Industrial Project 2024 Part 03: Reflectance Analysis

Comprehensive Guide for Project Execution and Usage

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1 Introduction

The **Industrial Project 2024** focuses on processing reflectance spectra from hyperspectral data with options for transformations such as SNV, first derivative, and second derivative. This project enables the customization of visualization settings for either `Ref` or `Charring` levels.

2 Project Features

- **Dynamic Spectral Analysis:** Processes reflectance spectra from specified folders.
- **Transformation Options:**
  - No Transformation
  - Standard Normal Variate (SNV)
  - First Derivative
  - Second Derivative
- **Custom Visualization:** Automatically adjusts shaded regions and vertical lines for 'Ref' or 'Charring' levels.
- **Configurable Parameters:** Utilizes a `config.yaml` file to set paths, transformation options, and analysis type.

3 Installation and Setup

3.1 Requirements

- Python 3.8 or higher.
- Required Python libraries:
  - `numpy`
  - `matplotlib`
  - `PyYAML`
  - `envi2`

3.2 Setup Instructions

1. Clone the repository to your local machine:

```
git clone https://github.com/your_username/
    Industrial_Project_2024.git
cd Industrial_Project_2024
```

2. Install the required dependencies:

```
pip install -r requirements.txt
```

3. Prepare your input data as per the `config.yaml` configuration.

4 Configuration

The project relies on a `config.yaml` file for setting input paths, transformation type, and analysis type. Below is an example configuration:

```yaml
folders:
  - "path/to/folder1" # Folder for Level 0 data
  - "path/to/folder2" # Folder for Level 1 data
  - "path/to/folder3" # Folder for Level 2 data
  - "path/to/folder4" # Folder for Level 3 data
transformation: "first_derivative" # Options: "no", "SNV", "
    first_derivative", "second_derivative"
is_ref: true # true for 'Ref' analysis, false for 'Charring' analysis
```

Listing 1: Example config.yaml File

5 Usage

Run the analysis by specifying the `config.yaml` file as input:

```
python spectral_analysis.py config.yaml
```

Listing 2: Run the Analysis

6 Project Structure

```
Industrial_Project_2024_Part_03/
|-- config.yaml                 # Configuration file for paths and parameters
|-- spectral_analysis.py        # Main script for spectral processing and plotting
|-- requirements.txt            # List of dependencies
```

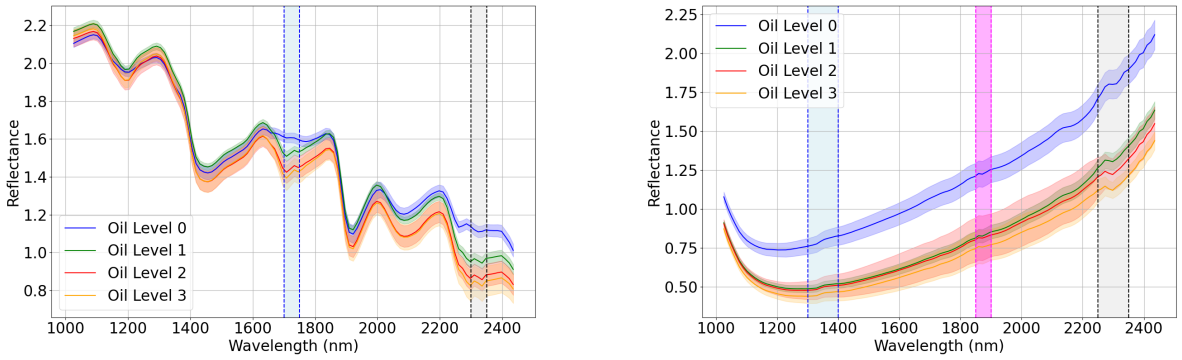
7 Available Transformations

- **None:** Uses raw reflectance spectra without modification.
- **SNV (Standard Normal Variate):** Normalizes each spectrum to mean 0 and standard deviation 1.
- **First Derivative:** Highlights spectral changes along the spectral axis.
- **Second Derivative:** Emphasizes rapid spectral changes.

8 Testing and Results

This project has been tested with:

- Multiple folders containing reflectance spectra for accuracy.
- Different transformations for visual consistency.
- Validation of ‘Ref‘ and ‘Charring‘ settings for correct visual output.



(a) Reference (b) C1

Figure 1: Spectral reflectance of raw reference and charring level 01 samples.

9 Acknowledgements

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