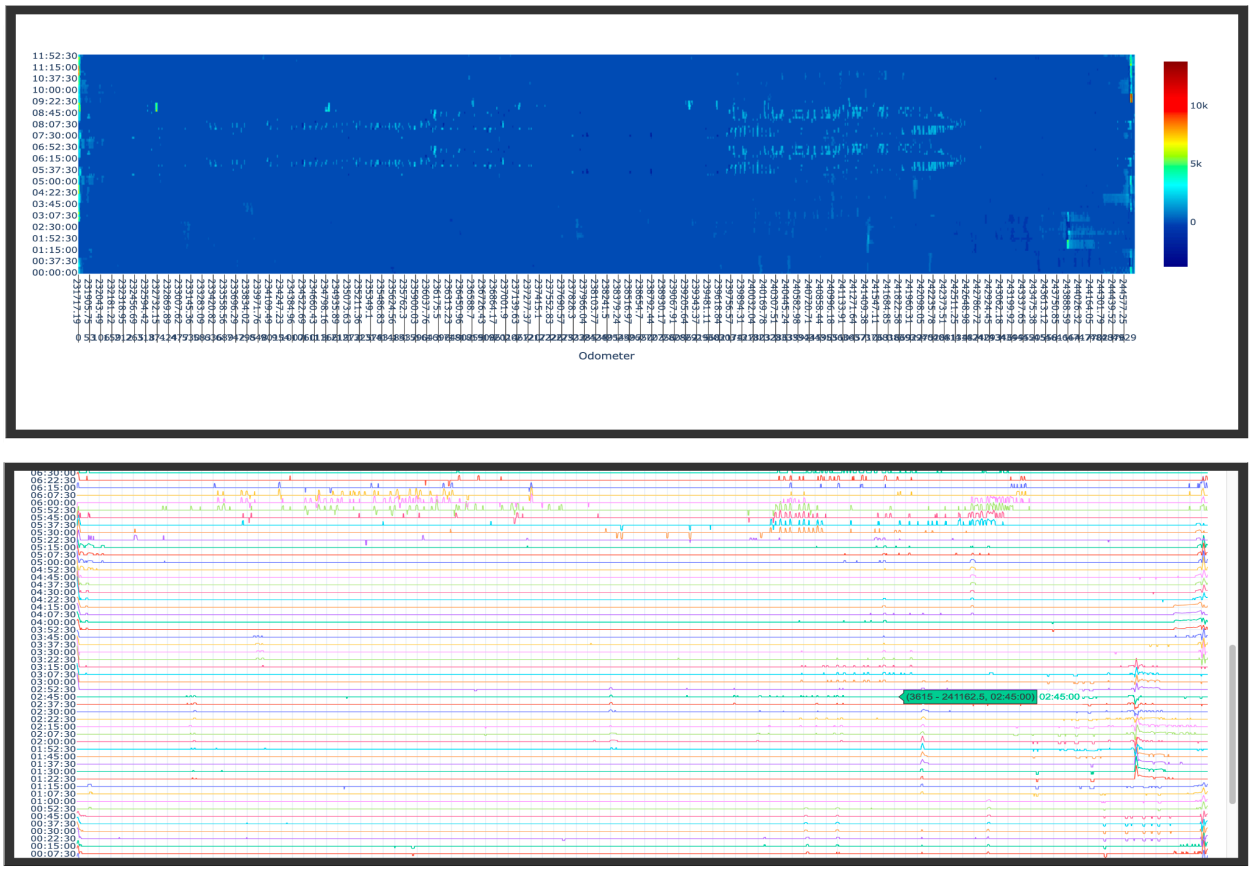

Fig 4-6

The default visual in Plot Tab is the 3D visualization of the pipe and the defects relative to their upstream position. *(Fig. 4-7)*

Fig 4-7

Features

5.1 Anomaly Distributions

Now when a user loads the anomaly plotting feature, they are able to plot various instances from data in Plot Tab Widget and view accordingly. *(Fig. 5-1)*

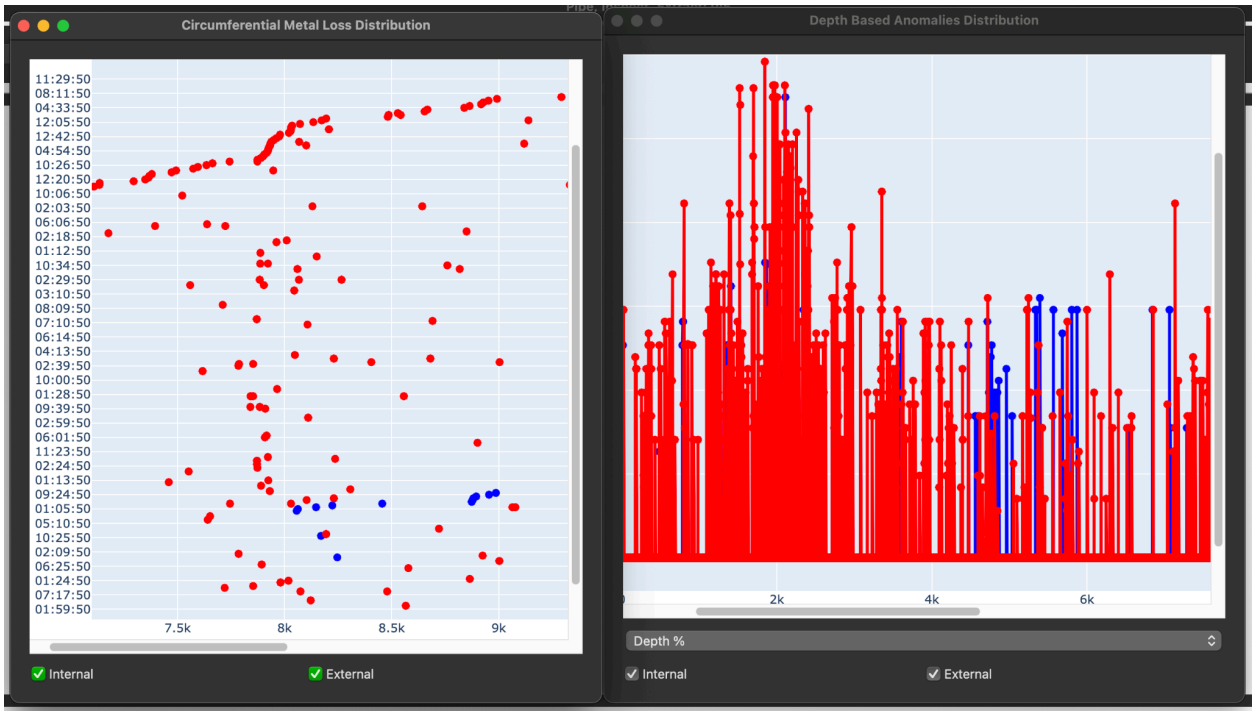

Fig 5-1

5.2 Telemetry Plotting

Telemetry will show the rundown of a particular sensor data with respect to time. *(Fig. 5-2)*

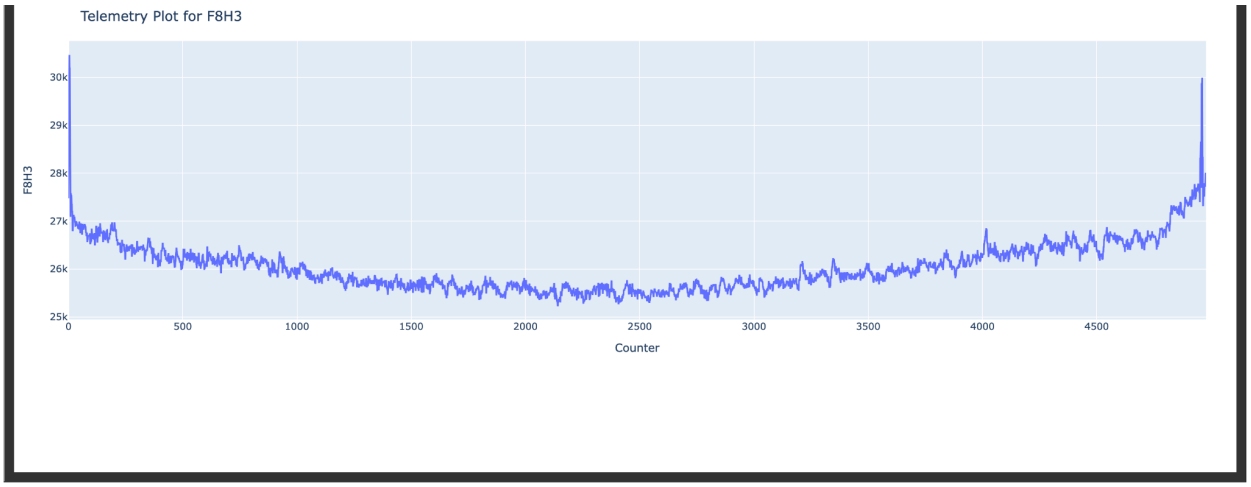

Fig 5-2

5.2.1 Magnetisation View

We can see the Magnetisation vs Distance value for the whole tool. *(Fig. 5-3)*

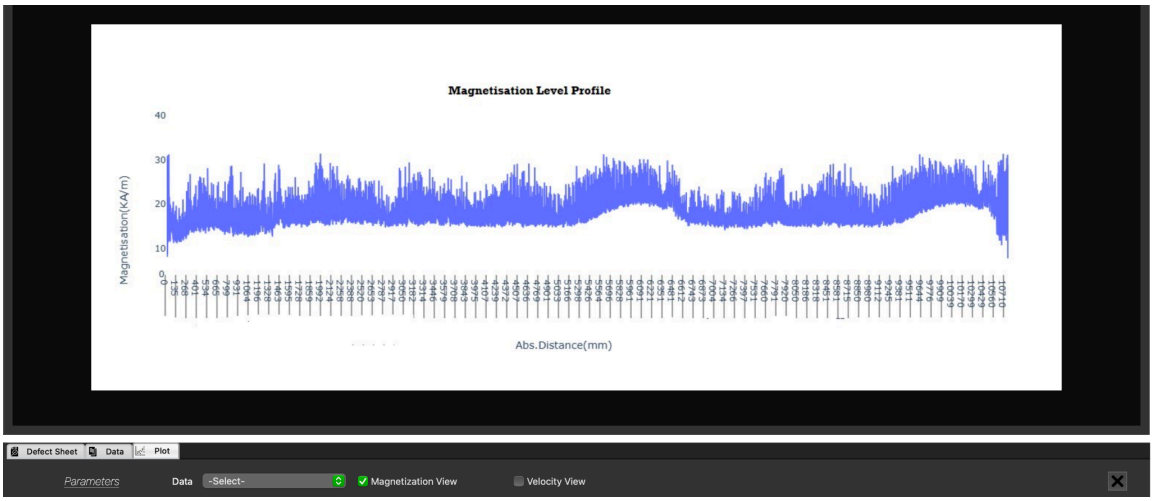

Fig 5-3

5.2.2 Velocity View

Here the Velocity of Tool sensors is represented as a whole.*(Fig. 5-4)*

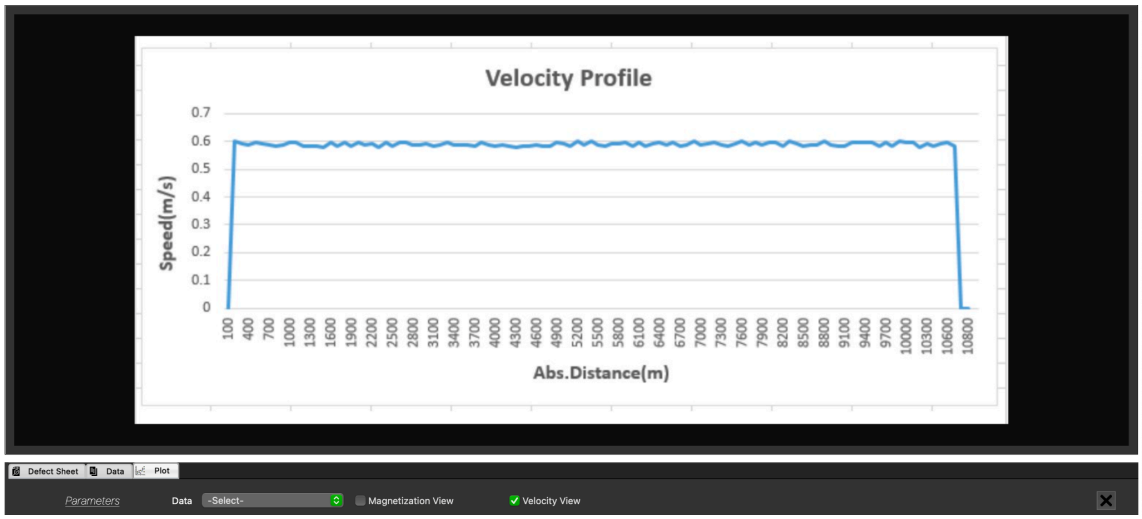

Fig 5-4

5.3 Defect Boxing

Clicking on Magnifying Button, all defects would be fetched from the heatmap and displayed. The major defects would be shown in Defect Sheet Tab below with their 'Defect IDs' annotated. *(Fig. 5-5)*

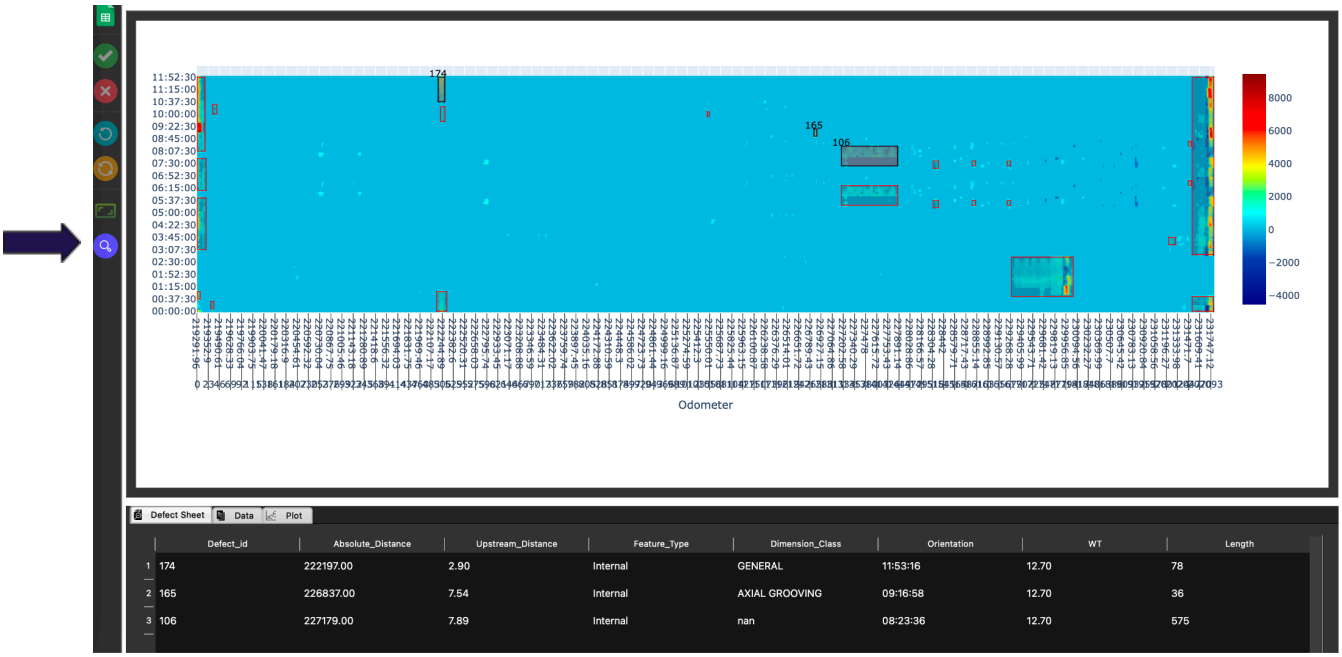

Fig 5-5

5.4 ERF Calculator

The ERF(Effective Reduction Factor) calculator will provide a quantitative measure of the severity and impact of different defects, helping users to prioritize maintenance tasks based on their potential consequences. *(Fig. 5-6)*

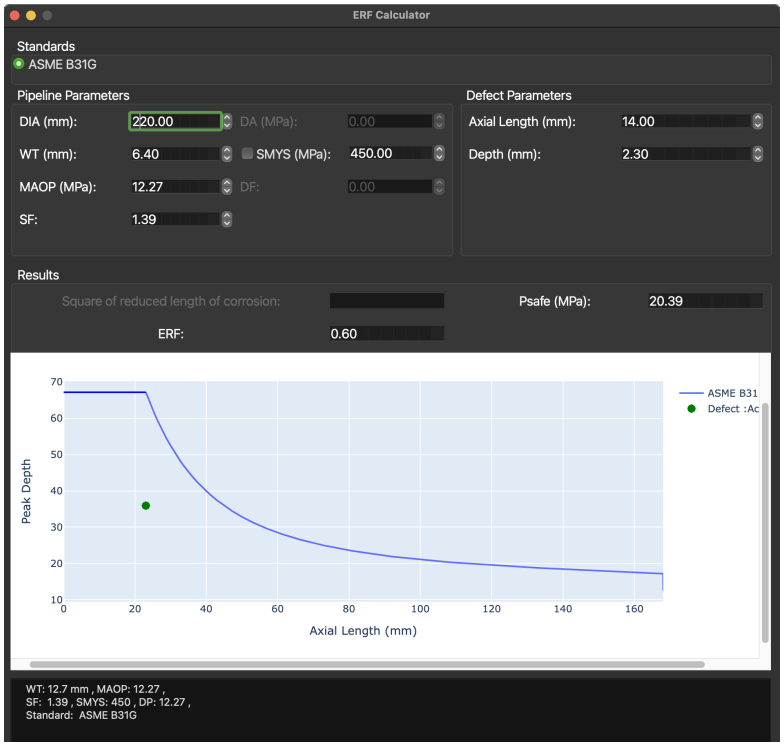

Fig 5-6

5.5 XYZ Mapper

XYZ Mapper will be used to integrate KML maps, enabling users to visualize data pipelines geographically, providing a spatial context for analyzing pipeline conditions in relation to their physical locations. *(Fig. 5-7)*

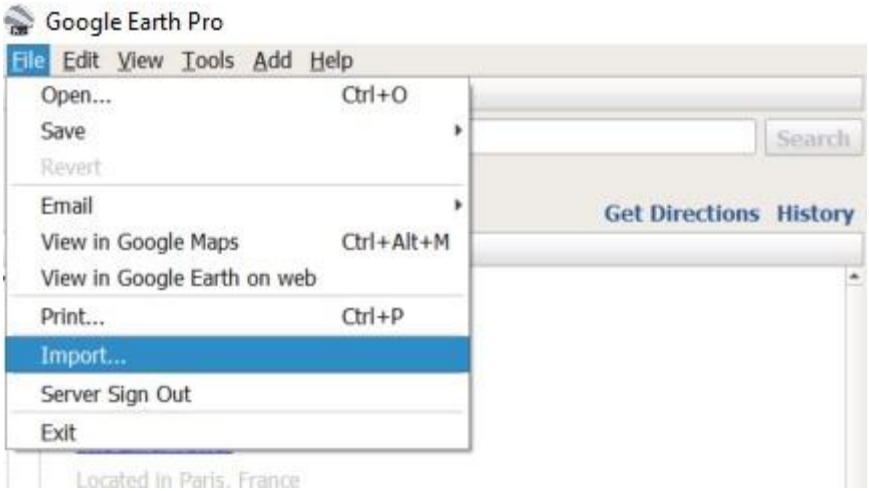

Fig 5-7

5.6 Pipe Highlight

This window displays all the statistics of anomalies related to pipeline in visualizations. The data is taken from Pipe Tally. *(Fig. 5-8)*

Fig 5-8

5.7 Pipe Scheme

Pipe Scheme provides a convenient way to overview the pipeline features in a schematic way. It includes various symbols for Metal Loss(Int or Ext) based upon Depth %. *(Fig. 5-9)*

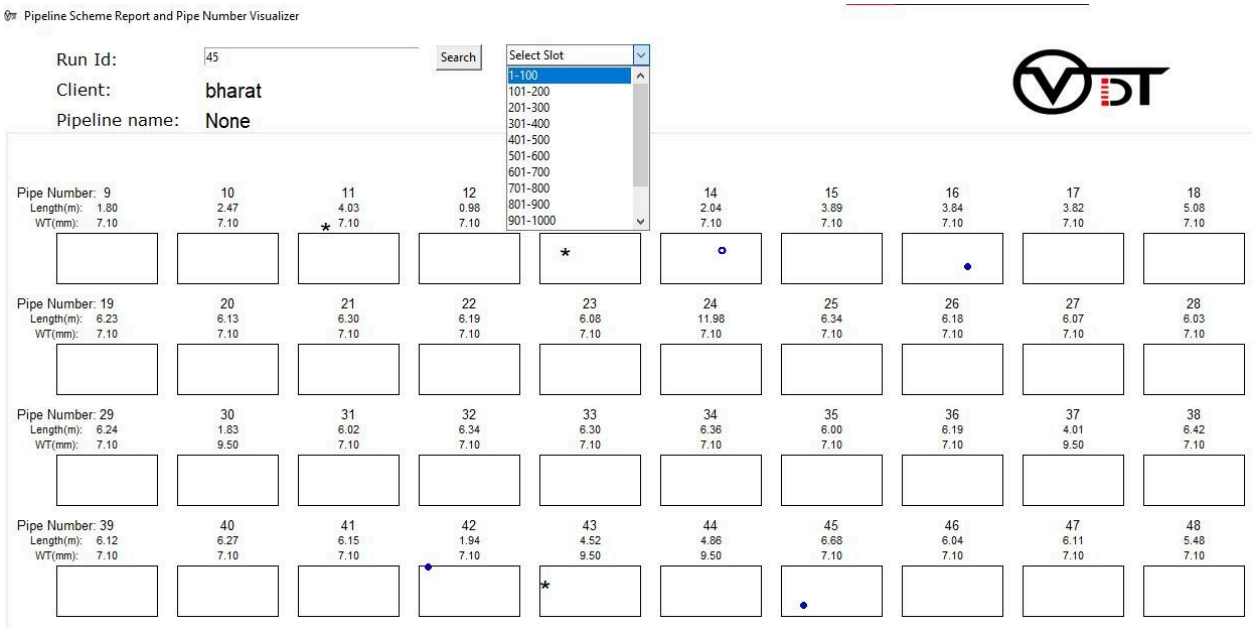

Fig 5-9

5.8 Reports

In this, the user id provided with detailed Preliminary and Final Report of pipeline. *(Fig. 5-10)*

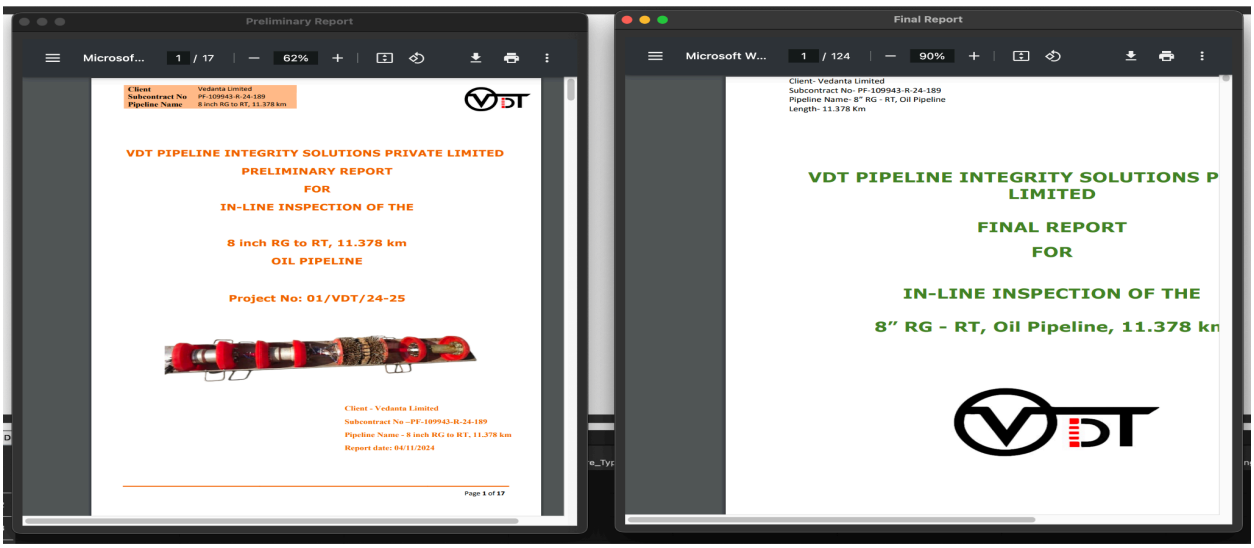

Fig 5-10

Dig Sheet

6.1 Introduction

Users can use this inbuilt software to visualize and generate calibrated reports of various defects found by our software. It is a proprietary software developed with PIE.

6.2 Use

Under **Report > Generate > Dig Sheet > Standard**, users can find the dig sheet. *(Fig. 6-1)*

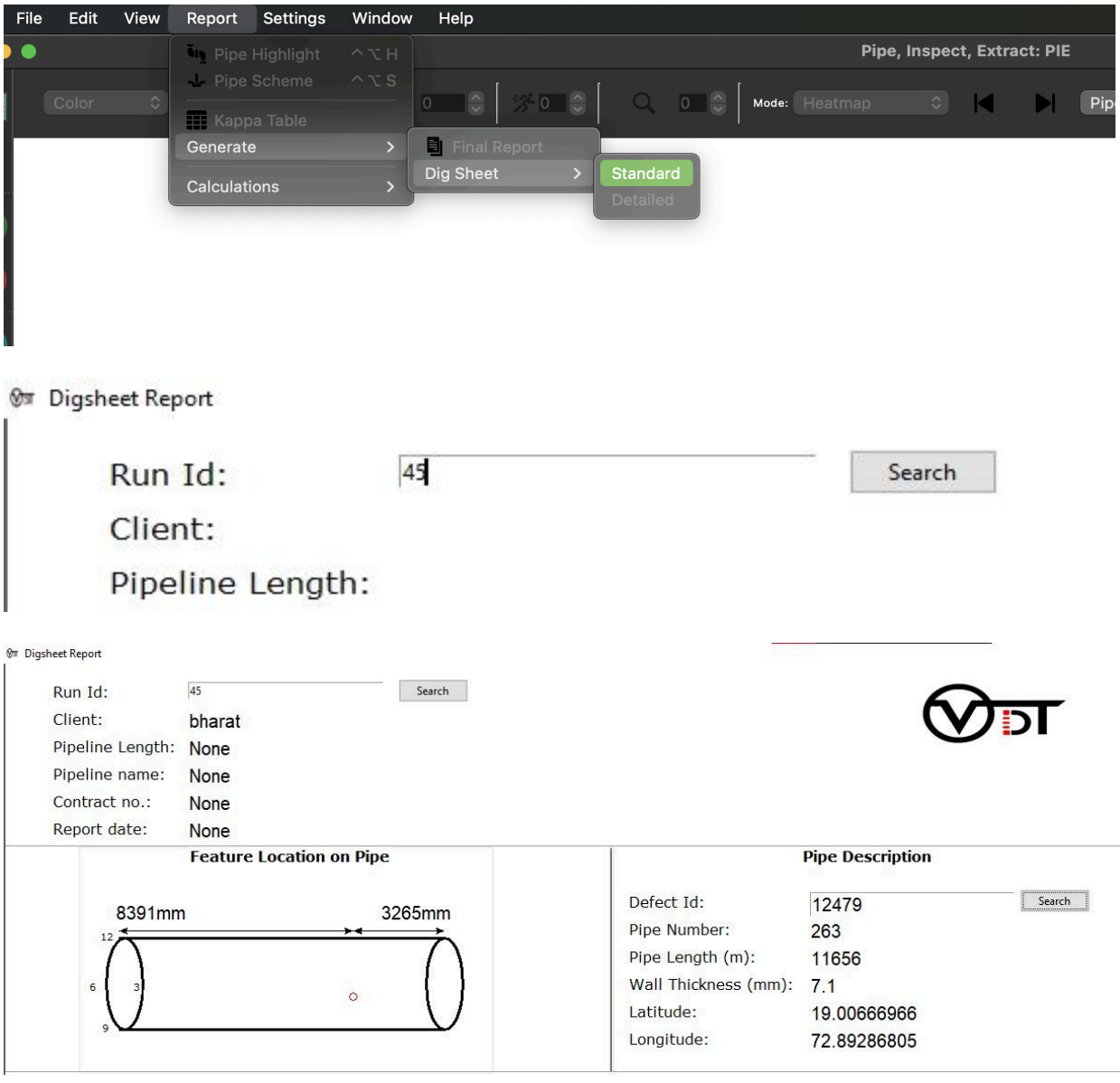

Fig 6-1

6.3 Report

Enter defect ID to get detailed information about the defect (PDF format for saving). *(Fig. 6-2)*

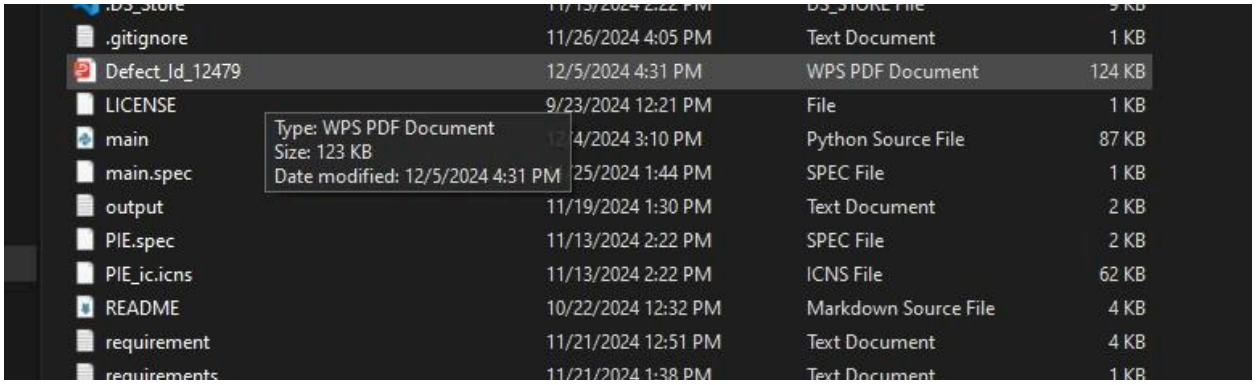

Fig 6-2

Appendices

7.1 Glossary of Terms

Pipe, Inspect, Extract (PIE)
A data visualization system designed for analyzing pipeline data to detect defects using various plots and heatmaps.

Visualization
The process of generating graphical representations of data to aid in analysis, such as custom plots, telemetry plots, anomalies distribution plots, and heatmaps.

Telemetry Plotting
The method of displaying sensor data over time to observe changes and trends in the pipeline data.

Defect Boxing
The feature that allows users to magnify and identify defects within a heatmap for detailed inspection.

Custom Plotting
The ability to create and view various types of plots based on user-defined parameters and data selections.

Heatmap
A data visualization tool that uses color coding to represent the magnitude of values in a matrix or grid, highlighting areas of interest, such as defects in pipeline data.

Tab Widget
A user interface component that organizes different views or sections within the software, such as Defect Sheet, Data Tab, and Plot Tab.

Back Screen
The area of the interface that displays plots and heatmaps in a minimized format when switching between tabs.

Magnetisation View
A plot that shows the relationship between the magnetisation values and the odometer readings, which helps in understanding the magnetic properties of the pipeline over its length.

Velocity View
A plot that represents the velocity of tool sensors, helping to analyze the speed and consistency of data collection.

Defect ID
A unique identifier assigned to each detected defect, used to retrieve detailed information about the defect from the dig sheet report.

Data Tab
A section within the software that displays raw sensor data collected from the pipeline, allowing for in-depth analysis.

Plot Tab
A section where users can create and view different types of plots based on the data collected from the pipeline.

Dig Sheet
A report generated by the software that provides detailed, calibrated information about detected defects, including attributes like length, width, and orientation.

Status Bar
A component of the user interface that shows the current status of the application and the time of data loading.

Tool Bar
A component of the user interface that contains tools for processing and exporting defect sheets, among other functions.

Menu Bar
A component of the user interface that provides access to various action buttons and functions of the software.

Magnetic Flux Leakage (MFL)
A non-destructive testing method used to detect defects in ferromagnetic materials, such as pipelines, by measuring changes in magnetic flux.