MMU
MULTIMEDIA UNIVERSITY

User Manual

INTELLIGENT DFOS CHARACTERISATION SYSTEM

Version 1
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Project

Multi-Sensory Distributed Optical Fiber Sensor Cable for Exploration and Production Phase

PETRONAS

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Document Version Control

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CHAPTER 1: INTRODUCTION

Distributed fiber optics sensing (DFOS) can transform an ordinary telecommunication optical fiber cable into a continuous length of sensing element, allowing detection and monitoring of physical quantities, such as temperature and strain along the cable. DFOS forms an advanced non-invasive, real-time sensing technology and is known to be able to overcome many limitations of traditional gauges. Among other things, fiber optic sensors are insensitive to electromagnetic noise, resistant to corrosion and high-pressure and high-temperature conditions, and do not require electronics along the optical path, making them suitable for many downhole sensing applications.

This manual is designed to provide the user with a comprehensive guide to the **Intelligent DFOS Characterisation System**, a system that is designed to characterise newly developed DFOSs. The artificial intelligence (AI) system will be able to generate user-friendly interpretations from the raw measurement data collected from the interrogator unit. Ultimately, the setup of the system will be as shown in Figure 1.0 where the system will also be trained to perform synchronization of the optical switch for simultaneous measurement of multiple sensing fiber optic cables.

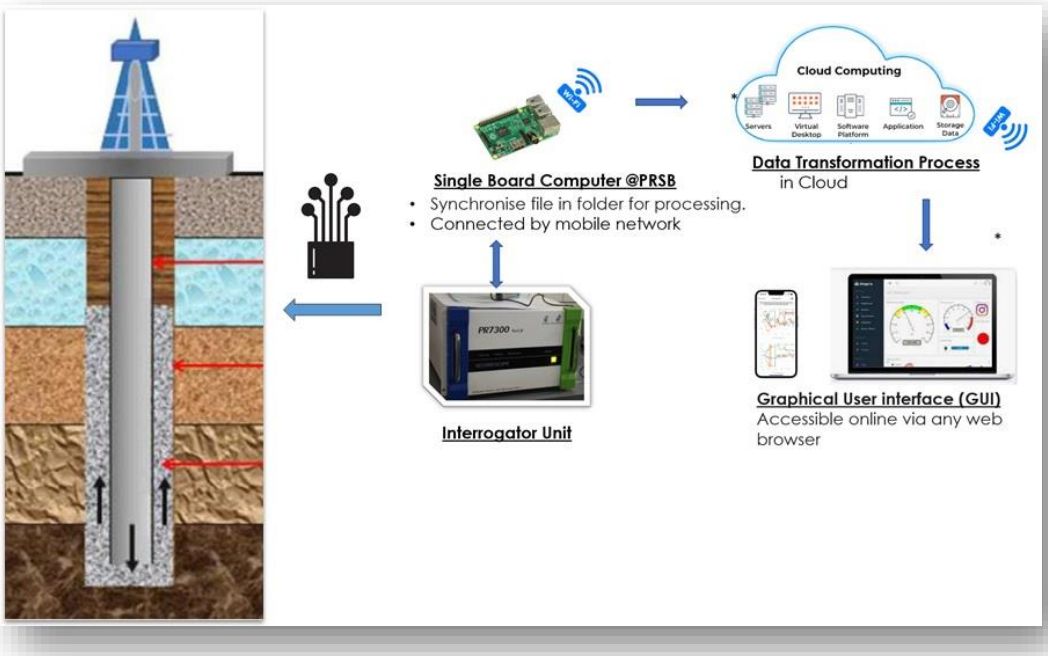

Figure 1.0: Schematic diagram of DFOS system.

System Requirements

- Intel i7 or i9 processor
- Windows 10 or 11
- 16 - 32 GB of RAM
- Dedicated video processor should be one of the following or greater: Nvidia Quadro, Nvidia® GeForce 1660, 2060, 3060 or greater.
- Minimum 500 GB hard drive (SSD hard drive)
- Wireless networking adapter (for internet)

CHAPTER 2: LOGIN AND NAVIGATION

2.1 User Login

Upon assessing the URL address **https://mmuprsb.loranet.my** the user is directed to the Login Page. Fill in your designated username and password in the areas provided. If you do not have a username and password, please email shima@dkss.com.my to register for the system. For now, the system is only accessible to members of the project and PRSB/Petronas staff. Once the user enters their credentials and clicks the "Sign In" button, the user is granted access to the Intelligent DFOS Characterization System.

Figure 2.0: Login page of the GUI.

2.2 Accessing the Components of the GUI

After you have signed in, the main features of the system will appear on the left side of the website as simple icons. Upon mouseover, details of each icon will come into view. There are **7 major components** listed under DASHBOARD as shown in Figure 2.1 below.

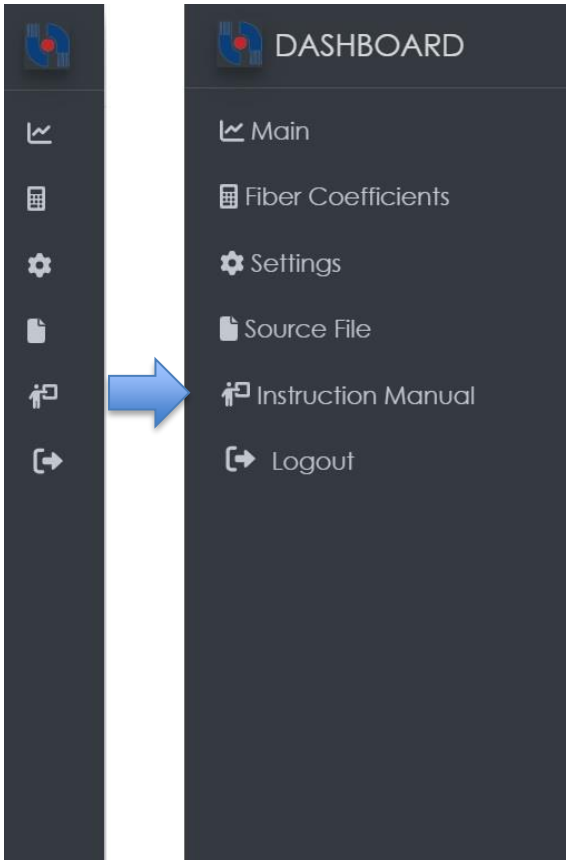

Figure 2.1: Main features of the GUI are listed under the DASHBOARD on the left side of the screen.

CHAPTER 3: SYSTEM FEATURES

3.1 Main

Upon login, the first page will display the results of pre-uploaded data to demonstrate the features of the system. The two graphs on the main page are interrelated. The first graph shows a plot of the **Frequency Difference vs Time** at a specified distance on the fiber cable. The distance can be changed by **moving the red marker on the second graph**, which is a plot of the **Frequency Difference vs Distance**, where Distance is the length of the fiber optic cable. Accordingly, **moving the marker on the top graph** will refresh the bottom graph to the signal reading **at a specific time along the entire length of the fiber optic cable**.

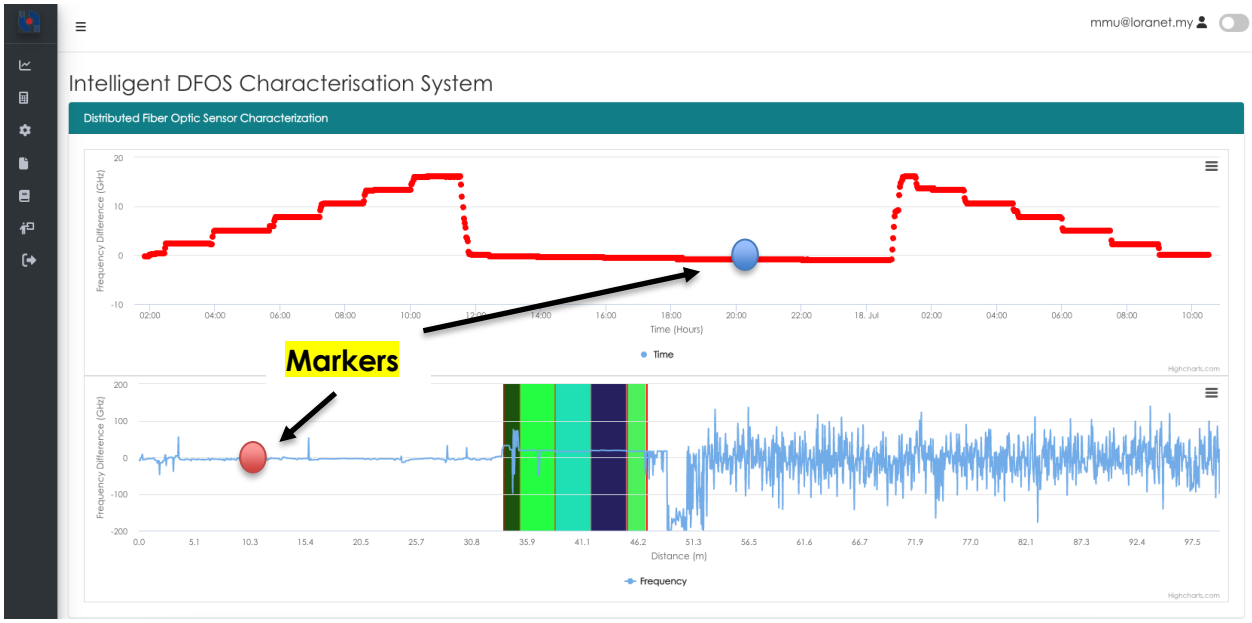

Figure 3.0: Understanding the graphs on the main page. The markers of both graphs can be moved along the length of the signal. Selecting a value and clicking on the marker will refresh the corresponding graph to display new data.

3.1.1 Determination of Different Fibers in the Optic Cable

One of the major features of the system is the ability to automatically determine the different type of sensors in the optic cable from an intelligent analysis of the signal. The green and blue colored areas in the second graph captures this feature. For this particular data set, **five different fibers are automatically identified from the data**. By selecting a rectangular area on the graph, the zoom feature can magnify the plot to record the distance of each fiber sensor from the start of the cable.

Figure 3.1: Intelligent identification of the boundaries of the fibres in the cable. There are 5 different fibre sensors in this example.

3.1.2 Uploading New Data File

The pre-uploaded data allows the user to familiarize themselves with the system easily. However, the system is also able to process new data files provided that the data is in the *.fdd format. To do this, the user must click on the **SOURCE FILE** tab in the dashboard. Since FDD files usually come in batches, the user can upload an entire folder of fdd files for processing in one go.

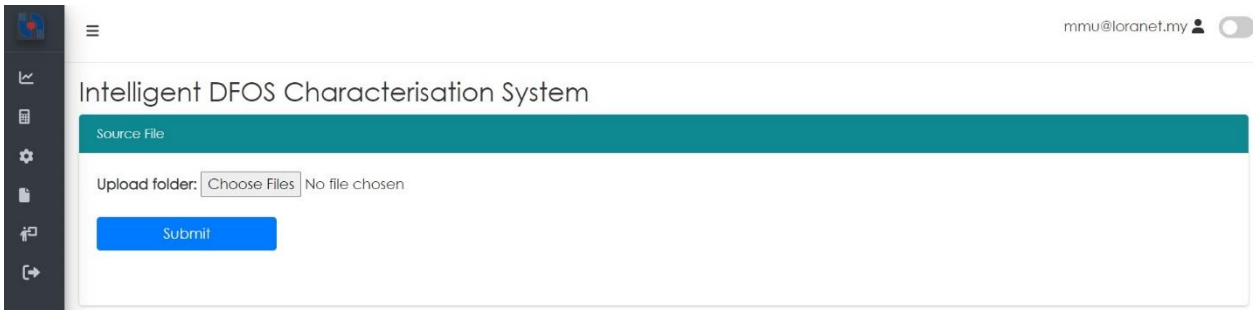

Figure 3.2: The system enables users to upload their own FDD files. The FDD files must be in the correct format for the program to execute smoothly.

3.2 Fiber Coefficients

The system can compute the fiber calibration coefficient for each fiber that is detected in the signal. The user may select the fiber of interest from the dropdown menu. Since 5 different fibers were detected from the test data, the user is presented with 5 fiber options.

Figure 3.3 represents 3 averaged readings (at different times) at various pressures levels from a selected fiber. The values at each pressure level are averaged to obtain the second plot shown in Figure 3.4.

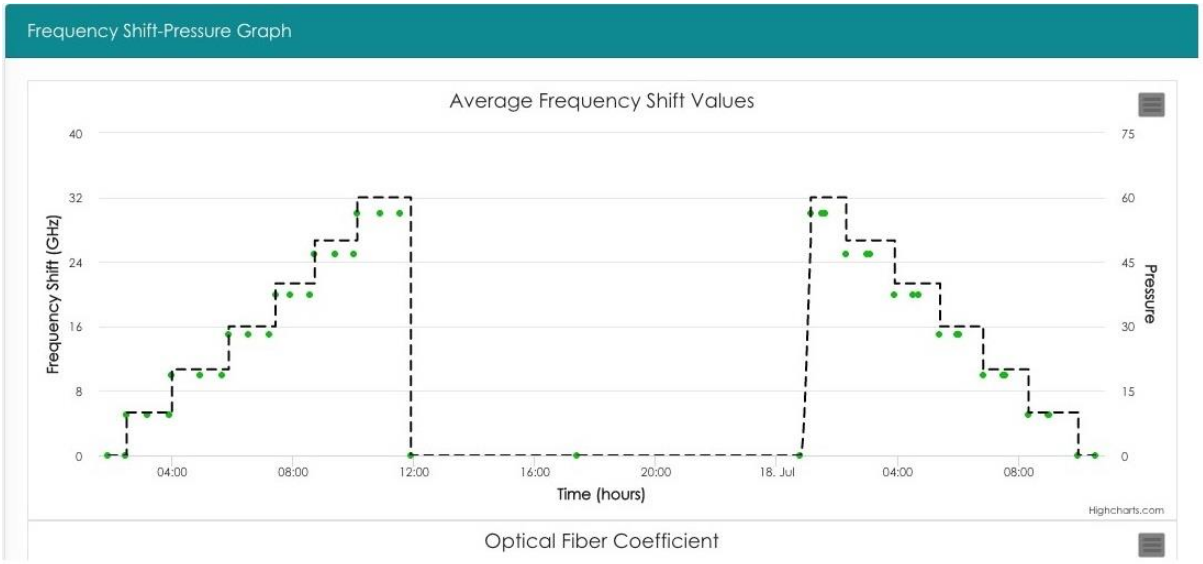

Figure 3.3: Plot shows the several best readings of the selected fiber of interest. The Y-axis on the right side denotes the pressure levels at the time the measurement was taken.

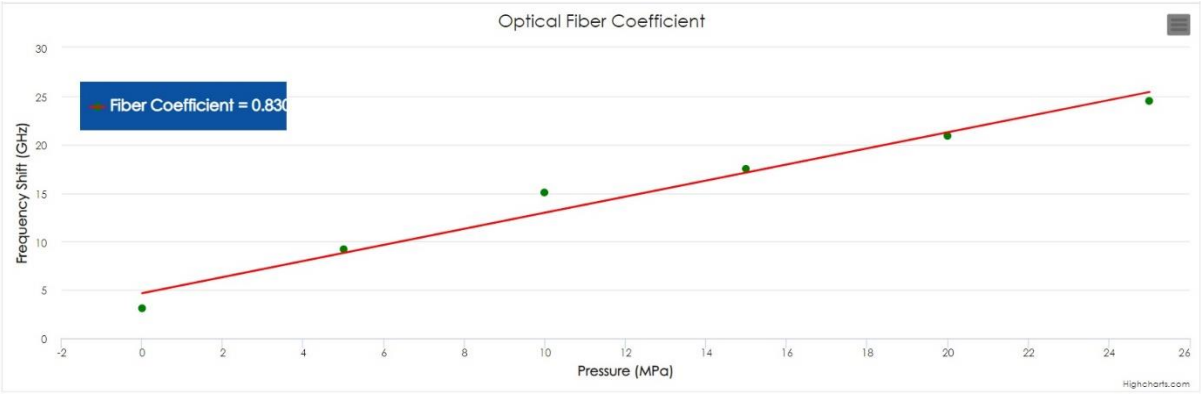

Figure 3.4: Plot shows the linear regression line for the selected fiber at various pressures. The computed fiber coefficient (slope) is shown in the top left corner in the blue box.

3.3 Pressure/Strain/Temperature Settings

Since the response of the sensing fibers are dependent on the environment, the user can initialise the parameters under which the fiber is sensing. On the user settings tab, the user can upload a file which includes this data or enter own data. This data is reflected on the right hand-side y-axis shown previously in Figure 3.3.

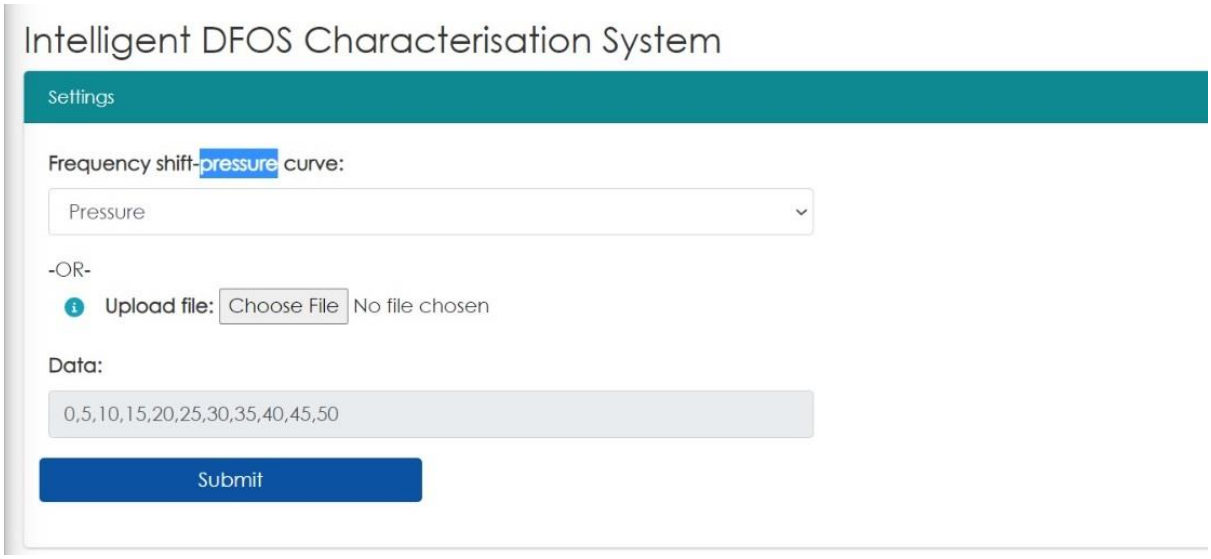

Figure 3.5: Plot shows the linear regression line for the selected fiber at various temperatures. The fiber coefficient (slope) is shown in the top left corner in the blue-dotted box.

Once the user has selected the desired y-axis parameter, the titles on the graphs in the MAIN and FIBER COEFFICIANTS page will automatically update itself.

3.4 Instruction Manual

The instruction manual is available to the user without the need to login to the system. Simply click on the icon in the top left corner of the Login Page. The manual is also available for access under DASHBOARD.

3.5 Logout

The logout button allows the user to end their current session on the system. To ensure the security of the data and the information it produces, kindly log out after each session.

CHAPTER 4: HELPDESK

The system is still in Beta version and may experience bugs and glitches during usage. For any questions, suggestions and feedback, please contact Dr Shima at shima@dkss.com.my or Dr Choo Kan Yeep at kychoo@mmu.edu.my.

We hope you have a smooth and informative experience with the system.

Thank you,
MMU Team