Industrial Project 2024 Part 04: PCA-Based Spectral Data Analysis

Comprehensive Guide for Project Execution and Usage

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📂 Contents

1 📂 Introduction 💡

The **Industrial Project 2024** focuses on analyzing spectral data using Principal Component Analysis (PCA). This project supports task-specific analysis (e.g., `structure_oil`, `structure_charring`, etc.) defined in the `config.yaml` file.

2 📂 Project Features ✅

- **PCA Analysis:** Reduces spectral data dimensions while preserving essential variance.

- **Task-Based Execution:** Supports task-specific configurations like 'structure_oil' or 'cracking'.

- **Custom Visualizations:**

  - Explained variance bar charts.

  - False-colored PCA component visualizations.

  - PCA loading vector plots.

- **Configurable Parameters:** Uses a `config2.yaml` file for input paths, PCA components, and tasks.

3 📂 Installation and Setup 🖥

3.1 🛠 Requirements ✅

- Python 3.8 or higher.

- Required Python libraries:

  - `numpy`

  - `matplotlib`

  - `PyYAML`

  - `scikit-learn`

  - `opencv-python`

3.2 🛠 Setup Instructions ⎇

1. Clone the repository to your local machine:

```
    git clone https://github.com/sonainjameel/
        Industrial_Project_2024_Part_04.git
    cd Industrial_Project_2024_Part_04
```

2. Install the required dependencies:

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

3. Prepare your input data as per the `config2.yaml` configuration.

4 📂 Configuration ⚙

The project relies on a `config2.yaml` file for task-specific settings. Below is an example configuration:

```yaml
tasks:
  - name: structure_oil
    dir_path: "path/to/oil/data"
    components: 10

  - name: structure_charring
    dir_path: "path/to/charring/data"
    components: 10

  - name: oil_charring
    dir_path: "path/to/oil_charring/data"
    components: 10

  - name: cracking
    dir_path: "path/to/cracking/data"
    components: 10
```

Listing 1: Example config2.yaml File

5 📂 Usage ▶

- Run all tasks defined in the `config2.yaml`:

```
    python3 pca_analysis.py
```

- Run a specific task (e.g., `structure_oil`):

```
    python3 pca_analysis.py --task structure_oil
```

6   Project Structure

```
Industrial_Project_2024_Part_04/
|-- config2.yaml              # Configuration file for tasks and parameters
|-- pca_analysis.py    # Script for PCA processing and plotting
|-- requirements.txt          # List of dependencies
```

7   Testing and Results

This project has been tested with:

- Multiple spectral datasets for task-specific accuracy.

- PCA component visualizations for clarity.

8   Acknowledgements

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